Fostering Job-Embedded Teacher Learning: Essential Features for Effective Instructional Coaching

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Abstract: Instructional coaching is an evidence-based form of professional development (PD) to support teacher learning. Few empirical studies examine conditions that define its effect on teachers' ability to use technology to support student engagement and learning. Using evidence from two pilot years of the Dynamic Learning Project, 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 a sustained, job-embedded PD, structured around a partnership between school administrator, teacher and coach. In a successful program, teachers collaborate voluntarily with coaches who provide personalized support in a non-evaluative manner.

Keywords: digital use divide, teacher professional development, impactful technology use, effective coaching

Issue addressed and significance of the work

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. Research shows that when used meaningfully in the classroom, technology can provide teachers with powerful ways to support learning and the development of students' 21st century competencies (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). 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 learning, 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).

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. The years between 2000 and 2015 saw the number of instructional coaches in U.S. schools double (Galey, 2016). 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 effect of coaching on teachers' ability to use technology in ways that support student engagement and learning (Brandt, Meyers, & Molefe, 2013; Barron, Dawson, & Yendol-Hoppey, 2009; Sugar, 2005).

To fill this gap, we conducted a longitudinal study on the Dynamic Learning Project (DLP), a national technology coaching program piloted in the 2017-2018 and 2018-2019 school years. Our goals were to explore: 1. Whether instructional coaching can help teachers use technology in more impactful ways with their students; 2. Under which conditions instructional coaching can help teachers in different grades and subject areas use technology in more impactful ways.

The Dynamic Learning Project launched with the goal of helping educators use technology in impactful ways that develop students' 21st century skills. 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 two pilot years, more than 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 technology use. Nearly 90% of these schools received Title I funding, with an average of 66% of students receiving free and reduced-cost lunch and an average of 56% students of color.

The Dynamic Learning Project provided coaches and principals in participating schools with a defined challenge-based coaching model, trainings, resources, and mentorship. As part of this coaching model, coaches segmented each school year into four eight-week coaching cycles. The majority of participating teachers worked with a coach for one eight-week cycle; coaches worked with 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 to participate. According to our data, the majority of teachers who participated volunteered to do so.

During each cycle, coaches provided each teacher with consistent in-person support through five steps in the DLP coaching model: (1) identify a classroom challenge(s) to be addressed (2) brainstorm possible strategies, (3) select personalized strategies/tools, (4) implement selected strategies in the classroom through co-teaching, modeling and/or observation, and (5) reflect on progress. Working with their coach, teachers learned how to use technology to address self-selected challenges that fell into eight categories: assessment, planning, classroom management, differentiation, engagement, content-based instructional strategies, developing student 21st century skills, and professional growth. Coaches also provided occasional school-level PD opportunities.

Participating schools received sustained mentoring and ongoing PD, including participation in both DLP-wide and regional PLNs. Coach and principal engagement began with a week-long Summer Institute where they met the mentor assigned to support their geographic region. Over the course of the year, mentors served the role of accessible experts who provided an outside perspective and personalized support to coaches and principals. After an initial school visit in the fall, mentors held virtual, biweekly meetings with coaches and monthly meetings with principals. Coaches and principals reconvened at a regionally-based Winter Institute.

Literature review

Teacher quality has been consistently identified as the most important school-based factor in student educational achievement (McCaffrey, Lockwood, Koretz, & Hamilton, 2003; Rowan, Correnti & Miller, 2002), and teacher effects on student learning have been found to be cumulative and long-lasting (Sanders, Wright, & Horn, 1997; Stronge, Ward, & Grant, 2011).

Schools and districts often offer frequent PD opportunities to teachers. Each year, $18 billion is spent on teacher PD, and a typical teacher spends 68 hours on professional learning activities directed by districts (Bill & Melinda Gates Foundation, 2014, p.3). However, fewer than 30% of teachers are highly satisfied with current PD offerings, and large majorities of them do not believe that their PD activities are helping them with the changing nature of their job, including using technology tools (Bill & Melinda Gates Foundation, 2014).

Pak and Desimone (2017), in a synthesis of cross-sectional studies, longitudinal studies, and literature reviews of experimental and quasi-experimental studies, identified five elements for effective professional development activities: 1. content focus, 2. active learning, 3. sustained duration, 4. coherence, and 5. collective participation. In the same vein, Darling-Hammond, Hyler, and Gardner's 2017 review of 35 methodologically rigorous studies demonstrating a positive link between teacher PD and student achievement found that high-quality PD: 1. is content-focused; 2. incorporates active learning; 3. supports collaboration; 4. uses models of effective practices; 5. provides coaching and expert support; 6. offers feedback and reflection; and 7. is of sustained duration. These studies are common in five features that can streamline and enhance PD programs for educators: content focus, collaboration/collective participation, active learning, coherence, and sustained duration.

Theoretical framework

In this project, we consider classroom coaching as a constructivist activity that supports teachers in building meaning and creating change through experience (Jonassen, 1999). In this vein, we follow researchers who conceptualize coaching as a form of PD (Darling-Hammond, Hyler & Gardner, 2017; Desimone & Pak, 2017; Desimone & Garet, 2015), and investigate instructional technology coaching through the lens of four key empirically predictive features of effective teacher PD that can be included in PD models for teachers in any grade level or content area (Darling-Hammond, Hyler & Gardner, 2017; Desimone & Garet, 2015):

(1) Collective participation: Opportunities for teachers to participate in collaborative structures for learning and problem-solving.

(2) Active learning: Opportunities that engage teachers in designing, implementing, and reflecting on teaching strategies while receiving feedback and guidance.

(3) Coherence: Goals and activities that are explicitly linked to curriculum, classroom/school context, the needs of the students, and teacher knowledge and beliefs.

(4) Sustained duration: Ongoing opportunities that provide teachers with an adequate number of contact hours for learning.

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

Each year, quantitative data included one beginning of year pre-survey and one end of year post-survey, administered to all principals, coaches, and teachers in schools participating in the DLP. 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 (participant group), with teachers who did not participate (comparison 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. In this proposal, quantitative analysis draws from the teacher surveys.

Due to improvements in instrumentation from year 1 pilot surveys, 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) of 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. The development of this metric built on previous studies that provided tools to measure teacher practices around students' 21st century competencies (NEA, 2012; Hixson, Ravitz, & Whisman, 2012), but which 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. It 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:

1. What are teacher self-ratings of 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 we asked teachers in the DLP specifically about the impact of the coaching they received in helping them use technology to tackle a self-selected challenge(s), and to what extent they have seen improvement in each of the other main classroom challenge categories (see Table 1). Each of the indices had strong reliability with approximately normal looking distributions and all items contributing.

Table 1: Variables in Teacher Surveys

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)	

Data analysis

The data was analyzed in SPSS using descriptive statistics to compare the responses of "coached" teachers and non-coached teachers for each of the variables. Statistically significant mean differences are reported using independent t-tests of statistical significance, and the size of the difference is provided using effect sizes (Cohen's *d*). To make it easier to interpret these differences, we illustrate the findings comparing percent from each group giving each response. For differences in mean index scores combining multiple Likert-style items, we report effect sizes and t-test results. When percent differences are reported, we include Chi-squared goodness of fit tests, and we use Pearson correlational analysis to test for linear relationships between independent and dependent variables.

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; analyzing 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 first studies in the field exploring the dynamics necessary for effectiveness of school-based technology coaching programs in K-12 settings. 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. 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. Each form of data collection complements the other form, resulting in a more solid understanding of the DLP and its impact.

Findings

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

Increased technology use by teachers and students

Over the year, teachers who received coaching, compared to their peers who didn't, more frequently reported an increase in classroom technology use. For example, 61% of coached teachers, compared to 46% of non-coached teachers, reported an increase in the number of courses/subjects in which they used technology, $X^2(1, N = 2404) = 52.93$, $p < .001$. Similarly, more coached teachers (72% vs 57%) reported an increase in hours per week they used technology in their teaching $X^2(1, N = 2418) = 59.67$, $p < .001$. Likewise, 70% of coached teachers compared to 55% of non-coached teachers reported an increase in the number of students used technology for class assignments $X^2(1, N = 2412) = 55.49$, $p < .001$.

More frequent Impactful Technology Use (ITU) by students

In addition to changes in the amount of technology use overall, coached teachers also reported more frequent ITU practices to develop their students' skills. There was a significant difference in the mean index score incorporating 17 items across all six indicators for coached (M = 2.72, SD = .87) and non-coached (M = 2.46, SD = .90) teachers; $t(2569)=7.391$, $p < .001$, $d=.29$. As an illustrative example of using technology for creativity (one of the six ITU indicators), 49% 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 37% of non-coached teachers, a statistically significant difference, $X^2(1, N=2708) = 35.54$, $p < .001$.

Stronger teacher confidence in Impactful Technology Use (ITU)

For self-ratings of their ability to implement ITU practices with their students, the overall index score combining all six indicators indicated a significant difference between coached (M = 5.24, SD = .79) and non-coached (M = 4.98, SD = .93) teachers; $t(2607)=7.771$; $p < .001$, $d = .30$. Coached teachers reported greater ability to implement ITU practices.

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

Concerning the impact of their overall ITU practices on their students' engagement and learning, there was a significant difference on the six item index score between coached (M = 3.57, D=.76) and non-coached (M = 3.36, SD = .79) teachers; $t(2302)=6.391$, $p < .001$, $d = .27$ with coached teachers reporting larger technology impacts on engagement and learning.

Teachers' improvement in classroom challenge categories

For participant teachers who received coaching, more than 90% 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. In all six of these categories, more than half of participating teachers reported "much" or "very much" improvement.

What features can make coaching programs effective

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

Our data shows that coaching programs can be successful in creating change in teacher practice when defined, understood, and implemented as a partnership among school administrators, coaches, and teachers. Over the two pilot years, 100% of the DLP's coaches and principals agreed that instructional coaching is a partnership with shared responsibilities, and it appears they were also successful in transferring this mindset to their teachers. 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 the coached teachers reporting they felt empowered to be a "collaborator in the coaching program" and their perceived improvement in the classroom challenge categories (corr for index score = .44, $p < .001$). This collaborative relationship was also correlated to teacher confidence in their ITU ability across the six areas (corr on index =.21, $p < .001$).

Additional findings suggest roles and approaches that help 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 = .30, $p < .001$). 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." Interviews also 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 suggest that an advantage of technology coaching compared to other forms of teacher coaching is that the expectation for partnership is more deeply embedded. As participants explained, coaches are the experts in technology use, but teachers are the experts in their content area, and so they must work hand in hand.

Coherence: Instructional coaching can be effective when it is personalized

DLP 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 reported that their PD was to a great or very great extent a good fit with what they needed in their current teaching assignments, only 36% of their non-coached peers reported this, a statistically significant difference, $X^2(1, N = 2631) = 104.83$, $p < .001$. Moreover, correlation analyses show a positive significant relationship between teachers reporting their PD was a good fit with their needs and their average confidence in the six areas of their ITU ability (corr = .31, $p < .00$).

In interviews, teachers described the timely and differentiated support they received as essential to their learning, and ultimately to their growth in use of technology with their students. Teachers showed more buy-in because they were empowered 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 include 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. There were two key methods of coaches actively working with teachers: 1:1 meetings and classroom visits. During 1:1 meetings, teachers collaboratively plan how to 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.

In 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 51% of coached teachers reported that their PD to a great or very 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, a statistically significant difference, $X^2(1, N=2632) = 37.64$, $p < .001$. 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 their ability in the six ITU areas (corr = .30, $p < .001$ for index score).

In interviews, teachers described consistent engagement in “sense-making” activities as they directly applied the practices that they were 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

Finally, 48% of coached teachers reported that their PD was sustained over time with coherent follow-up to a great or very great extent, while only 32% of their non-coached peers reported the same, a statistically significant difference $X^2(1, N= 2623) = 62.00, p < .001$. 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, $p < .001$).

Interviews with teachers and coaches suggest that it was sustained collaboration between coaches and teachers that allowed 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 provided 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 teachers’ needs. Although needs varied, there was a pattern that the more teachers participated the more they reported benefits from coaching.

Conclusions and implications

A number of studies have found large positive effects of coaching on teachers’ learning and practices. However, few studies have examined factors and dynamics that define the effect of coaching on teachers’ skills in using technology to support student engagement and learning. Using evidence from two pilot years of an instructional technology coaching program in 108 schools nationwide, this study focused on understanding the attributes that teachers, coaches, and principals reported contributed to the effectiveness of coaching and which were associated with impactful use of technology. Results suggest the instructional coaching framework, with four core elements of effective PD, can be a powerful tool for improving teacher learning and practice. The findings suggest that a successful teacher coaching program is structured around a partnership between school administrator, teacher and coach. In a successful program, the coach and school administrator collaborate to ensure that teachers participate voluntarily and perceive the coach’s support as non-evaluative. Teachers showed more improvement in their learning and practices when they participated in sustained opportunities for active learning that were aligned to their needs and classroom context. These findings chart the course for further research on effective coaching and its impact on impactful technology use. We look forward to additional research in the coming year that will build on these findings by adding a rubric that teachers and coaches can use to more closely examine impact on student engagement and learning.

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