Instructional Coaching Holds Promise as a Method to Improve Instruction with Technology

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Abstract: Instructional coaching is an evidence-based form of professional development (PD) to support teacher growth. Few empirical studies examine conditions that define its effectiveness in improving teachers' ability to use technology to support student engagement and learning. Using evidence from two pilot years of an instructional technology coaching program in 108 schools nationwide, our study examines and explores the attributes that teachers, principals, and coaches report contribute to the effectiveness of coaching for improving teacher use of technology in their practice. Findings suggest that a successful instructional technology coaching program is sustained, job-embedded, and structured around a partnership between school administrator, teacher and coach. In a successful program, teachers participate voluntarily to collaborate with coaches who provide personalized support in a non-evaluative manner.

Introduction

As access to technology becomes increasingly commonplace in schools, discrepancies continue to emerge concerning not whether technology is being used, but *how* it is being used. Multiple teacher surveys (PWC, 2018; U.S. Department of Education, 2017) report that many teachers in the U.S. do not have enough experience, resources, or training to use technology in the most effective ways to advance student achievement, especially in low-income schools. The National Education Technology Plan (U.S. Department of Education, 2017) calls for "thoughtful intervention" to close this digital use divide, namely by enabling educators to "design highly engaging and relevant learning experiences through technology" (p. 20). Within schools, teachers are the greatest asset to student achievement. To enrich student learning, we must empower teachers (Darling-Hammond, 2000; Harris & Sass, 2011).

Evidence across multiple studies suggests that instructional coaching could be one such thoughtful intervention, providing a critical form of professional development (PD) to improve teacher practice (Kohler, Ezell, & Paluselli, 1999; Knight, 2007; Guinney, 2001; Neufeld & Roper, 2003). Over the past decade, instructional coaching has increasingly attracted the interest of researchers and practitioners alike. We also know from empirical research that coaching is more effective than traditional PD workshop models in creating meaningful change in teacher practice and student achievement (Kraft, Blazer & Hogan, 2018). That said, few studies examine the impact of coaching on how teachers use technology, or the factors and dynamics that define the effectiveness of coaching on teachers' ability to use technology in ways that support student engagement and learning. To fill this gap in the

field, we conducted a longitudinal study on the Dynamic Learning Project (DLP), a national technology coaching program beginning in the 2017-2018 school year. Our research questions are:

1. Can instructional coaching help teachers use technology in more impactful ways with their students?
2. Under which conditions can instructional coaching help teachers in different grades and subject areas use technology in more impactful ways?

The Dynamic Learning Project

The Dynamic Learning Project was launched in 2017-2018 with the goal of helping educators use technology in impactful ways that develop students' 21st century skills and prepare them to navigate an increasingly interconnected and complex workforce. More precisely, in the context of the DLP, Impactful Technology Use (ITU) refers to the ability of teachers and students to use technology in ways that develop students' agency, collaboration, communication, creativity, critical thinking skills, and ability to select relevant technology tools and strategies (Bakhshaei et al., 2018, 2019; NEA, 2012). Over the past two years, over 100 schools across seven U.S. states enrolled in the DLP, each engaging one site-based coach to provide their educators with personalized support in using technology. Nearly 90% of these schools received Title I funding, with an average of 66% of students receiving free and reduced-cost lunch.

The DLP provided coaches and principals in participating schools with a defined challenge-based coaching model, training, resources, and mentorship. Mentors served as accessible experts who provided an outside perspective and personalized support to coaches and principals. Coaches segmented the year into four eight-week coaching cycles, coaching an average of nine teachers per cycle, allowing more than 1,100 teachers (out of 2,250 total) in 2017-2018 (year 1) and 1,945 teachers (out of 4,497 total) in 2018-2019 (year 2) to participate. According to our data, the majority of teachers volunteered to participate in the DLP coaching program. During each cycle, coaches provided each teacher with consistent in-person support to identify, tackle, and reflect on a personal teaching and classroom challenge. Teachers worked with their coach to use technology to address self-selected challenges that fell into these eight categories: assessment, planning/preparation, classroom management, differentiation, engagement, content-based instructional strategies, developing student 21st century skills, and professional growth. Coaches also provided occasional school-level PD opportunities.

Literature Review

Technology use alone is not the goal, but rather the vehicle that teachers employ to improve instructional practices (Ertmer & Ottenbreit-Leftwich, 2013). Research shows that when used meaningfully in the classroom, technology can expose students to new perspectives, make content more interactive and accessible for them, and engage them in activities that develop 21st century skills (Bernard, Borokhovski, Abrami & Schmid, 2011; Delgado, Wardlow, McKnight & O'Malley, 2015; Darling-Hammond, Zielezinski & Goldman, 2014). However, before teachers can use technology in meaningful ways, they need adequate training on how to apply technology and how to update their pedagogical strategies in the context of technology use (Darling-Hammond, Zielezinski & Goldman, 2014).

Instructional coaching can be a powerful avenue for delivering support to teachers in technology use (James, 2011). Several decades of research support the benefits of coaching for teachers. For example, Kohler, Ezell, & Paluselli (1999) link coaching with teacher ability in helping students with special needs improve their social interaction skills. Guinney (2001) and Neufeld & Roper (2003) report positive outcomes of coaching in improvement of teacher collaboration and school culture. Cornett & Knight (2009) show that coaching can improve teachers' sense of efficacy. Beyond that, a recent meta-analysis of 60 teacher coaching programs shows a strong causal effect of coaching on teacher practice and student achievement (Kraft, Blazar, & Hogan, 2018).

Nevertheless, empirical research on the role of instructional coaches in supporting meaningful teacher use of technology remains thin. At least to our knowledge, only a few studies have investigated the effects of technology coaching on teacher practice and student achievement. Research on the eMINTS program, which used cognitive coaching to guide teachers in implementing technology professional development in their classrooms, found

promising outcomes on teacher levels of technology integration (Brandt, Meyers, & Molefe, 2013). Likewise, an evaluation of the Partners in Learning program showed the potential of peer coaching to support teachers in integrating technology in their classrooms (Barron, Dawson, & Yendol-Hoppey, 2009). A 2005 study on a technology coaching program implemented in five schools in the same school district described successful coaching approaches and impact of the program on the technology use of nine teachers (Sugar, 2005).

Given the limited evidence on the role of instructional technology coaching in teaching and learning, more research on the features, characteristics, and components that ensure its effectiveness is needed using both qualitative and quantitative lenses.

Theoretical Framework

Considering coaching as a form of teacher PD, in this study, we investigate instructional technology coaching through the lens of the features that according to the research developed during the past three decades define high-quality PD models (Darling-Hammond, Hyler & Gardner, 2017; Desimone & Pak, 2017; Desimone & Garet, 2015). Among those features, we particularly focus on the top four empirically predictive ones that can exhaustively be included in PD models for teachers in any grade levels or content areas:

(1) Collective participation: PD that gives teachers the opportunities to share their ideas, work collaboratively, and help with each other's learning.

(2) Active learning: PD that provides teachers with opportunities to get hands-on experiences in designing and/or trying new instructional strategies using real examples of their classroom and teaching challenges.

(3) Coherence: PD activities that are explicitly linked to curriculum teachers use and their classroom/school context.

(4) Sustained duration: Opportunities that provide teachers with sufficient time to learn and reflect on strategies that improve their practice.

We try to understand if and to what extent these features are necessary for the effectiveness of technology coaching programs. For each feature, we use evidence from the DLP to translate these broad principles into specific approaches, attitudes, strategies, or practices in order to form a better understanding of how and when instructional technology coaching programs work more effectively to improve teacher practice and student outcomes.

Data and Methods

To investigate the ways technology coaching can work to create rich classroom experiences, we used a convergent parallel mixed methods design, in which extensive qualitative and quantitative data was collected over the 2017-2018 and 2018-2019 school years. There is a growing consensus that mixed-method designs, linking emic and etic approaches, and triangulated data, are essential to emerging research endeavors (Creswell & Plano Clark, 2011).

Quantitative study

Data collection and sample

Quantitative data included one beginning of year pre-survey and one end of year post-survey each year, administered to all principals, coaches, and teachers in schools participating in the DLP. Although it was not possible to create a control group outside of the participating schools to prevent spillover effects, we administered the survey among teachers within participating schools who did not receive coaching. To better understand the effectiveness of the DLP, we compared the responses of teachers who participated in the DLP, receiving at least eight weeks of coaching (target group), with teachers who didn't participate (control group). Participation in the DLP was not randomly assigned. Instead, coaches and principals were encouraged to solicit voluntary participation from teachers. Most survey questions used five-level Likert scales and included these main thematic areas: (i) Teacher/student use of technology, (ii) respondents' opinions about available PD opportunities, (iii) respondents' roles in the DLP, and (iv) perceived impacts of coaching. Questions in each theme varied depending on the role of

the respondent. Coaches and principals reported on their own growth and school-level impact on teachers and students, whereas teachers reported on their own growth and that of their students. Therefore, in this proposal, when we correlate impact on teachers with program elements, we draw from the teacher rather than the coach and principal surveys.

Findings from the year 1 surveys informed improvements in the year 2 surveys. For that reason, in this paper, we discuss findings from the year 2 post-survey data gathered from teachers who received coaching at some point during year 1 and/or year 2 as well as teachers who never received coaching during those two years. Of the 2,708 teachers who completed the post-survey, 65% (N = 1,784) received coaching in some capacity during year 1 and/or year 2. The remaining 35% (N = 924) teachers never received coaching as part of the DLP. Teachers with varying levels of experience were represented in both groups; almost 35% had more than fifteen years of teaching experience, while 20% had less than five years of experience. Of both coached and non-coached teachers, the most commonly taught subjects were core subjects: English, Math, Science, and Social Studies.

Variables - To measure teacher and student ability in using technology in impactful ways, we developed the Impactful Technology Use (ITU) metric, referring to the ability of teachers and students to use technology in ways that develop students' 21st century skills.[1] The ITU metric conceptualizes six indicators to define impactful technology use. Five concern the core areas of 21st century skills that have shown very strong statistical reliability in previous 21st century skills' surveys (Hixson, Ravitz, & Whisman, 2012): Critical thinking, collaboration, communication, creativity, and agency. A sixth indicator was also developed to focus on the selection of relevant technology tools and strategies. Definition of each indicator drew from a general body of literature on 21st century skills (including NEA, 2012), but expanded to include an explicit link to technology use. For each indicator, we asked three questions from teachers in our surveys:

1. How do teachers rate their ability to engage students in impactful technology use?
2. How frequently do students use technology in impactful ways in their classrooms? Through which specific classroom practices?
3. To what extent do these students' technology uses have a positive impact on their engagement and learning?

In addition to these three ITU-related variables that we asked from both our target and control groups, to capture the impact of the coaching helping teachers use technology to tackle a self-selected challenge(s), we asked the target group to what extent they have seen improvement in each of the main eight challenge categories.

Dependent Variables (DV)	Independent Variables (IV)
Changes in frequency of technology use by students and teachers (4 items, std. alpha = .94)	Coaching as collective participation
Frequency of ITU by students (17 items, std. alpha =.95)	Coaching as a PD with active learning opportunities
Teacher confidence in their ITU ability (6 items, std. alpha = .93)	Coaching as a PD with coherent learning opportunities
Impact of ITU on student engagement and learning (6 items, std. alpha = .93)	Coaching as a sustained PD opportunity
Teachers' improvement in classroom challenge categories (7 items, std. alpha = .94)	

Table 1. Variables in Teacher Surveys

Analyses of the teacher survey showed the measures of teacher self-rating ability to engage students in ITU, frequency of student ITU practices, and teacher perceived impact of ITU on student engagement and learning all three demonstrated strong reliability (Standardized Alpha > .90 for combined indices). The frequency of student ITU practices items produced reliable index scores consisting of 2-4 items for each skill (Standardized Alpha > .80 or item correlations > .74).

Data Analysis

1 The development of this metric was indispensable because previous studies that provided tools to measure teacher practices around students' 21st century competencies (NEA, 2012; Hixson, Ravitz, & Whisman, 2012) treated technology use as a separate variable. The ITU metric we used in our teacher surveys are the result of several rounds of user testing among teachers and coaches (through focus groups and survey analyses) as well as collaborations among educational researchers and practitioners.

The data was analyzed in SPSS. Usually (for IV #2, #3, and #4), descriptive statistics were first used to compare the responses of coached teachers (target group) and non-coached teachers (control groups) in each of the variables. When a statistically significant difference was observed, inferential analyses were conducted to examine the correlation between the independent and dependent variables. For IV #1, since it did not make sense to ask control group teachers questions about a partnership that they did not participate in, we directly conducted correlational analyses.

Qualitative study

Data collection

Four volunteer case study schools participated in qualitative data collection in each year, with a total of six schools participating. School selection considered diversity in geographic region, socioeconomic status, access to technology, and school size. At each case study school, 2-3 site visits were conducted each year, during which our team conducted individual interviews with principals, coaches, and 3-7 volunteer teachers. Analyzing dynamics within and between multiple perspectives accounts provided an opportunity to triangulate individual accounts to produce a more complete understanding. Case Study teachers taught a variety of subjects at different grade levels, and had a broad range of teaching experience. The interviews were semi-structured around protocols covering the following thematic areas: (i) implementation of coaching in schools, (ii) respondent's role in coaching, (iii) respondent's understanding of the coach-teacher-principal partnership, (iv) impact of technology coaching.

Data Analysis

Interview data were analyzed using a thematic approach involving the following phases: familiarization with the data; generating codes that identify relevant features of the data; identifying themes, and then collating data relevant to each theme; analysing each theme; weaving together the analytic narrative, and contextualizing the analysis in relation to the theoretical framework (Braun & Clarke, 2006). This theoretically flexible approach was essential to our study because it was one of the very first studies in the field exploring the dynamics necessary for effectiveness of technology coaching programs. A complex coding scheme was developed throughout the project based on emerging themes from interviews. Dedoose was used for multiple coding passes of transcripts, conducting reliability checks, and synthesizing findings across different groups of participants.

Our mixed-method approach

Quantitative and qualitative data were analyzed separately, and then the results were compared and integrated through side-by-side comparison in a discussion. By triangulating a variety of data sources and perspectives, this mixed-method analysis allows for the convergence of evidence of if and how the coaching intervention can improve teachers' abilities to harness technology in impactful ways. Using this design, one data collection form supplies strengths to offset the weaknesses of the other form, resulting in a more solid understanding of the program and its impact.

Findings

Effectiveness of the DLP: Impact on Impactful Technology Use (ITU)

More frequent technology use by teachers and students

Over the year, teachers who received coaching, compared to their peers who didn't participate, more frequently reported an increase in the number of days students used technology (70% vs. 56%), the number of students who used technology (70% vs. 58%) and the number of courses/subjects in which they used technology (62% vs. 48%) (Effect sizes = .4, $p < .001$).

More frequent Impactful Technology Use (ITU) by students

Coached teachers also reported more frequent ITU practices to develop their student skills (effect sizes = .4, $p < .001$). As an illustrative example of using technology for creativity (one of the six ITU indicators), when limiting analysis to teachers of "core academic" subjects (math, science, social studies, English, general subject), 51% of coached teachers said their students use technology at least monthly to "come up with different ideas to see how they work and then improve them" compared to 38% of non-coached teachers.

Stronger teacher confidence in Impactful Technology Use (ITU)

Moreover, compared to teachers who were not coached, coached teachers' ratings were significantly higher on index scores (alpha > .82, usually about .9) for their own ability to implement ITU practices.

More impact on student engagement and learning as a result of teacher Impactful Technology Use (ITU)

Finally, compared to teachers who were not coached, coached teachers' ratings were significantly higher on index scores for the impact of their overall ITU practices on their students' engagement and learning (effect sizes = .4, $p < .001$).

Teachers' improvement in classroom challenge categories

More than 90% of participating teachers reported at least some improvement in the following teaching challenges as a result of working with their coach: assessment, differentiation, instructional strategies to support a specific content area, classroom management, planning and preparation, and professional growth. Remarkably, in all six of these categories, more than half of participating teachers reported "much" or "very much" improvement.

What can make effective coaching programs

Collective participation: Instructional coaching can be effective when framed as a partnership

Our data shows that when defined, understood, and implemented as a partnership among school administrators, coaches, and teachers, coaching programs are more successful in creating change in teacher practice. Over the two pilot years, 100% of the DLP coaches and principals agreed that instructional coaching is a partnership with shared responsibilities. They were also successful in transferring this mindset to their teachers. At the end of year 2, more than 82% of teachers who received coaching in year 1 and/or year 2 reported that their principal and coach provided an environment where they felt empowered to be a collaborator in the DLP. Correlation analyses show a positive significant relationship between teachers reporting coaching as a partnership and their confidence in the six areas of their ITU ability (corr between .16 and .21, $p < .001$) as well as their average improvement in their selected classroom challenge(s), such as assessment or differentiation (corr for index score = .43, $p < .001$).

Our extended findings suggest precise roles and approaches that each of the partners can take to create a powerful coaching partnership. The most important conditions seem to be that teacher participation is voluntary (corr with improvement in classroom challenges = .36, $p < .001$) and that teachers receive support from a coach in a non-evaluative manner (corr with improvement in classroom challenges = 0.3, $p < .001$). Our interviews with principals, coaches, and teachers suggest that when teachers clearly understand the goal of coaching and its alignment with instructional and curricular priorities, they feel more motivated to work with a coach. This highlights the importance of the principal's role in promoting coaching to teachers. "I think it's important to have the principal share the 'why' behind coaching to help with buy-in," one coach said. "I also think that if the principal believes in it, it will show in how he/she talks about it throughout the school year with staff." Likewise, interviews revealed the importance of the coach's and principal's role in ensuring that teachers felt safe that their collaboration with their coach would remain confidential and that they felt comfortable experimenting with new technologies and instructional practices even if it meant that they might make mistakes as part of the learning process. As one principal put it, "Teachers won't work with instructional coaches if they think that person is just a spy, to come back to administration. It's not an effective, trusting relationship."

Our data also suggests that one advantage of technology coaching compared to other forms of teacher coaching programs is that the expectation for partnership are built more deeply embedded As explained by our

participants, while coaches are the experts in tech use, teachers are the experts of the content area and they work hand in hand.

Coherence: Instructional coaching can be effective when it is personalized

Our coaches provided personalized support to teachers by tailoring their pacing and approach to meet each teacher's unique needs in the use of technology. While 56% of coached teachers in core subject areas reported that their PD was to a great extent a good fit with what they needed in their current teaching assignments, only 36% of their non-coached peers reported this (Chi-Sq $p < .001$). Moreover, correlation analyses show a positive significant relationship between teachers reporting their PD as a good fit with their needs and their average confidence in the six areas of their ITU ability (corr = .3, $p < .001$ for index score). In interviews, teachers described the immediate differentiated support they received as essential to their satisfaction with coaching, and ultimately with their growth in use of technology with their students. Teachers showed more buy-in to the coaching program because it empowered them to tackle self-selected challenges in ways that were relevant to their background, skills, classroom context, and goals. As one middle school history teacher put it, "The two previous years it was [only] Google Docs. I just didn't know of everything else that was out there, because there's so much, and how do you find what's right for what you need, and what's right for your students? That's why I like [my coach], because I'll talk to her and she will come back with a few resources that are geared for exactly what I'm looking for."

Active learning: Instructional coaching can be effective when it is job-embedded

Our data suggest that when coaching models require frequent face-to-face meetings between coach and teacher for the implementation of new tools and strategies, they are more likely to improve teacher skills and practice. The DLP model employs two key methods of coaches actively working with teachers: 1:1 meetings and classroom visits. During 1:1 meetings, teachers collaboratively plan how they will implement strategies and technology tools during classroom visits, and/or debrief a classroom visit. During classroom visits, coaches see the teacher in action and support the teacher by co-teaching, modeling, or collecting data for feedback and reflections. Over year 2, the majority of coached teachers (more than 87%) consistently reported 1:1 formal meetings with their coach, coach classroom visits for observation, and conversations with their coach outside of formal meetings as the most valuable coach-teacher interactions to address their challenges and help them use technology in impactful ways (compared to coach-facilitated departmental/grade-level meetings, coach-facilitated school-wide PD, co-teaching and/or modeling).

While 49% of coached teachers reported that their PD to a great extent included enough time during and between events to think carefully about, try, and evaluate new ideas, only 38.5% of their non-coached peers reported this (Chi-Sq $p < .001$). Correlation analyses show a positive significant relationship between teachers reporting their PD including enough time to try and evaluate new ideas and their average confidence in the six areas of their ITU ability (corr = .3, $p < .001$ for index score). In interviews, teachers described that in these ways, they consistently engage in "sense-making" activities as they directly apply the practices that they are learning to their classrooms. For example, one third grade teacher said that through co-teaching or modeling in her classroom, her coach was able to "be in my shoes and see the problems that come up." Taking this shared classroom experience as a starting point, she and the coach engaged in dialogue where they co-constructed appropriate revisions and next steps toward their shared goal.

Sustained support: Instructional coaching is more effective when it provides a substantial number of contact hours between coach and teacher

While 47% of coached teachers in core subject areas reported that to a great extent their PD was sustained over time with coherent follow-up, only 30% of their non-coached peers reported the same (Chi-Sq $p < .001$). Correlation analyses show a positive significant relationship between teachers reporting their PD being sustained over time and their average confidence in the six areas of their ITU ability (corr = .3, $p < .001$).

In addition, interviews with teachers and coaches suggest that sustained collaboration between coaches and teachers allows time for building rapport. As the coach-teacher relationship develops, teachers feel increasingly comfortable speaking openly with their coach without fear of evaluation or judgement. Simultaneously, coaches gain a deeper understanding of teachers' individual needs and can therefore provide more differentiated support.

Consistent support from the coach over the course of one or more eight-week cycles also provides teachers with time to experiment, reflect, iterate, and tackle additional challenges as well as transfer their learning to other teachers in their department or grade level.

While working with their coach, more than 81% of coached teachers received at least 30 minutes of one-on-one coaching per week, with 43% of them receiving more than an hour of coaching each week. Coached teachers received, on average, more than 16 hours of coaching support over the school year. This represents a wide range of total coaching hours; some teachers received 0-8 hours for the year and some received 80 hours or more. Coaches noted that the intensity of support they provided varied based on teacher's needs.

Discussion and Conclusion

Our findings establish coaching as a valuable PD opportunity for improving teacher technology knowledge, skills, and practice. They show how coaching is consistent with research-based ideas of effective teacher PD, specifically with its fulfillment of four key features of effective PD - collective participation, active learning, coherence, and sustained (Darling-Hammond, Hyler & Gardner, 2017; Desimone & Pak, 2017).

A successful instructional technology coaching program that can create rich classroom experiences is structured around a partnership between school administrator, teacher and coach. In such a coaching partnership, the coach and school administrator collaborate to ensure that teachers understand that coaching is about providing opportunities for teachers to work on their challenges and think about how they can tackle them by trying new instructional strategies, and feel supported in those opportunities. The coach and school administrator collaborate to ensure that teachers participate voluntarily and perceive the coach's support as non-evaluative. They actively work to build a relationship of trust between coach and teacher, and clearly communicate to teachers that the coach is only a thought-partner, and what the coach observes in classrooms would be kept confidential. As a result, teachers are more likely to open the doors of their classroom to their coach, work with their coach voluntarily, and be willing to work on their areas of improvement without fear of failure or judgement.

In a successful coaching program, teachers have frequent and sustained opportunities where they can learn actively by interacting directly with the new practices they are learning and draw connections to their classroom environment. Effective professional development is relevant to the teachers' needs and day-to-day experiences, and includes a rhythm of follow-up and consolidation (e.g., activities including discussion, experimentation and analysis and reflection).

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