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The Effect of Job-embedded Professional Development on Teacher and Student Outcomes: A Multi-Level Meta-Analysis

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Abstract: The aim of this meta-analysis was to analyze the experimental research into the effects of job-embedded professional development (JEPD) for teachers and student outcomes. Our meta-analysis of experimental studies of the effects JEPD, included 20 studies (with 79 experimental comparisons) at teacher level and 19 studies at student level (with 34 experimental comparisons). Analyses of the studies, representing 2,062 teachers and 21,425 students, revealed a significant, medium-to-large effect size at teacher level (ES= 0.699, SE= 0.092) and a significant medium effect at student level (ES = 0.523, SE= 0.137). Effects for teachers were smaller in studies with a large sample size. Effects for students were positively related to the length of the intervention. The positive outcomes at teacher and student level support the implementation and expansion of JEPD programs across schools.

Keywords: Professional development; job-embedded professional development; Student achievement; Meta-analysis.
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Introduction

Job-Embedded Professional Development and Student Achievement

Teachers have a broad range of responsibilities in schools, including working productively in their classrooms, translating and modeling curricular aims and theoretical concepts into effective classroom and school-wide practices, and providing an instructional environment for effective student learning (Broad & Evans, 2006). Given these many responsibilities, it is not surprising that wide variation exists among teachers with respect to teaching quality (e.g., Hanushek & Rivkin, 2010). Teaching quality is often defined by teacher input measures, such as training or level of education, or by teacher output measures, such as value-added scores (Goldhaber et al., 2015). Moreover, research evidence emphasizes the significance of overall teaching quality as a lever for improving student achievement (e.g., Hendriks et al., 2010).

To address needs related to improving teaching quality, there is a significant and growing emphasis on providing teachers with effective professional development (PD) designed to improve teaching quality in schools (Guskey, 2003; Özer, Can, Duran, 2020; Vernon-Feagans et al., 2018). Research findings highlight three essential characteristics of professional development activities that are related to significant and positive changes in teachers' knowledge and skills as well as changes in classroom instructional practices (Garet et al., 2001). These

characteristics include: (a) a focus on increased content knowledge; (b) opportunities for participants to engage in active learning; and (c) alignment with other learning activities for teachers (Garet et al., 2001).

Likewise, the direct relationship between teaching quality and student achievement has long been established (e.g., Balta et al., 2015; Darling-Hammond, 1997; Stronge et al., 2008; Taylor et al., 2010). For example, Stronge et al. (2008) conducted a study in which they created an indicator of teaching effectiveness (degree to which the teacher can activate learners and influence student learning) by comparing actual student achievement with expected achievement. Teachers with the highest teaching effectiveness scores had significantly higher scores in instructional practices and techniques, student assessment, classroom management, and personal qualities, such as interaction style. Teachers' effectiveness was measured based on "… effective teachers are those who foster achievement gains beyond that expected from the student's past achievement (p.170)." Researchers found similar results for relationships between teacher quality (characteristics that teachers possess) and classroom achievement (e.g., Borman & Kimball, 2005), finding that more effective teaching was related to higher mean classroom achievement. Meanwhile, Stronge et al. (2008) measured the qualities of teachers on four dimensions, that is, "instructional expertise, student assessment, learning environment, and personal qualities of the teacher (p. 168)". Moreover, the unequal distribution of teacher quality variables (instructional planning, classroom management, instructional interactions, and professional responsibilities) across various indicators of student disadvantage has been established (Borman & Kimball, 2005; Goldhaber et al., 2015). On average, more advantaged students, those socio-economically better, are placed in classrooms with higher teaching quality, and disadvantaged students tend to be placed in classrooms with lower teaching quality.

Although the effect of teaching quality on student achievement is important, the relationship among all three constructs – professional development, teaching quality, and enhanced student achievement – is crucial. Yoon and colleagues (2007) examined studies that met strict evidence standards and found aspects of PD that significantly affected student learning included (a) a longer duration (14 or more hours) of PD learning programs, (b) facilitation by authorities or well-prepared researchers, (c) a relatively small-scale (ranging from approximately 5 - 44 participants at one or up to a few schools sites), and (d) follow-up support and feedback for teacher participants. On average, results indicated that ongoing and intensive PD, can improve student achievement by as much as 21 percentile points. However, in a review of PD initiatives related to improved teaching, Kennedy (2016) notes that evidence-based PD design features such as those detailed by Yoon and colleagues (2007), are uncertain predictors of PD program success.

One promising way to address Kennedy's (2016) conclusion and to provide effective PD to support teachers' learning and increased teaching quality related to student achievement is by conducting job-embedded professional development (JEPD) in schools (Croft et al., 2010). Unlike traditional PD where teachers are removed from classrooms for workshops, JEPD is mainly school- or classroom-based and is incorporated into the regular workday, allowing teachers to address immediate problems of practice around student learning within their daily work

environment (Cavazos, 2013). By addressing professional development within the same context in which new learning would be applied (Korthagen, 2010; Langer, 2009), JEPD programs have the potential to directly impact teachers' instructional efficacy, which in turn can positively affect student learning.

Therefore, the purpose of this meta-analytic study is to systematically analyze the research exploring the strength of the relationship between JEPD and teacher performance and student achievement outcomes. There is a need for research that demonstrates the relationship between teacher PD and improved student achievement (Smith & Gillespie, 2007). Establishing an empirical link between teachers' JEPD and student learning outcomes enhances our understanding of the JEPD programs that may lead to improved classroom instruction. This knowledge may also shape the future development and implementation of these programs in educational practice.

Teacher Professional Development (PD)

The quality of PD provided in schools is generally linked to improved quality of teaching within schools (Fischer et al., 2018; Hanushek & Rivkin, 2006; Vescio et al., 2008). For example, Fischer and colleagues (2018) determined that teachers' participation in PD along with other school- and teacher-level factors had an impact on teachers' instructional practices, based on their study of over 7,000 teachers. Likewise, Vescio, Ross, and Adams (2008) examined a small number of studies on professional learning communities (PLCs) and determined that well-developed PLCs were related to improved instructional practices.

PD is one way that educators can gain new knowledge and techniques to address the necessities of 21st century learners. PD is typically organized around satisfying the needs of the school population primarily to improve student achievement and, at the same time, increase the efficacy of teachers and the work they do in the classroom. In such a context, PD is defined as, "the processes and activities designed to enhance the professional knowledge, skills, and attitudes of educators so that they might, in turn, improve the learning of students" (Guskey, 2000, p. 16). There has been rising concern that the main role of highly effective PD programs in supporting teachers is to be responsive to the evolving, interrelated, and composite needs of teachers and education more broadly (Berliner, 2001; Joyce & Showers, 2002).

PD also focuses on an individual teacher's practice within the context of his or her school (Knight, 2011), so that the collective effectiveness of teachers can lead to classroom- and school-wide improvement in student performance. For teachers, not only is the context of PD changing, but also, and even more importantly, how PD is integrated into teachers' workdays is changing as well. Experts recommend an integrated design for teachers' PD that, ''focuses upon student and teacher learning, linking to the larger system and incorporating a range of possible learning activities within a job-embedded context'' (Broad & Evans, 2006, p. 4).

Job-embedded Professional Development (JEPD)

JEPD is a type of teacher learning embedded in teachers' everyday teaching practice with the aim of increasing student learning by developing teachers' content- and context-specific instructional practices. Theoretically, within JEPD models teachers should be able to transform their knowledge and learning into practice (Carlisle et al., 2011; Desimone, 2011; DuFour, 2004; Linder et al., 2012), and this transformation is an integrated and ongoing process (Croft et al., 2010).

For PD to be considered JEPD, it is typically conducted during the instructional school day and provides immediate, appropriate activities for teachers to use and later reflect upon. JEPD can take place in the classroom in real time, in the presence of students, and focus on authentic teaching practices. Conversely, PD that takes place outside the school, removed from instruction, away from learners, but still focused on issues of practice cannot be considered JEPD (Croft et al., 2010). JEPD also encompasses embedded activities such as observing one's own and other teachers' instruction and reflecting on it; analyzing, and improving methods of teaching; as well as discussing and sharing common issues and ideas with colleagues. These JEPD activities focus on the enhancement of teaching practices to positively affect student achievement as a common goal (Hussey, 2013).

Formats of Job-embedded Professional Development

Croft et al. (2010) defined a wide range of twelve formats for JEPD, ranging from action research to study groups. Five frequently implemented formats have been evaluated in different empirical studies (they are also included in this meta-analysis) and this selection is briefly described below.

Coaching: Coaching is identified as a procedure in which practitioners are matched with more experienced professionals. Through this matching, teachers may develop their own content knowledge and instructional practices as well as pedagogy specific to their discipline. A coach can help teachers in their efforts to initiate and then apply new learning through personalized assistance (Neuman & Cunningham, 2009). Coaching can enable teachers to improve their practice and to overcome adverse experiences due to unusual conditions, such as working in remote areas and being left alone to provide instruction to students (Symonds, 2003). Coaching can also be implemented through observing other teachers. However, matching teachers who study in the same content area and preparing efficient plans and timetables for the observation process typically results in the best outcomes (Croft et al., 2010).

Lesson study: Lesson study focuses on the joint study of real classroom lessons (Lewis et al., 2006) and is a cycle of instructional improvement in which a group of teachers works together to design and revise a lesson. It provides an organized process which includes planning, observing, and discussing lesson steps. The primary goal of lesson study PD is to improve teachers' lesson planning and implementation skills by enhancing their ability to observe, predict, and react effectively to students' thinking (Woodruff et al., 2013). During sessions, teachers alternate in preparing a best possible lesson to demonstrate a specific performance while other teachers observe while the lesson is taught. After the lesson, all teachers meet and ask questions, discuss the lesson's strengths and weaknesses, and

make suggestions to improve the lesson (Fernandez, 2002). Teachers then observe the subsequent lessons to see the effects of feedback on the new lesson.

Mentoring: Mentoring is a process in which an experienced professional and a less-experienced colleague work together to enhance pedagogical outcomes. There are two key actors in mentoring: mentors and mentees. In such a collaboration process, mentors provide advice and support for their colleagues and act as a role model. In return, they obtain novel experiences and improve their expertise. To be most successful, the mentoring collaboration is often structured and deliberate. Frequently, the participants for mentoring PD are beginning teachers and others in pursuit of deeper understanding of the factors that impact the learning process. Mentors provide a model for the thinking and communication processes needed in teaching and enable new educators to improve their efficacy in language use and pedagogical methods (Diaz-Maggioli, 2003).

Professional learning communities: In professional learning communities (PLC; DuFour, 2004), teachers come together during a planned time and discuss issues of classroom practice including instruction for students (Croft et al., 2010; Vescio et al., 2008). Teachers form teams to observe critically and discuss standards-based learning expectations for students through collaboration. Teachers in PLCs often engage in a systematic process around a particular topic: study, select, plan, implement, analyze, and adjust. Researchers note five features of effective PLCs: supportive and shared leadership, collective creativity, shared values and vision, supportive conditions, and shared personal practice (Hord, 1997). Supporting and fostering the construction of teachers' capacity through collegial, purposeful PD is a basic principle of a PLC (Wells & Feun, 2007).

Action Research: Action Research is a technique of methodical investigation that teachers carry out as researchers of their personal teaching. The main aim of action research is to develop the teachers' own practice; moreover, if relevant, the goal is to generalize it across further situations in the school or elsewhere (Cochran-Smith & Lytle, 1990).

Teacher study groups: Teacher study groups are an alternative to traditional PD programs because teachers in diverse schools are able to investigate issues related to pedagogy and learning in a collaborative format (Clair, 1998). The term study group suggests that teachers review professional resources and literature and analyze samples of students' work. Teachers' interactions within the groups are typically guided by protocols (i.e., agendas) (Birchak et al., 1998) and use lesson plans or student work samples as a matter of discussion. There is not a single leader in these meetings; all members rotate as the study group leader. Teachers in study groups may help each other to have a deeper understanding of the topics in the field or of ways to assess their students' work (Birchak et al., 1998). Professional Development: Other types. Professional development in this category is defined as a unique PD model, often borrowing from, or combining aspects of, the multiple PD models described earlier. For example, Bruce et al. (2010) employed a model of PD where participants employed a combination of models including PLCs, lesson study, and coaching. Teachers, administrators, and consultants met together in a series of two-day sessions on

multiple occasions to: (a) set student learning goals in mathematics, (b) plan a mathematics lesson with a small group, and (c) co-teach and/or observe the lesson. Later, based on student responses, participants revised the lesson in the subsequent two-day session and co-taught and/or observed its implementation a second time. Between two-day sessions, participants also co-planned and co-taught in their home placement, although this varied by district.

Teacher Professional Development and Student Achievement

Research has found significant, positive relationships between teaching quality and student achievement (Balta et al., 2015; Caena, 2011; Fischer et al., 2018), illustrating why, ‘‘professional development needs to be, first and foremost, attentive and responsive to student learning and performance’’ (Broad & Evans, 2006, p. 40). Taken from this perspective, there is little use for PD programs if teachers do not carry newly learned practices and content knowledge to their classrooms. By extension, one primary purpose of PD is to help teachers increase student achievement (French, 1997; Guskey, 2000; Joyce & Showers, 2002). In other words, one crucial goal of PD is the connection to student learning.

Purpose of the Study

Given the expense of PD, it is critically important to synthesize studies that have been conducted in relation to teach highly explorative er PD and student learning. Consequently, this study focused on JEPD programs designed to increase student achievement because PD is generally acknowledged to be an important way of improving teacher practice, and thereby student learning (Guskey 2000; Kennedy, 1998, 2016). Specifically, the purpose of this meta-analysis was to systematically analyze the research exploring the strength of the relationship between teachers’ JEPD and student achievement outcomes. This study addressed the following research questions: (a) What is the relationship between job-embedded professional development and teacher performance? (b) What is the relationship between job-embedded professional development and student achievement?

Method

Study Design

We synthesized the current knowledge by way of a systematic review and meta-analysis of the effects from experimental studies of JEPD. In this review study, there were three consecutive steps: the literature search, coding of the relevant studies, and analysis of the data.

Literature Search and Selection of Studies

The meta-analysis started with an intensive electronic search using the ERIC, EBSCO, JSTOR, SPRINGERLINK, and Google Scholar databases. The search profile was based on the list of formats for JEPD given by Croft et al. (2010), and included various key words, including job-embedded professional development, lesson study, coaching, mentoring, case discussion, critical friends groups, portfolio, learning community, study groups, peer observation,

action research, supervision, discourse community. A broad search profile was used at this stage to include all relevant JPED studies.

A three-step screening stage was performed to determine the eligible studies. In the first step, the first and second authors reviewed the studies on three criteria: whether the publication reported a quantitative study; if one of the JPED formats as distinguished by Croft et al. (2010) was involved; and whether the study was published between 2000 and 2019. The 2000–2019 timeline was set to synthesize recent research on JEPD. Studies that did not meet one or more of the criteria were excluded.

The database search yielded 1,907 articles. A scan of the abstracts resulted in 1,511 being rejected. In total, 396 unique studies met all three criteria.

In the second step, the same authors independently read the introduction, method, and results sections of the studies (when necessary, full texts were read) and rated each study on two additional criteria: focus on K–12 students and report on teacher outcomes and/or student achievement outcomes. Of the 396 studies, 92 studies met these criteria and proceeded to the final round of screening. The inter-rater agreement, defined as the percentage of agreement, at this second stage was 96 percent. Disagreements were resolved through discussion. The two criteria for the final stage were: (a) is the PD intervention job-embedded and (b) does the article report an effect size or include sufficient data to calculate an effect size? After this stage, 33 studies met these criteria and comprised the final sample. Of the 33 studies, 14 reported only teacher outcomes, 13 reported only student outcomes, and 6 studies reported both teacher and student outcomes. Hence, our sample included 20 studies at teacher level (14 with only teacher data + 6 combined studies) and 19 studies at student level (13 with only student data + 6 combined studies).

Coding of Studies

The variables coded for this meta-analysis included: author identification, date of publication, publication status; country; school level, content area, type of JEPD, contact hours/duration. We also coded sample size and random assignment as methodological characteristics for the included (quasi-)experimental studies (see Table 1 for an overview). Two independent coders were involved in the coding process; inter-rater agreement was 96%.

Data Analysis

Except for the study by Doppelt et al. (2009), which reported t-test statistics, all studies reported pretest and posttest results including mean, standard deviation, and sample sizes for both the experimental and control group. The effect size Hedges' g was calculated, which corrects for bias due to small sample size (Hedges & Olkin, 1985; Üstün & Eryılmaz, 2014). The unit of analysis in our meta-analysis was the experimental comparison for each outcome measure within a study.

Version 2 of Comprehensive Meta-Analysis (CMA, 2015) software and MLWiN (Rasbash, Steele, Browne, & Goldstein, 2020) were used to aggregate the effect sizes with a multi-level random effects model, taking into account that experimental comparisons (level 1) were nested within studies (level 2). A random effects model was chosen a priori because there was significant variation in the study characteristics and outcomes of the included studies; the outcomes of our analysis also confirmed that there was significant heterogeneity of outcomes at study level. The fit of the models was evaluated with the restrictive iterative generalized least squares method (RIGLS).

Results

The PD in 33 studies involved a training-the-trainer approach, where the teacher PD was provided by coaches, mentors, or colleague teachers. This is the basic principle that differentiates JEPD from conventional PD programs. The formats of these studies on JEPD were as follows: 20 studies involved coaching, two action research, five mentoring, two professional learning community, three teacher study group, and one is categorized as other.
The large majority of studies (18 studies) involved only elementary school, followed by two studies with middle school, and two with high schools. In eight studies, combinations of schools were involved; three studies included both elementary and middle school, two included both middle and high school, and three studies included both all types of schools. In total, elementary schools are included in 24 out of 33 studies (72.7%).

Description of Studies with Evaluation of Teacher Outcomes

The eighteen experimental studies with evaluation of teacher effects were mostly published in peer-reviewed journals (17 studies, 94%). The studies were predominantly controlled experimental studies. Assignment to the experimental or control condition was random in most of these studies (N=11, 65%). The sample sizes varied significantly, from 8 to 177 teachers (M= 65.9, SD= 44.2).

The JEPD interventions were focused on the language domain (e.g., reading, language arts, writing, literacy; 16 studies; 48%) or math and science (e.g. geometry, physics; 9; 27%) or a combination thereof (6; 18%). One study focused on classroom management (3%); and one study did not report the curricular domain. The average duration of the interventions, which varied from 1 to 20 months, was less than one year (M= 8.93, SD= 5.47); three studies did not report the duration of the intervention. Thirteen studies reported the number of JEPD hours for the participating teachers, which varied from 5.5 to 60 hours with a mean of 29.8 (SD= 20.6) (see Table 1 for a further description).

Finally, the individual effect sizes at teacher level showed a wide range (min-max: -0.48 – 4.24, median: 0.59) due to some deviant effect sizes for a specific outcome measure. Variation at study level with mean effect sizes (see Table 1) showed a smaller range (0.06 - 1.74).

Description of Studies with Evaluation of Student Outcomes

The 19 experimental studies with evaluation of JEPD effects on student achievement, were mainly published in peer-reviewed journals (14 studies, 74%). Study designs were fairly evenly split with 10 quasi-experimental studies and nine randomized control trials. There was significant variation in the student sample size of the studies. On average, 794 students were included (SD= 978), varying from a low 30 to a high 3,547. The average number of teachers was 52.4 per study (SD= 55.1, min-max: 4 – 177).

The duration of the JEPD interventions in studies with student outcomes, which was similar to the studies with evaluation of (only) teacher effects was about a year (10.9 months, SD= 7.88); teachers, were, on average, involved in JEPD activities for approximately 35.5 hours (SD= 33.1). The interventions used in the studies estimating effects at the student level were more often focused on the language domain (13; 68%) than on the mathematics and science domain (5; 26%); one study involved a combination.

At student level, the effect sizes showed a wide range due to one negative outlier (ES= -2.35) and one positive outlier (ES= 2.46); the median was 0.24. The average effect sizes at study level ranged from -0.31 to 2.05 (see Table 1).

Aggregated Effect of JEPD at Teacher Level

The aggregated effect size of the JEPD programs at the teacher level was 0.699 (95% CI: 0.519 – 0.879, $p < .001$), equal to a medium-to-large effect. At student level, the aggregated effect size is 0.523 (95% CI: 0.254 - 0.523, $p < .001$), which is a medium effect (see Table 2). There was significant variation in experimental effects among the studies, both for teacher and student outcomes.

Sensitivity Analysis

We estimated the aggregated effect size with the leave-one-study-out method to evaluate whether the meta-analytic outcomes may have been influenced by statistical outliers; we excluded studies (not experimental comparisons). The aggregated effect sizes ranged from 0.660 (SE= 0.089) to 0.742 (SE= 0.087) for teacher outcomes. For student outcomes, the aggregated effect size ranged from 0.433 (SE= 0.115) to 0.563 (SE= 0.140). In summary, the general outcomes of the meta-analysis remained relatively stable at both teacher and student level. Therefore, the meta-analytic results do not seem to be heavily influenced by deviant outcomes from a particular study in our sample.

Moderator Analysis

The variation among study outcomes was statistically significant, both at teacher and student level (see Table 2). Although the number of studies is modest for a meta-regression, we conducted exploratory investigations into which variables explained some of the significant variation in study outcomes.

Outcomes at the teacher level were not moderated by any of our coded methodological or educational variables with one exception. The effect of JEPD for teachers was moderated by the size of the study: studies with larger sample sizes reported somewhat smaller effects (β= -.004, SE= .002). This moderator explained 40.8 percent of the variation at study level; the variance at study level decreased from 0.125 (SE= .052) for the intercept-only model without predictors to .074 (SE= .034) for the model that included sample size as the only predictor. A closer inspection of the data showed that outcomes were not only more positive but also more variable in smaller studies (N < 25), with effect sizes ranging from nearly zero to 4 with a mean of 1. Effect sizes showed less variation with sample sizes from 50 to 100 teachers and were, on average, still large (ES = 0.80).

At student level, outcomes appeared significantly related to only one of the coded variables. More positive effects were found for students who participated in JEPD interventions with a longer duration (β= 0.019, SE= 0.005, intercept: 0.300); two studies did not report intervention duration, leaving 32 effect sizes from 17 studies. Duration of JEPD program (expressed in months) varied in the included studies from a low 0.6 month (i.e., 18 days) to a high 30 months with a mean duration of 11.85 months (SD= 6.73). Based on our regression model, the average JEPD intervention with the average duration of one year adds a small effect (ES= 0.228) to the intercept of 0.300, which results in an effect size of 0.528, corresponding to a medium effect.

Finally, a explorative analysis of the relationship between average effect sizes at teacher and student level for a small subset of studies with combined data, did not show a strong correlation due to one outlier study, rs = .086, p= .872, N= 6 studies (the study of Amendum, 2014 reported the smallest teacher effect but also the largest student effect, see Table 1). After removing this outlier, there was a strong correlation between teacher and student outcomes, rs = .900, p= .037, N= 5 studies.

Discussion and Conclusions

The goal of this meta-analysis was to investigate the presence and magnitude of the effects of JEPD programs on teacher performance and student outcomes in K–12 schools. Based on the selection criteria, 39 quantitative effect size estimates from 33 empirical studies were analyzed, distinguishing between evaluations at teacher level (N = 20) and student level (N = 19). The analysis of the included studies involved 2,062 teachers and 21,425 students. The main findings were: (a) For teachers, participation in job-embedded professional development was positively related to teacher outcomes; that is, teachers who participated in job-embedded professional development programs tended to have higher performance in areas such as teacher efficacy (teacher's judgment of his/her competences to create anticipated results of student engagement and learning), content and pedagogical content knowledge, behavior management, and use of evidence-based instructional practices. (b) For students, teacher participation in job-embedded professional development was positively related to student achievement; students from classrooms where teachers participated in job-embedded, on average, attained higher achievement than those who did not. Each of these conclusions is explored further below.

JEPD and Teacher Outcomes

First, the teacher effects of JEPD from our review appeared to be related to the teacher sample size of the studies. This relation may possibly reflect a so-called "file-drawer" effect. This explanation raises the question whether smaller experimental JEPD studies with less positive results may not have been published, which may bias the results from the published literature. However, a rival explanation is that JEPD may be difficult to implement successfully in large-scale studies with relatively large number of teachers. Unfortunately, it is not possible to disentangle the possible methodological or educational mechanisms based on review, but the findings from the meta-analysis provide promising results for teacher learning through JEPD programs.

Second, JEPD has a medium-to-large effect on various teacher characteristics and competencies due to the various types of job-embedded professional development teachers engaged with. For example, after engaging in JEPD, teachers in several studies showed improved teacher self-efficacy (e.g., Aljuzayri, 2021; Karimi, 2011; Tschannen-Moran & McMaster, 2009). Others showed improved content knowledge (e.g., Cavazos, 2013; Doppelt et al., 2009; Garet et al., 2008) or pedagogical content knowledge (e.g., Kramarski & Revach, 2009; Walker et al., 2012). Additional teacher characteristics and competencies improved through JEPD were related to effective instruction (e.g., Bradshaw et al., 2018; Cavazos et al., 2018; Stanulis et al., 2012), demonstrating improvement in constructs such as use of modeling, behavior management, or promoting student questions and reflection. These findings were consistent with the idea that JEPD models should support teachers as they transform their new knowledge and learning into instructional practice (Carlisle et al., 2011; Desimone, 2011; DuFour, 2004; Linder et al., 2012). In addition, the JEPD programs reviewed, in general, represented an integrated and ongoing process necessary for teacher learning (Croft et al., 2010).

Finally, given the relationship with teacher sample size and the positive effects for JEPD programs in general, more research is needed into the different mechanisms of change for the different JEPD formats. This line of research may even be linked with the stages of teachers' careers to provide an answer to the question 'What works for whom and when?' within the context of JEPD.

JEPD and Student Outcomes

There was great variability in duration of JEPD programs in the included studies and interventions with a longer duration of JEPD programs for teachers associated with more positive student outcomes across various learning domains. These findings echo those presented by Blank and de las Alas (2009) and Yoon and colleagues (2007) who note the importance of key factors related to effective professional development (e.g., longer duration), and there seems to be substantial evidence in the literature that longer JEPD programs, on average, are more effective for students. It should be noted, however, that in our study duration was not a significant predictor at teacher level. One reason this may have occurred was that the majority of studies included in the meta-analysis had adequate duration (e.g., greater than 14 hours as suggested by Yoon et al., 2007), and therefore JEPD programs met a "threshold" for program duration with respect to teacher outcomes.

The experimental effect was medium for students from elementary, middle and high schools, acknowledging that elementary school students were the largest group. A more modest effect than the teacher level is expected for students, given that JEPD interventions are targeted at proximally at teachers and student outcomes are more distal effects. In, addition, positive outcomes were found for students across the language, math, and science domain. Such a finding is welcome, demonstrating promising evidence for the robust nature of JEPD programs across content areas related to student achievement.

Finally, based on a small sample of studies examining both teacher and student outcomes, we found some tentative evidence that JEPD effects at teacher level may go hand-in-hand with positive outcomes for their students. However, more research with both teacher and student data is needed to study this relationship.

Implications and Limitations

A moderate effect of JEPD on teachers' and students' outcomes from the meta-analysis provides promising evidence that JEPD programs should be supported and expanded across schools and districts (Croft et al., 2010). In other words, findings from our synthesis provide sufficient evidence to argue that JEPD programs make a positive difference for teachers and students (e.g., Vescio et al., 2008). Because the evidence indicates that JEPD has a positive impact on student outcomes, government policy-makers should provide support and assistance in designing JEPD programs across schools.

In addition, researchers, should learn more about the effects of different JEPD formats, disaggregating types of JEPD in their analyses and results. Investigations are also needed into other aspects of JEPD. For example, researchers should examine the effects for teachers in different stages of their career, or in different school contexts (e.g., urban vs. rural). These lines of research can broaden the current knowledge base and development additional insight into the effects of different JEPD formats and potentially differential effects for teachers at different stages of their career or teaching in different contexts.

Moreover, in future research studies of JEPD programs researchers should investigate the key components of targeted types of JEPD programs to reveal the most effective formats in terms of gains for teaching and learning. The field would benefit from future experimental studies that disaggregate many components of JEPD programs to determine which key aspects positively impact learning outcomes. Moreover, JEPD is a broad concept which includes many formats, which makes the implementation of an effective JEPD program in practice not straightforward.

Finally, given Kennedy's (2016) argument that specific evidence-based PD design features can be uncertain predictors of PD program success, comparative studies are needed. That is, rigorous studies using a treated control where JEPD programs are compared to other types of professional development programs are needed to reveal the effectiveness of different types of professional development designs.

Limitations

There were important limitations to the current study that could be addressed in future research. First, a relatively small number of studies were identified and included in the meta-analysis. This small number of studies reduced the reliability of generalizing the results. Future studies that broaden the inclusion criteria for studies could improve the reliability for generalization. Likewise, the meta-analysis included studies found in the ERIC, EBSCO, JSTOR, SPRINGERLINK, and Google Scholar databases and was limited to the period 2000–2019. Future research that includes other databases and the time span before 2000 may be helpful. Broadening the sample may be particularly helpful in future moderator analyses in meta-analytic review studies that aim to find barriers and facilitators of JEPD interventions. Finally, the international perspective adopted in the current meta-analysis is rather limited, considering that only seven countries were included in this study.

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Appendix

Table 1

Key Characteristics of the Studies Examining Job-embedded Professional Development (JEPD)

Author(s) & Year of publication	**Study Design**	**Contact hour/ Duration**	**Country**	**PD Type**	**Content Area**	**School Level**	**Study Participants**	***ES*Teacher**	***ES*Student**
Amendum, 2014	QED	8 months	USA	Coaching	Reading	Elementary (1st grade)	10 teachers 45 students	0.19	1.52
Amendum & Liebfreund, 2019	QED	8 months	USA	Coaching	Reading	Elementary	29 teachers 125 students (74 E, 51 C)		0.58
Bradshaw et al., 2018	RCT	1 academic year	USA	Coaching	Across teaching areas	Elementary & middle	158 teachers	0.06	
Cheung, 2011	RCT	1 academic year	China	Learning study	Writing	Elementary (3rd grade)	4 teachers 137 students		2.05
Cotabish et al., 2011	RCT	60 hours 2 years	USA	Coaching	Science	Elementary, (2nd-5th grade)	59 teachers	1.52	
Davis et al., 2018	RCT	10 months	USA	Coaching	Reading	High school (9th grade)	118 teachers (38E1, 44E2, 36C); 2,354 students (623E1, 908E2, 823C) C	ADD	0.06
Doppelt et al., 2009	QED	20 hours 2 years	USA	Learning community	Physics	Middle (8th grade)	23 teachers 1656 students		1.17
Fabiano et al., 2018	RCT	4 weeks	USA	Coaching	across teaching areas	Elementary	89 teachers	0.61	
Faulk, 2004	QED	100 hours 8 months	USA	Coaching	Reading & math	Elementary (3rd, 5th grade)	16 teachers 336 students		1.58
Garet et al., 2008	RCT	60 hours 1 academic year	USA	Coaching	Reading	Elementary (2nd grade)	177 teachers 3,547 students	0.28	-0.31
Gersten et al., 2010	RCT	20 hours 7.5 month	USA	Teacher Study Group	Reading	Elementary (1st grade)	81 teachers 468 students	1.07	0.34
Glazerman et al., 2010	RCT	1 academic year	USA	Mentoring	Reading	Elementary	99 teachers 1,690 students		0.06

Author(s) & Year of publication	Study Design	Contact hour/ Duration	Country	PD Type	Content Area	School Level	Study Participants	$ES_{Teacher}$	$ES_{Student}$
Henson, 2001	QED	15 hours 1 academic year	USA	Action research	-	Elementary, middle & high school	8 teachers	0.87	
Karadag & Yasar, 2010	QED	4 months	Turkey	Action research	Language	Elementary (5^{th} grade)	30 students		0.44
Karimi, 2011	QED	24 hours 8 months	Iran	Study groups, Mentoring	English	High school	60 teachers	0.58	
Kim et al., 2011	RCT	2 years	USA	Mentoring	Science	-	47 teachers	0.62	
Knight et al., 2000	QED	2 years	USA	Collaborative teacher research	Writing	Elementary (grades 1-4)	753 students		0.27
Kraft & Blazar, 2017	RCT	50 hours 1 academic year	USA	Coaching	Across teaching areas	Elementary, middle & high	59 teachers	0.37	
Kramarski & Revach, 2009	RCT	16 hours 4 weeks	Israel	Peer coaching	Math	Elementary	64 teachers	0.82	
Li et al., 2010	RCT	-	Canada	E-mentoring	Mathematics	Middle school	67 students		0.63
Matsumura et al., 2012	RCT	3 years	USA	Coaching	Reading	Elementary (4^{th} & 5^{th} grades)	167 teachers 2983 students		0.60
Ma et al., 2018	QED	5 weeks	China	Coaching	Language	-	20 teachers (10 E, 10 C)	1.63	
Murray et al., 2009	QED	-	USA	Peer coaching	Math	Middle, High (grades 7-9)	11 teachers 307 students		0.03
Reinke et al., 2014	RCT	1 academic year	USA	Coaching	Classroom management	-	52 teachers	1.74	
Ross & Bruce, 2010	RCT	-	Canada	Peer coaching	Math	Elementary (6^{th} grade)	106 teachers	0.35	
Sailors & Price, 2010	RCT	2 days	USA	Coaching	Reading	Elementary, middle (grade 2-8)	44 teachers 527 students		0.33
Sailors & Price, 2015	RCT	6 hours, 1 year	USA	Coaching	Reading	Elementary, middle	44 teachers 444 students	0.71	0.33
Stanulis & Floden, 2009	RCT	48 hours 1 academic year	USA	Mentoring	Science, English & math	Elementary, middle, high	24 teachers	0.45	
Stanulis et al., 2012	QED	36 hours 1 year	USA	Mentoring	Reading & math	Elementary	83 teachers	0.89	
Tienken, 2003	QED	14 weeks	USA	Coaching	Writing	Elementary (5^{th} grade)	5 teachers 98 students		0.41

Author(s) & Year of publication	Study Design	Contact hour/ Duration	Country	PD Type	Content Area	School Level	Study Participants	$ES_{Teacher}$	$ES_{Student}$
Tschannen-Moran & McMaster, 2009	QED	6 hours	USA	Coaching	Reading	Elementary	93 teachers	0.86	
Vogt & Rogalla, 2009	QED	27 hours 1 academic year	Switzerland	Coaching	Science	Elementary	50 teachers (E 32, C 18) 976 students (E 623, C 353)	0.43	0.04
Walker et al., 2012	QED	3 months	USA	Other	Science & mathematics	Middle, high (grades 7–9)	51 teachers 1,247 students	0.94	0.22

Note. RCT = Randomized control trial; QED = quasi-experimental design

Table 2

Aggregated Effect of JEPD at Teacher Level (k = 79) and Student Level (k = 34)

	Teacher Level		Student Level	
Parameters	*g*	*SE*	*g*	*SE*
Fixed effect				
Integrated effect size	0.699*	0.092	0.523*	0.137
Random effects				
Variance between experimental comparisons	0.125*	0.052	0.318	0.113
Test of homogeneity	χ^2 (*df*= 79) = 182.2*		χ^2 (*df*= 34) = 3771.5*	

Note: An asterisk indicates a statistically significant effect ($p < .001$).

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