

Using the EQuIPD Coaching Model to Implement Inquiry, Technology, and Engineering Design in K-9 Classrooms

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Abstract—This research to practice paper describes a K-12 Teacher Professional Development (PD) program model which has been applied in multiple academic settings to help teachers develop an understanding of four main principles for effective teaching: pedagogy, curriculum, system thinking, and technology integration. The Engaged Quality Instruction Through Professional Development (EQuIPD) PD Program was an intensive 3-year program with 184 hours of facilitative coaching, bootcamps, and PD sessions for over 200 K-9 teachers from 121 schools across Florida. This paper explores the coaching model that was developed to support the successful grant program.

A facilitative/dialogic coaching model was developed for this PD model and was designed to allow coaches to support teachers in achieving personalized grant objectives while simultaneously targeting program goals. These grant goals were centered around eight key areas: inquiry-based lessons, student use of technology for concept knowledge building, collaborative grouping for concept development, core concept model building, engineering design/design thinking, system thinking/process mapping, authentic workforce applications, and fostering quality classroom discourse.

The facilitative/dialogic coaching model was unique in that it combined research-based practices for coaching with an infrastructure and coaching model that provided coaches with rubrics, coaching logs, resources, and templates for use with their teachers. This unique coaching model can be applied to other professional development programs to improve teacher practice.

The role of the coaches was not specifically addressed in the grant, but we posit the in-service teacher PD coaching framework was largely responsible for the successful implementation of the PD model. This coaching model is novel in that it transcends the traditional relationship between expert and learner through facilitative coaching. This study analyzed the coaching process utilized by expert instructional coaches and teachers within a teacher professional development program, EQuIPD, and the resulting PD framework for coaching.

Index Terms—component, formatting, style, styling, insert

I. INTRODUCTION

National and state policymakers and educators have established efforts to improve the quality of K-12 education by advocating reforms regarding content and pedagogy [1].

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Teaching practices that foster active and authentic learning have been heavily encouraged and, as a result, teachers are required to adapt to new teaching methods and frameworks, utilize career-oriented standards and adopt new practices. For some teachers this could mean altering teaching practices that they have utilized and implemented over the years. Due to the influential roles that teachers play in facilitating education reforms [2], providing support and professional development (PD) opportunities that create systematic improvements in teaching practices and student outcomes is essential. Guskey [3] noted that teacher PD is necessary in supporting teachers in their implementation of reform-based teaching practices while creating connections between instructions and promoting student motivation.

Through the Engaged Quality Instruction Through Professional Development (EQuIPD) PD program, an intensive in-service teacher PD model was created that included strategies transcending the hierarchical relationship between PD provider and teacher learner using a facilitative/dialogic coaching model. The goal of EQuIPD coaching model was to provide coaching that resembles a dialogical interaction between two established professionals through instructional coaching. Coaching involves teachers receiving support from a more knowledgeable other to improve teaching practices. Coaching generally involves two colleagues engaged in a mutually supportive relationship, aimed at improving practice [4]. Coaching has been used in the public and private sectors to develop employees' skills and performance and to meet organizational goals [5]. In education, coaching has traditionally supported teachers in the acquisition of knowledge, skills and abilities that target student achievement [6], [7]. Different models and practices of peer coaching have been a part of teacher development, both in-service and pre-service since the early 1980s [8]. Gottesman [9] points to the difference between the role of the 'evaluative supervisor' and the coach. Gottesman's non-evaluative model of peer coaching supplies 'simple procedures and rules for teachers to begin the conversation about instructional strategies in a non-threatening manner and includes a structure to begin lesson analysis

without evaluation.

Coaching can be effective and satisfying for teachers by providing them with an opportunity to observe, reflect, exchange ideas, and share problem-solving strategies and techniques [10], [11]. A growing body of research has reported effects of coaching towards increased teacher efficacy [12], [13], including improved students' standardized test outcomes and changes in teaching practice. On the other hand, research about coaching also reported positive benefits for coaches such as development of teaching identity [14] and calls for increased partnership with school administration as part of the coaching support system [15]. Despite the increasing number of studies on coaching, there is little known about how coaching works and how both the coaches and the teacher work together in practice for successful coaching for implementation of practices at the classroom level.

II. COACHING MODELS

PD models that consist of standalone training or workshops have been reported to be insufficient in providing the necessary support for improved and sustained teacher practice [16]. Coaching is one of the various strategies supplementing PDs and has emerged as a promising way to support teachers and for sustained teacher change of practice over time [17]. Effective coaching has also been proven to improve teachers' behaviors and practice in language and literacy when they were provided with on-going and job-embedded coaching [18].

In designing the EQuIPD coaching model, multiple coaching models were researched to find the best combination of models to utilize in the program. Instructional coaching, a popular method, is directed toward individual teachers in their own classroom and has been shown to have a positive impact on attitudes of teachers, increases in skill transfer and implementation of new strategies in the classroom, increased feelings of teacher-efficacy, as well as improved student achievement. According to Desimone and Pak [6], effective instructional coaching, as a PD strategy, should reflect five features, namely, content focus, active learning, coherence, sustained duration, and collective participation. Desimone highlighted that one-on-one coaching makes these features possible. For example, the coach and teacher could work together to co-construct the lesson with the coach providing feedback to ensure that the students are learning the subject matter. Gibbons and Cobb [19] conducted a literature review within the teacher education space to determine what is known about high-quality professional learning opportunities, specifically searching for productive sets of coaching activities. Gibbons and Cobb [19] found there were five characteristics of high quality coaching: Intensive and ongoing, A focus on teacher issues at the classroom level, a process of orienting teachers towards student thinking, building teacher communities of practice and enactment of pedagogical routines and practices. The coaching model proposed by Knight [20] is widely used in school districts and has three approaches to coaching: facilitative, directive, and dialogical. In Knight's model [20], the facilitative coach is more of a sounding board and questioning

guide to help the teacher realize new approaches, while the teacher leads. In the directive approach, the coach is telling the teacher what to do, so that the coach leads. In the dialogical model, there is an inquiry-based approach through questioning strategies by the coach. However, this model is missing ways to accommodate reform in a way that helps the teacher bring innovative methods towards their practice. On the other hand, Aguilar's model [21] relies on facilitative coaching, drawing from classroom observations to produce a change of practice. While all these coaching models have benefits, they fail to provide teachers with necessary pedagogical tools and frameworks to effect changes and to fully understanding of how the changes are situated in learning theory.

In this study, effective coaching has features promoting equal and dialogical interaction between two established professionals. Equal and dialogical interaction sets both the coach and the teacher as equals, with the teacher identifying the coaching goal depending on the learning needs of the students and relates those needs back to the grant program pedagogical approaches and tools, using the grant tools and frameworks to support the change to practice.

III. THE EQuIPD PROGRAM AND COACHING MODEL

This study is contextualized within the EQuIPD program, a PD project that supported nearly 250 science, technology, engineering, and mathematics (STEM) teachers across 10 districts in the state of Florida [22]. Teachers were recruited from schools listed as the State's lowest performing for grades K-9, and teachers enrolled in the grant matched the demographics for teachers within the state. For more on teacher demographics, see the full grant report [22]. EQuIPD aimed to promote teacher capacity building and professional growth, focusing on areas such as System Thinking, Conceptual Modeling, Inquiry-based Lessons, Design Thinking, Process Mapping, Workforce skills, Technology, Collaboration and Classroom Discourse. The project was run from 2018 to 2021 and served teachers through diverse and high-quality PD strategies that included one-on-one facilitative/dialogic coaching, technology training, boot camps and professional learning communities. Teachers received 40 hours of PD each summer covering the eight main grant goals, and then had two follow-up PD sessions twice a semester (32 hours) to build knowledge needed to implement the pedagogical practices. Coaches also held PDs for small groups or individual teachers as needed. Teachers received nearly 240 hours of PD in the first two years of the program.

One-on-one coaching was a core aspect of the PD and was provided by seven instructional coaches who had varying levels of experience in teaching and coaching. Coaches were hired by the grant independently and through buy-out from districts and were supervised by the grant for the term of the project for coaching duties. At the start of the project, coaches provided face-to-face and one-on-one classroom visits with a ratio of one coach to twenty teachers. However, the global COVID-19 pandemic disrupted the face-to-face interaction with the teachers and pushed coaches to utilize online platforms to reach out to the teachers through a virtual

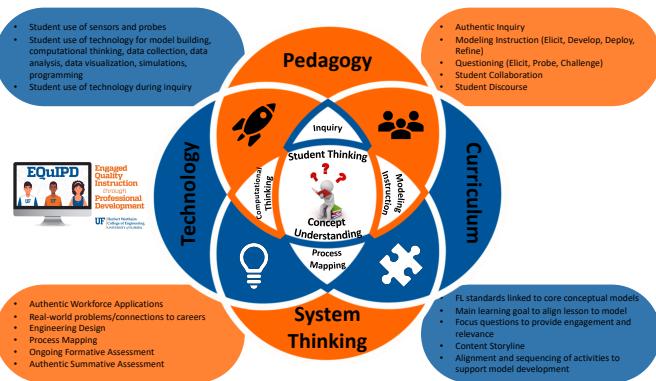


Fig. 1. The EQuIPD Professional Development Model

environment. In 2020 and 2021, the coaches met with the teachers via online meeting platforms, Zoom, Google Meet or Microsoft Teams meeting. Each coaching session lasted for an hour and occurred every two weeks. Coaches tracked these meetings through a Qualtrics form developed for the grant which had them enter the duration, topics, grant goals and progress monitoring for the coaching cycle. Coaches also had a Teams site with the teacher to share resources and collect artifacts during the coaching cycles.

Goals for improved student learning are centered around eight key areas: inquiry-based lessons, student use of technology for concept knowledge building, collaborative grouping for concept development, core concept model building, engineering design/design thinking, system thinking/process mapping, authentic workforce applications, and fostering quality classroom discourse [23]. These goals are demanding and have important implications for changes in instructional practices. Improved student learning includes students' deeper conceptual understanding in a range of domains, engaging students in meaningful practices that reflect workforce skills. High quality instruction that results in enactment of pedagogical routines that promotes rich learning for students is therefore required [23].

Coaches were directly responsible for the implementation of the eight grant goals through coaching cycles, PD sessions and workforce field trips for teachers. A summary graphic of the grant professional development model may be seen in Figure 1 and has four main areas of focus; Pedagogy (how we teach), Curriculum (what we teach), System Thinking (how we organize concepts and assess conceptual knowledge in students) and Technology (how we utilize technological tools to build and assess conceptual models).

In EQuIPD, coaches were prepared through an initial week long 40-hour PD to understand various pedagogical tools to bridge the needs of the teachers with the goals of the PD program and were then supported through additional support over the grant period through infrastructure and additional PD sessions. Coaches were provided with over 120 hours of PD a year for pedagogical practices, technology (sensors, probeware, edtech platforms, programming, robots), and

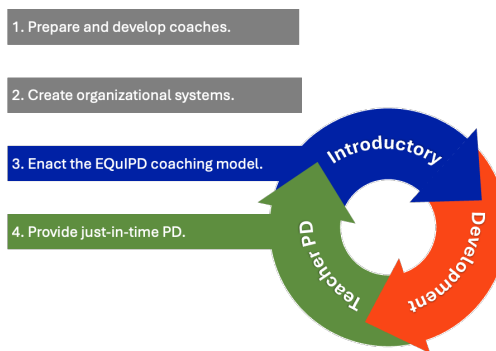


Fig. 2. The EQuIPD Facilitative/Dialogical Coaching Development Model

questioning and collaborative strategies within the coach PD sessions. Coaches also had monthly follow-up PD sessions to build coaching skills, questioning strategies and coaching book club to build skills in coaching teachers. During the coaching sessions with teachers, coaches had access to the Teams site with all the coaching and PD materials as well as access to training materials and standard operating procedures and hack-sheets for all technology.

A coaching development model may be seen in Figure 2, where there are four parts to the support of coaches by; Preparing and developing coaches through PD, Creating Organizational systems of support, Enact the facilitative/dialogical coaching model, and Providing just in time PD for the teachers as needed.

IV. COACHING IMPLEMENTATION MODEL

The coaching of teachers occurred through multiple activities including one-one-one coaching, large and small group PD and industry field trips. Coaches were prepared through a train-the-trainer model via PD sessions delivered by the grant PI to design and create teacher-level PD for the eight grant goals, and to identify and provide field trips for teachers to experience technology in workplace environments. The implementation of the grant goals by the coaches had three stages as seen in Figure 3. First is the introductory stage, which acquaints and situates the facilitative/dialogical coaching relationship. This stage had three parts, the pre-coaching interview and survey, the classroom processes and resources through interviews or observations and pedagogical goal setting aligned with the eight grant goals.

The first stage of the coaching model was implemented in the first month of the coach working with the teacher. At the onset of the program, coaching sessions were face-to-face, and the coaches met with and interviewed the teachers using an interview protocol developed by the grant to help them get acquainted. The coaches also did a classroom observation to get a background of the teachers' pedagogical practices and shared the grant goals and classroom level implementation rubric with the teachers to start the goal setting process.

The development stage, the second stage of coaching implementation in Figure 3, is centered on the coaching cycle

Stages of the EQuIPD Coaching Model



Fig. 3. The EQuIPD Coaching Implementation Model

facilitated by the coach through dialogue with the teacher and uses grant pedagogical practices for system thinking to provide targeted coaching to the teachers. When starting a coaching cycle and before identifying available resources and methods, coaches dialogue with teachers about the concept using system thinking. A system thinking perspective promotes teacher development by providing them with a more contextual, meaningful and conceptual understanding. This requires a constant practice of thinking about one thing in relation to other things. In addition to system thinking, creation of a model for conceptual development provides a holistic view of the interrelated concepts and ideas. In this program, using a system thinking perspective allows for a dialogue between the coach and the teacher about where the problem of focus sits in terms relative to a larger system within the classroom or school structure. This also allows teachers to situate concepts within larger concepts using a system thinking framework when assessing or designing lessons to build conceptual knowledge in students. For a teacher who identifies a problem of focus, there exists a macro-system with more complex structure that the teacher may or may not be able to identify at once. Traditionally, when a teacher identifies problems with teaching certain concepts, coaches seek methods and resources that have been used in the same context. System thinking allows a teacher to use process mapping to see directly where the redesign needs to happen, rather than relying on resources which may or may not work for this particular classroom problem. All coaching was grounded in understanding conceptual models, models for the learning environment, and school systems in order to map out the teaching and assessment of the conceptual model. This focus on system thinking and process mapping allowed teachers to better design coaching goals through better problem identification and situation during this stage.

This was the iterative part of the coaching cycle, repeated each time a coaching session started. Coaches would spend the first fifteen minutes of their one-hour sessions checking in with the teachers on their goals for themselves relative to the grant goals, and then work with them to develop a workplan composed of SMARTER (Specific, Measurable, Action-Oriented, Realistic, Time-bound, Evaluated) goals [31] and action items for both teacher and coach. This was created in a Teams site that the teacher and coaches shared and

where work could be collected between the teacher and coach. Subsequent meetings would be centered on the SMARTER goals and the implementation and problem-solving process around this workplan. This would continue until the SMARTER plan was actuated and evaluated at which time the coach would start a new coaching plan with the teacher. In general, teachers worked through 2–6 workplans with SMARTER goals a year.

The PD stage, the third stage of the coaching implementation in Figure 3, involves coaches understanding the high-level pedagogical needs of their teachers in the areas of questioning strategies, computational or engineering design thinking, student centered inquiry activities or problem-based learning, and assessment of learning related to the conceptual model. Coaches worked with the teachers to identify these pedagogical needs and then designed professional development sessions held twice a semester, with follow-up coaching cycles then implemented by coaches. In addition to the coaching cycles with teachers, coaches planned local field trips for teachers to industries using technologies at differing levels so that there was an anchor for workforce development of students and to enhance teacher connections within their local STEM ecosystem. Based on teacher needs, coaches also provided technology specific coaching, and technology was included in every PD session held for teachers to model the PD. The grant worked with district provided classroom technologies, or provided technology to the teachers in the grant. All coaches were trained on a variety of technologies including Scratch, Micro:bits, Arduinos, and probeware (Vernier, Pasco). After the PD, the coaches would work with the teachers to incorporate the PD content into their coaching cycles.

While coaches were available to support the teacher during implementation of grant pedagogical goals and technology within the classroom, the grant did not allow for “co-teaching” of lessons or modeling of pedagogy with the teacher’s students. It was an important aspect of the grant that the classroom teacher was always viewed as the expert for the learning at the classroom level, and that the coach was only there to support learning. Any modeling of instructional practices was conducted within the coaching cycles and not in front of students.

“During our coaching times we set goals and plan for the future weeks ahead. Coach Name has pulled lessons to share and help modify lessons to help fit my classes needs. I would say our quality time for coaching is put to good use and always successful.”

–Teacher 49

V. INFRASTRUCTURE FOR COACHING

Few coaching models discuss or describe the infrastructure necessary for successful implementation of pedagogical practices [24]–[27]. Many of the papers on infrastructure are related to professional coaching as opposed to teacher coaching. The most comprehensive teacher coaching paper was put forward by Massachusetts [25] on their early learning coaching model technical assistance guidelines which called for a coaching academy, standardizations in the job

descriptions and tasks/activities for coaches, and an online toolbox for use by the coaches. The EQUiPD grant developed a similar model to create an infrastructure plan for coaches that standardized the coaching model and coaching cycle. The grant also developed an online management and tracking system for coaching time for the grant goals, online coaching logs and deliverables tracking, work templates and rubrics for the grant goals and implementation goals. This management system was instrumental in the fidelity tracking within the grant [22].

The grant utilized Microsoft Office 365 tools and Qualtrics Data logging surveys to support the infrastructure for coaching. Coaches were required to use Outlook calendars to track and share their appointments with teachers, PD and field trips. Each coach had a dedicated Microsoft Teams site with their teachers to store coaching workplans which included SMARTE goals, deliverables, files, resources and materials related to the grant. Resources include a grant goals primer, a coaching cycle primer, and rubrics for implementation. Additionally, there were Standard Operating Procedures, sample lesson activities, and troubleshooting guides available as resources for coaches and teachers for technology use and implementation. There was a separate Teams site for all field trips and the scheduling, sign up and surveys that were collected as part of the field trips.

In addition to Outlook and Teams, there were Qualtrics logs for the sign in and out of coaching sessions, field trips and coaching cycles with a dropdown menu for the related grant goals they were working on. A flow map of the infrastructure may be seen in Figure 4 where a process map for policies and procedures was created to help coaches understand the coaching implementation and documentation.

The main purpose of creating infrastructure was to keep the coaching focus on the eight grant goals for both coaches and teachers. Literature suggests that many coaches deviate from grant goals to support teacher immediate needs for things like disciplinary support, or personal support rather than focusing on the goals for the program [28]. Additionally, it was found in many coaching studies that coaches used paper notes for grant tracking, and these notes were not made available in forms that could be analyzed for fidelity or goals progression.

When interviewed, the teachers described coaching sessions as anchored towards specific grant goals.

“So we always start off with, I should say at the end of every coaching session and as I’m moving through it I have a list of to-do’s, what things that I’m going to bring to the next session, things that I’m going to accomplish. So at the beginning of every coaching session, we kind of review, where we were at the last one. I bought my list, and then we literally go through here’s what I was supposed to do, and then we do what I just said, well evaluate that particular session, and I will ask questions because usually as I’m doing whatever it is that I was supposed to do during that two weeks I’ll come across something that I need help with so we’ll pause

and if I need help [my coach] will go grab resources for me and bring them into the coaching session”.

This comment from the teacher indicates that there was a clear process for the coaching cycles and that the coaches were implementing the process framework to support teacher change to practice for the eight grant goals.

During COVID-19, the coaching sessions moved from in-person meetings to virtual meetings. While multiple teachers reported liking the transition to virtual owing to increased flexibility, others would have liked to continue the face-to-face sessions.

“The virtual meetings are not as in depth as the in person, and do not allow for collaboration that previously was able to be done with multiple teachers at the same school.”

Some teachers found it difficult to implement student level technology, and inquiry centered lessons during COVID, but found that their teacher level use of technology increased during this time with the assistance of coaching sessions to learn new educational technology for students. Coaches shifted practice during this time to support teachers for best practices in online learning environments. Coaches were provided additional PD to upskill for these practices in advance of working with their teachers.

VI. RESULTS

A randomized controlled trial and mixed methods study was designed by the evaluation team to assess implementation fidelity and teacher and student impacts through annual surveys, interviews, observations, and data from state and district tests, attendance, and other measures for the grant goals. This study was designed to meet What Works Clearinghouse metrics [29]. The role of coaches was not specifically addressed in the grant study, although yearly surveys addressing the effectiveness of the coaches towards helping support the grant goals was given and that data is presented in this study. The tracking of coaches was related to the fidelity of the coaching in supporting the eight grant goals.

As part of the study, teachers were asked in interviews to identify grant topics that were emphasized through the coaching and PD sessions and where they felt they had improved understanding and implementation for. The improvement seen in the interviews and observations were aligned with the professional development teachers received in the program and the support from the coaches to implement the practices at the classroom level. Control teachers were also interviewed about their implementation of practices aligned to the grant goals. The grant exceeded What Works Clearinghouse level of change for teacher practice for the grant goals showing that the PD model is sufficient to create change at the classroom level [22]. The coaching model was not studied as a separate contributor to the success of the program implementation, but coaching effectiveness was studied.

Some of the change to teacher practice results from the surveys are shown in Table 1. The survey questions were

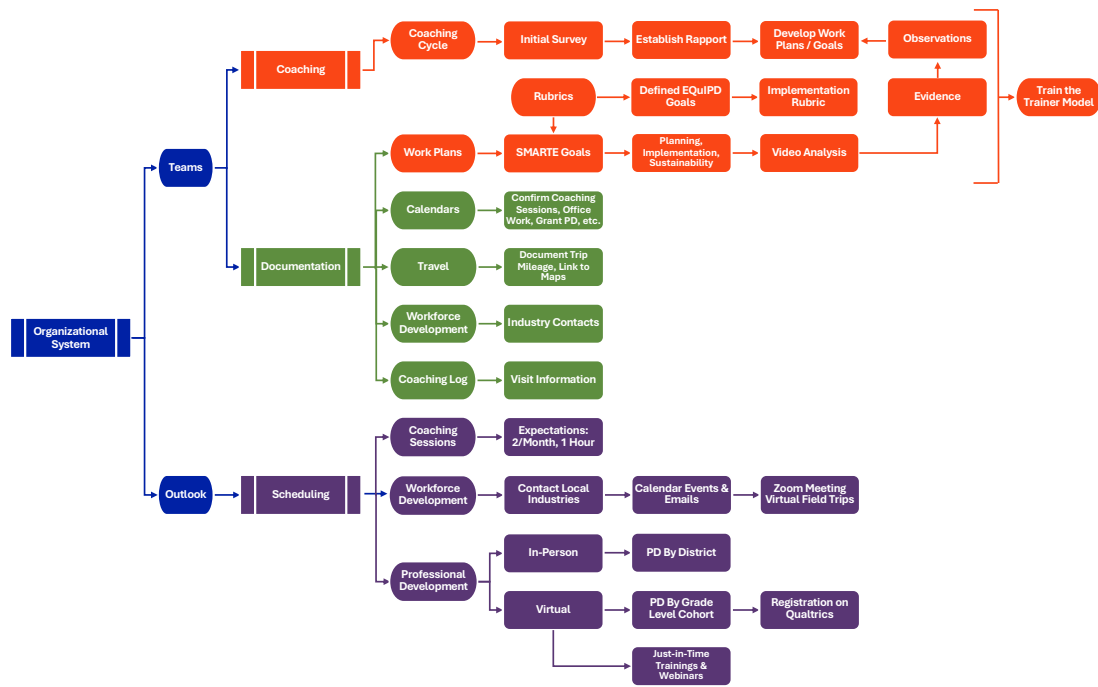


Fig. 4. The EQUIPD Coaching Process Map for Policies and Procedures

designed by the external evaluation team on the grant to collect information on implementation of the grant goals through PD and coaching. There were also separate coaching interviews and surveys with teachers to evaluate the fidelity of the coaching implementation and teacher feelings about the coaching process and coaching effectiveness.

The increase in respondents showing greatly improving tracked closely with the focus of the grant PD and coaching between year 1 (2019-2020) and year 2 (2020-2021) for the grant goals, where the teachers continued to improve over the two-year period [30]. Additional data showing the gains in comparison to the control teachers may be found in the evaluation report [22].

A. The Role of the Coaching Model in The Success of the Change to Teacher Practice

During the Spring of the first two years of the program, the coaching effectiveness and the fidelity of the coaches to implementing the grant goals was studied by the research team. An example excerpt from the second year of coaching is shown below in Table 2 for one of the coaches (Coach "C"). This particular coach was an engineering PhD and had little formal teaching experience entering into coaching. It can be seen from Table 2, while they viewed the coach as an expert in the areas of System Thinking and Technology, they viewed the coach less knowledgeable on lesson planning. This allowed the grant to understand areas of need for the professional development of the coaches and areas of weakness for implementation of the grant goals.

The results of this survey differed in areas related to the coaches' area of expertise relative to the subject the teacher

was focused on. This indicated that teacher's felt the coaches had the requisite knowledge to support the implementation of the grant goals when coaches had knowledge in areas related to the subjects they were teaching, but deficits in areas where teachers felt they had more expertise.

In Table 3, teachers were asked the extent to which their coach had helped them directly in each of the main grant focus areas after year 2. Some variations were again seen between coaches in these areas, as some coaches tended to focus on their strengths with teachers, like engineering, and less on areas where they themselves may need additional support, like questioning strategies. Seeing where teachers felt coaches focus helped the grant address where teachers may need additional support with the coaches' areas through coaching and PD. Overall, teacher respondents were supported and felt improvement in all areas of grant goal focus by coaches.

Through Year 1 surveys, evaluators found that coaches needed additional infrastructure and support for the coaching cycles and grant implementation and materials were developed for the coaching cycle and additional PD was provided to coaches to upskill them for grant goals including additional rubrics and infrastructure. The evaluation team found that the coaches all met the fidelity of the program through their coaching activities across the three year grant period.

While the grant did not directly study the impact of coaches on the outcomes for the program, the program posits that the coaching was critical to the success of the grant implementation at the classroom level. The grant posits there were three critical areas of coaching that were important to the success of the PD model.

TABLE I
RESULTS OF TEACHER SURVEY FOR INCREASE TO AREAS OF KNOWLEDGE RELATED TO GRANT GOALS

Areas Targeted by EQuIPD	Year 1 (N = 75-76)			Year 2 (N = 60)		
	% “Greatly Improving”	Mean	SD	% “Greatly Improving”	Mean	SD
Inquiry-Based Instruction	25%	2.67	1.02	63%	3.52	0.72
Concept Modeling	21%	2.57	1.04	62%	3.47	0.77
System Thinking	17%	2.44	1.03	52%	3.35	0.80
Questioning and Student Discourse	20%	2.41	1.11	67%	3.57	0.70
Process Mapping	18%	2.39	1.06	60%	3.43	0.79
Lesson Planning	20%	2.39	1.10	60%	3.45	0.77
Integration of Real-World Problems	16%	2.32	1.06	55%	3.38	0.80
Student Collaboration	19%	2.31	1.14	57%	3.38	0.85
Use of Technology in Instruction	17%	2.29	1.12	62%	3.45	0.81
Probes and Sensors	11%	2.12	1.08	32%	2.85	1.01
The Engineering Design Process	17%	2.08	1.15	42%	3.20	0.82
Teaching in an Online/Virtual Environment	N/A	N/A	N/A	63%	3.42	0.89

TABLE II
EXAMPLE RESULTS OF TEACHER SURVEY ON COACH “C” KNOWLEDGE TO SUPPORT GRANT GOAL IMPLEMENTATION IN YEAR 2

Coaches (N = 9) Knowledge	Cannot Judge	Very Little	Insufficient	Sufficient	Expert
System Thinking	0.0%	0.0%	0.0%	11.1%	88.9%
Concept Modeling	0.0%	0.0%	0.0%	33.3%	66.7%
Process Mapping	0.0%	0.0%	0.0%	33.3%	66.7%
Inquiry-Based Instruction	0.0%	0.0%	0.0%	22.2%	77.8%
Lesson Planning	0.0%	0.0%	0.0%	66.7%	33.3%
Probes and Sensors	0.0%	0.0%	0.0%	11.1%	88.9%
Use of Technology in Instruction	0.0%	0.0%	0.0%	11.1%	88.9%
Student Collaboration	0.0%	0.0%	0.0%	33.3%	66.7%
Questioning and Student Discourse	0.0%	0.0%	0.0%	44.4%	55.6%
Integration of Real-World Problems	0.0%	0.0%	0.0%	33.3%	66.7%
The Engineering Design Process	0.0%	0.0%	0.0%	11.1%	88.9%
Core Content Knowledge in Field	0.0%	0.0%	0.0%	44.4%	55.6%
Teaching in an Online/Virtual Environment	0.0%	0.0%	0.0%	44.4%	55.6%

TABLE III
THE EXTENT TO WHICH TEACHERS BELIEVED COACHES HELPED THEM IMPROVE IN TARGET AREAS IN YEAR 2

How Much Coaches (N = 8) Helped Teachers Improve	Not At All	A Little	Moderately	Greatly
System Thinking	0.0%	0.0%	12.5%	87.5%
Concept Modeling	0.0%	0.0%	12.5%	87.5%
Process Mapping	0.0%	0.0%	25.0%	75.0%
Inquiry-Based Instruction	0.0%	0.0%	12.5%	87.5%
Lesson Planning	0.0%	12.5%	37.5%	50.0%
Probes and Sensors	0.0%	12.5%	25.0%	62.5%
Use of Technology in Instruction	0.0%	12.5%	0.0%	87.5%
Student Collaboration	0.0%	0.0%	25.0%	75.0%
Questioning and Student Discourse	0.0%	12.5%	12.5%	75.0%
Integration of Real-World Problems	0.0%	12.5%	12.5%	75.0%
The Engineering Design Process	0.0%	0.0%	50.0%	50.0%
Teaching in an Online/Virtual Environment	0.0%	12.5%	12.5%	75.0%

1) *Coaching Starts with Teacher’s Needs:* The choice of coaching session focus must emanate from the teacher. This approach is described by Aguilar [21] as facilitative coaching with the teacher, being the end user, identifying the focus and planning out the coaching tasks alongside the coach. This process was augmented in the EQuIPD grant by having the teachers identify specific target areas based on the grant goals for pedagogical practices as their focus for the coaching sessions. In the following quote a teacher describes the goal setting process.

“Usually, [goal-setting] is conversational. We at the end of let’s say we decided I’m going to write a lesson for this particular goal. I will write the lesson, then we share it, and then we talk about whether or not it’s fitting the most important components of that particular goal, because we have a rubric that we use and we’ll pull up the rubric together and see if it’s hitting those and if we find that maybe I’m doing most of this but I’m really not doing this that’s when we get into our conversational pieces and

[my coach] say things like ‘Well, this is really good that you’re really strong in this, but here’s the piece that’s missing’. So it’s never like all at once, it’s not like here’s the goal. The evaluations are ongoing and I’m making progress towards that, and then, if I hit a roadblock, and I just don’t know how to do this, one particular time, then one of our coaching sessions will be working on just that that one thing and then I upload a lot of information on to the web page that has my name on it and then we use that information as proof or data, whether it’s videos or student notebooks or lesson plans or whatever it is, as visual evidence of what we’ve done”. –Teacher 4

The SMARTE workplan (Specific, Measurable, Action-Oriented, Realistic, Time-bound, Evaluated) [31] described by Teacher 4 is the collaborative infrastructure piece that serves to frame the goal identification and setting during coaching. In the workplan, the teacher and coach explicitly identify which grant goal is the focus for coaching. The coach ensures that the decision is informed and made by the teacher. The rubric outlining the grant goals and what effective implementation looks like at a classroom level serves as the concrete evaluation and a self-reflection tool for the teachers. Awareness of the professional growth path and outcome is essential in maintenance and progress tracking by the coach and teacher. This provides the teacher with a reflective tool for practices and allows them to self-evaluate their progress.

2) *Coaching is Providing Social and Emotional Support:* Instructional coaches perceive building relationships as the most important strategy to achieving success in coaching as reported by Anderson [32]. Through observations, it was found that coaching sessions were built on the degree of comfort that exists between the coach and the teacher. This builds a coaching relationship that resembles partnership and transcends the traditional “expert-novice” structure of coaching. At the onset of the coaching sessions, a good amount of time is spent establishing trust and comfort through informal conversations. One-on-one coaching allows for this type of relationship building that could not have been possible in the presence of more people. This type of partnership also sets the tone of all coaching sessions and leads to coaches knowing how to fully support the teachers.

When interviewed, the teachers also share the same view of a supportive coaching process. At various instances during coaching session observations, coaches were intentionally motivating teachers, which was perceived as supportive. The coach served as a sounding board for teachers, not sharing expertise, but listening and asking questions.

“Usually at the beginning of the session there’s always just kind of hey how’s your headspace like a check in just bouncing off each other, see how we’re doing. And then. We kind of talk, then we’ll go into what lesson I am currently in the middle of”. –Teacher 18

3) *Coaching is a Means to Share Relevant Resources Otherwise Not Accessible to Teachers:* Providing support also includes sharing of resources and professional development that the coaches view as important for the teacher’s improvement. Coaches ability to identify teacher needs and providing access to resources was viewed as support by teachers. During interviews by the evaluation team, the teachers expressed how resources shared by the coaches are helped them in lesson planning and implementation of grant goals. During the COVID-19 change of teaching platforms, accessibility of technological tools was one of the factors identified by teachers as important for teaching in an online environment. The evaluation showed that the sharing of resources by coaches in a “just-in-time” manner was important to the teachers.

“I think coaching is sharing of resources, because a lot of times I don’t have time to go in and pull out resources, I know I what I need but, again, I just don’t have the time, whereas [my coach] has a vast amount of resources at your fingertips, I don’t know where they come from but [my coach] has a vast amount of resources that she does share with me. So for me time is gold for any teacher so [my coach] helps me a lot when I am stuck so that I don’t have to go out and find resources, she can just share this with me.” –Teacher 110

“I wanted to try to figure out how to embed a little bit of some technology into maybe some of the kids at home and so my coach managed to provide me micro bits and help me with the training of them, and she shared with me some legos and some of her past lessons with me.” –Teacher 21

VII. CONCLUSION

A facilitative/dialogic coaching model was developed and implemented as part of a teacher professional development grant within the state of Florida. This program was designed to meet What Works Clearinghouse statistical thresholds for change to teacher practice [29]. The grant was successful in creating change to teacher practice and, while not studied, the program posits that the coaching model along with the infrastructure and support of the coaches in the program were instrumental to the changes seen by teachers [22]. This intensive PD model included a coaching model which provided professional development of teachers for the grant goals, one-on-one coaching and workforce centered field trips. The purpose of the coaching was to support teachers in developing an understanding of four main principles for effective teaching: pedagogy, curriculum, system thinking, and technology integration.

The one-on-one coaching occurred at least 2 times per month, and teachers and coaches worked through coaching cycles focused on the grant goals. Coaching was supportive in three ways to teachers – starting with their needs, providing social and emotional support, and providing resources and just in time PD to teachers.

Supporting infrastructure was provided to coaches to provide a framework, template and focus for their work with teachers. This infrastructure included rubrics, templates, coaching materials, grant primer, tracking software and coaching workspace.

This coaching model and infrastructure could be implemented into other PD programs or grants as a test of how well a facilitative/dialogic model works to support grant goals centered on classroom level pedagogical practices. The purpose of this paper is to highlight the coaching model developed as part of this program and posit the importance of coaching to creating classroom level change to teacher practices.

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REFERENCES

- [1] Discipline-Based Education Research. National Academies Press, 2012. doi: 10.17226/13362.
- [2] L. Darling-Hammond, "How Teacher Education Matters," *Journal of Teacher Education*, vol. 51, no. 3. SAGE Publications, pp. 166–173, May 2000. doi: 10.1177/0022487100051003002.
- [3] T. R. Guskey, "What Makes Professional Development Effective?," *Phi Delta Kappan*, vol. 84, no. 10. SAGE Publications, pp. 748–750, Jun. 2003. doi: 10.1177/003172170308401007.
- [4] M. Devine, R. Meyers, and C. Houssemard, "How can Coaching Make a Positive Impact Within Educational Settings?," *Procedia - Social and Behavioral Sciences*, vol. 93. Elsevier BV, pp. 1382–1389, Oct. 2013. doi: 10.1016/j.sbspro.2013.10.048.
- [5] J. Yates, "Coaching for Career and Professional Development," *Coaching in Professional Contexts*. SAGE Publications Ltd, pp. 41–54, 2016. doi: 10.4135/9781473922181.n4.
- [6] L. M. Desimone and K. Pak, "Instructional Coaching as High-Quality Professional Development," *Theory Into Practice*, vol. 56, no. 1. Informa UK Limited, pp. 3–12, Dec. 29, 2016. doi: 10.1080/00405841.2016.1241947.
- [7] D. A. Robertson, E. Ford-Connors, T. Frahm, K. Bock, and J. R. Paratore, "Unpacking productive coaching interactions: identifying coaching approaches that support instructional uptake," *Professional Development in Education*, vol. 46, no. 3. Informa UK Limited, pp. 405–423, Jun. 26, 2019. doi: 10.1080/19415257.2019.1634628.
- [8] B. R. Joyce and B. Showers, "Transfer of Training: The Contribution of 'Coaching,'" *Journal of Education*, vol. 163, no. 2. SAGE Publications, pp. 163–172, Apr. 1981. doi: 10.1177/002205748116300208.
- [9] B. L. Gottesman, *Peer Coaching in Higher Education*. R&L Education, 2009.
- [10] T. Bergen, A. Engelen, and K. Derksen, "The quality of coaching in relation to the professional development of teachers," in *Competence Oriented Teacher Training*. Brill, pp. 97–114, 2006.
- [11] R. C. Zwart, T. Wubbels, S. Bolhuis, & T. C. Bergen, "Teacher learning through reciprocal peer coaching: An analysis of activity sequences," *Teaching and Teacher Education*, vol. 24, no. 4, pp. 982–1002, 2009.
- [12] S. C. Cantrell and P. Callaway, "High and low implementers of content literacy instruction: Portraits of teacher efficacy," *Teaching and Teacher Education*, vol. 24, no. 7, pp. 1739–1750, 2008.
- [13] G. D. Hughes, "Teacher retention: Teacher characteristics, school characteristics, organizational characteristics, and teacher efficacy," *The Journal of Educational Research*, vol. 105, no. 4, pp. 245–255, 2012.
- [14] C. E. Coburn, "Shaping Teacher Sensemaking: School Leaders and the Enactment of Reading Policy," *Educational Policy*, vol. 19, no. 3. SAGE Publications, pp. 476–509, Jul. 2005. doi: 10.1177/0895904805276143.
- [15] C. Coburn and J. Russell, "Getting the most out of professional learning communities and coaching: Promoting interactions that support instructional improvement," *Learning Policy Brief*, vol. 1, no. 3, pp. 1–5, 2008.
- [16] P. Snyder, M. L. Hemmeter, M. McLean, S. Sandall, T. McLaughlin, and J. Algina, "Effects of Professional Development on Preschool Teachers' Use of Embedded Instruction Practices," *Exceptional Children*, vol. 84, no. 2. SAGE Publications, pp. 213–232, Nov. 13, 2017. doi: 10.1177/0014402917735512.
- [17] K. S. Yoon, T. Duncan, S. W. Y. Lee, B. Scarloss, and K. L. Shapley, "Reviewing the evidence on how teacher professional development affects student achievement," Reg. Edu. Lab., Washington, DC, USA, Rep. REL2007-No.033, Oct. 2007.
- [18] A. Sibley and K. Sewell, "Can multidimensional professional development improve language and literacy instruction for young children?," *NHSA Dialog*, vol. 14, no. 4, pp. 263–274, 2011.
- [19] L. K. Gibbons and P. Cobb, "Focusing on teacher learning opportunities to identify potentially productive coaching activities," *Journal of Teacher Education*, vol. 68, no. 4, pp. 411–425, 2017.
- [20] J. Knight, *The impact cycle: What instructional coaches should do to foster powerful improvements in teaching*. Corwin, 2018.
- [21] E. Aguilar, *The art of coaching: Effective strategies for school transformation*. John Wiley & Sons, 2013.
- [22] J. A. Edmunds, N. Arshavsky, V. C. Coyle, B. C. Hutchins, D. Gicheva, K. Lewis, M. Williams, L. Rosof, and R. A. Henson, "Improving teachers' instruction: The impact of Project EQuIPD," The SERVE Center, Greensboro, NC, USA, Univ. NC, Final Eval. Rep., Jan. 2022.
- [23] L. Darling-Hammond, "Changing conceptions of teaching and teacher development," *Teacher Education Quarterly*, pp. 9–26, 1995.
- [24] C. James-Ward, "The development of an infrastructure for a model of coaching principals," *International Journal of Educational Leadership Preparation*, vol. 6, no. 1, 2011.
- [25] J. Norton, B. Goodson, A. Checkoway, and M. Velez, "Commonwealth Coaching: A Proposed System for Supporting Massachusetts's Early Educator Workforce. Statewide Infrastructure and Delivery Model for Coaching and Technical Assistance to the Early Education Field," Abt Associates, Feb. 2017.
- [26] H. J. Gettman, S. K. Edinger, and K. Wouters, "Assessing contracting and the coaching relationship: Necessary infrastructure?," *International Journal of Evidence Based Coaching & Mentoring*, vol. 17, no. 1, 2019.
- [27] A. Stein, "Educational infrastructure and instructional coaching: A study of coaching practice in two school districts," PhD dissertation, Learning Sciences, Northwestern Univ., Evanston, IL, USA, 2022, doi: 10.21985/N2-ZEZE-6S48.
- [28] A. G. Kretlow, and C. C. Bartholomew, C. C. "Using coaching to improve the fidelity of evidence-based practices: A review of studies," *Teacher Education and Special Education*, vol. 33, no. 4, pp. 279–299, 2010.
- [29] U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse.
- [30] K. D. Chisholm, O. Lancaster, and N. J. Ruzycki, "Coaching for Classroom-Level Change: The EQuIPD Grant Coaching Model," in *Proc. 2024 AERA Annu. Meeting*, Philadelphia, PA, Apr. 2024. doi: 10.3102/2112113.
- [31] G. T. Doran, G. T., "There's a S.M.A.R.T. way to write management's goals and objectives," *Management Review*, vol. 70, no. 11, pp. 35–36, 1981.
- [32] V. Anderson and P. Wallin, P., "Instructional Coaching: Enhancing Instructional Leadership in Schools," *National Teacher Education Journal*, vol. 11, no. 2, pp. 53–59, 2018.