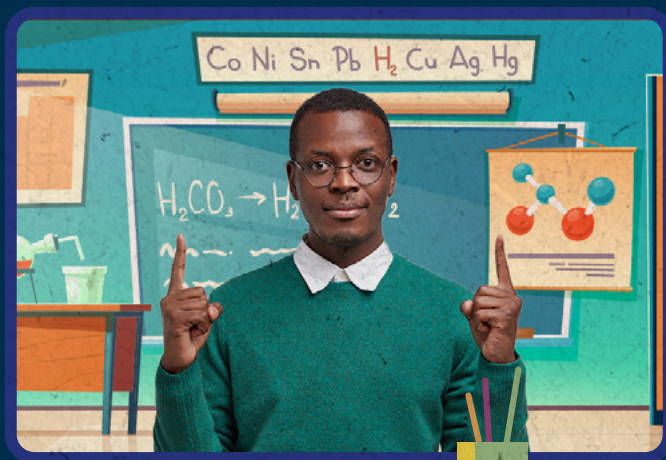


TECHNOLOGY FOR TEACHER PROFESSIONAL DEVELOPMENT NAVIGATION GUIDE



A Summary of Methods



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Contents



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Abbreviations

3G	3 gigabytes
AV	audio-visual
CoP	communities of practice
DI	direct instruction
DRL	digital resources for learning
DRT	digital resources for teaching
EIA	English in Action
ELLN	early language, literacy, and numeracy
FCV	fragility, conflict, and violence
FGD	focus group discussion
GPRS	General Packet Radio Services
HALI	Health and Literacy Intervention
ICT	information and communications technology
IE	impact evaluation
IM	instant messaging
ITS	instructional tips and strategies
IWB	interactive whiteboard
kbps	kilobytes per second
LAC	Learning Action Cell
LED	light-emitting diode
LMICs	low- and middle-income countries
MBP	modeling best practices
mbps	megabytes per second
MOOC	massive open online course
OER	open educational resources
PL	Pedagogical Leader
SBPD	school-based professional development
SD	secure digital
SMS	short message service
T4T	Technology for Teaching
TESS-India	Teacher Education through School-Based Support in India
TPD	teacher professional development
TV	television
WBG	World Bank Group



About Technology for Teaching (T4T)

Technology for Teaching (T4T) is the World Bank's program to assist countries implement effective, scalable teacher professional development (TPD) programs that use low- and high-technology solutions to train and support teachers/Pedagogical Leaders (PLs). T4T provides practical tools to policymakers and practitioners to design and implement operationally feasible technology-based TPD in their contexts, thus helping build inclusive and resilient education systems.

T4T is part of a comprehensive set of tools and solutions offered by the World Bank to help countries enhance teaching and learning practices. Cutting across two principles of the [Global Platform for Successful Teachers](#), T4T supports countries to use technology effectively to provide high-quality professional development while employing the [EdTech principles](#). T4T builds on the foundation of the [Coach program](#), which helps countries improve in-service TPD to accelerate learning.

T4T leverages the Coach and the EdTech Principles to outline how technology can be harnessed by governments to train and support teachers/PLs at each of the three stages of the TPD experience: access, engage, and apply.

Overview

Education systems face the daunting task of delivering effective continuous professional development to teachers and educators. Delivering on this promise can be especially challenging in settings with resource and capacity constraints. If used well and with clear purpose, technology offers many solutions that can support the delivery of effective TPD. Evidence and operational experiences illustrate how systems can enhance TPD by leveraging technology throughout the learning experience across all three TPD stages: access, engage, and apply.

The *Technology for Teacher Professional Development Navigation Guide: A Summary of Methods* summarizes evidence on designing and implementing six common methods to deliver tech-based TPD. These methods are coaching, communities of practice, digital resources for learning, digital resources for teaching, instructional tips and strategies, and modeling best practices. A snapshot is provided of the evidence, impact, technology employed, associated costs, and implementation considerations of these methods. This Guide serves as a tool for policymakers and practitioners to assess and compare implementation factors across common methods to train and support teachers and PLs using technology.



Introduction

Teacher professional development (TPD) aims to enhance student learning by supporting and improving teachers' adoption of effective teaching and learning practices. TPD encompasses all forms of continuing in-service education for teachers/Pedagogical Leaders¹ (PLs), including, but not limited to, trainings, workshops, coaching, peer-collaboration, and self-led learning (Quota and others 2022). As highlighted by Coach, TPD that enhances student-teacher interactions provides tailored, focused, practical, and ongoing support to teachers/PLs. Designing and delivering such high-quality TPD that is contextually relevant calls for an understanding of the available evidence, resources required for implementation, needs of teachers/PLs, and the context.

When well integrated in the system, technology can facilitate at-scale delivery of high-quality TPD. In contrast, using technology as a “quick-fix” or integrating it in a program without a careful purpose will not lead to desired changes in teaching and learning outcomes. To harness the benefits of technology, a TPD program must consider not only the availability of devices and connectivity but also set of intervening contextual factors² and how technology is applied to the given challenge.

The Technology for Teacher Professional Development Navigation Guide: A Summary of Methods brings together available evidence on tech-based TPD to help policymakers and practitioners design and deliver high-quality TPD in their contexts. This Guide provides a summary of evidence on designing and implementing six common methods to deliver tech-based TPD. These methods are coaching, communities of practice, digital resources for learning, digital resources for teaching, instructional tips and strategies, and modeling best practices. Identified using existing evidence on tech-based TPD programs, these methods are scored systematically³ to provide a snapshot of their evidence strength, impact on teaching practices, technology employed, and associated costs. This summary of TPD methods aims to help inform policymakers' and practitioners' decision-making for designing and implementing tech-based TPD programs and support scale-up or replication of successful programs, particularly in low-resource contexts. It also serves as a guidance and framework for analyzing additional studies.

1 Pedagogical Leader (PL) refers to any individual who provides ongoing support to teachers. Most commonly, this role is filled by coaches. However, individuals with varied backgrounds can fulfill the role of Pedagogical Leader, including specially trained master teachers, researchers, principals, pedagogical advisors, school support officers, or inspectors (Darling-Hammond and others 2017; Wilichowski and Popova 2021).

2 The contextual factors can include teachers/PLs' familiarity with technology; technological infrastructure including internet bandwidth, connectivity, and electricity; training to use and apply technology for teaching and learning; availability of Pedagogical Leaders and coaches; group dynamics among teachers/PLs in case of a community of practice (CoP); or even the quality of partnerships. Some of these factors are outside the control of the program team and can contribute to a number of challenges that, although not directly related to a program's design, can affect program impact and sustainability.

3 This Guide lays out the detailed methodology for arriving at the summary and will help practitioners score additional studies. These aids are essential because, although there is plenty of work written on TPD and technology for teachers/PLs, the combination of these two dimensions is not something sufficiently documented. This Guide aims to be a step in this direction. See appendix B for scoring methodology for individual studies and appendix C for aggregation methodology for TPD approaches.

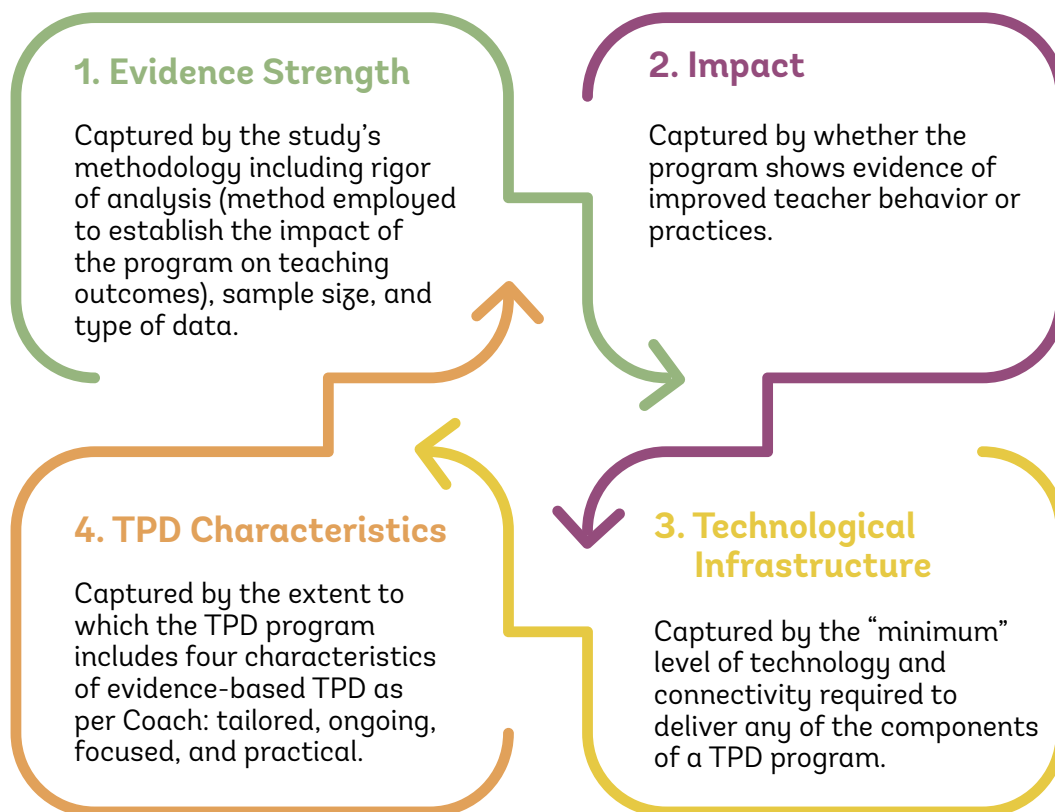


Methodology

This Guide is informed by a review of global literature on tech-based TPD programs in low- and middle-income countries (LMICs) conducted from December 2020 to March 2021. This review included peer-reviewed studies and working papers that evaluated programs using technology to train and/or support K-12 teachers/PLs. Following an appraisal of each study for its methodological quality and relevance to teacher-based outcomes, 27 studies were shortlisted to be included in the final evidence base (appendix A). Next, information on four dimensions—evidence strength, impact, technological infrastructure, and TPD characteristics (figure 1) was extracted from these 27 studies.

Using information from the method of applying technology to deliver TPD, each study was broadly categorized into the six TPD methods (table 1). Finally, each study was scored on evidence strength and impact (appendix B). These scores then were aggregated by the type of TPD method (appendix C).

Figure 1. The Four Dimensions





















TPD Methods That Leverage Technology



TPD Methods That Leverage Technology

Six main methods were identified through a review of global evidence. These methods are communities of practice, modeling best practices, coaching, digital resources for learning, digital resources for teaching, and instructional tips and strategies (table 1). This section describes the six methods and highlights their respective findings regarding evidence, impact, technology employed, associated costs,⁴ and implementation.

Table 1. TPD Methods That Leverage Technology

TPD Methods (What)	Technology-Enabled Delivery Employed (How)	Insights (Outcomes ^a)		
		IMPACT	COST	EVIDENCE
Communities of Practice	Internet-based group chats, video-conferencing Low-Tech: short message service (SMS), voice calls, cloud storage and file-sharing platforms			
Modeling Best Practices	Audio-visual (AV) materials, videoconferencing Low-Tech: Pre-loaded offline content on devices ^b photos			
Coaching	AV materials, video-conferencing, Internet-based chats Low-Tech: SMS, voice calls			
Digital Resources for Learning	AV materials, open educational resources (OER) ^c , websites Low-Tech: Pre-loaded offline content on devices			
Digital Resources for Teaching	AV materials, teaching software applications Low-Tech: Pre-loaded offline content on devices			
Instructional Tips and Strategies	Low-Tech: SMS, Internet-based chats			

 HIGH  MODERATE  LOW

Notes:

- Both TPD methods—Digital Resources for Learning and Digital Resources for Teaching—have a moderate impact that has been downgraded to low. The reason was the mixed nature of impact owing to some studies that had negative or null/no impacts on teaching outcomes.
- Technological devices used by studies included in the T4T Evidence Matrix to store pre-loaded offline content are secure digital (SD) cards, CDs, and DVDs. Not leveraged in any of the studies included is another low-tech option: USB/Flash drives. Pre-loaded content can be consumed by participating teachers/PLs on their devices and/or displayed in classrooms using projectors, smart projectors (smartboards), or interactive whiteboards. Printed materials are another low-tech option to exchange resources.
- Open educational resources (OERs) are “teaching, learning, and research materials in any medium—digital or otherwise—that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation, and redistribution by others with no or limited restrictions” (UNESCO 2021).

⁴ This Guide presents a cost bucket (low/moderate/high) for each TPD method, calculated by a component-based approximation approach (table D1). Determining essential cost data before implementing a program or before scaling up involves estimating the costs of both the enabling infrastructure (such as devices, connectivity, electricity) and the program component costs (such as costs to meet in-person, design, and develop a course). The disaggregation of costs is not captured in this Guide due to the unavailability of consistent and detailed data on costs of implementation of the TPD programs referenced here. Refer to the “[Capturing Cost Data](#)” note on how to collect data to measure the cost of interventions.

Communities of Practice

High impact for moderate cost, based on moderate evidence



Communities of practice (CoP) is defined as a forum to provide avenues for teachers/PLs to reiterate and implement key takeaways from TPD trainings (remote, blended, or in-person), discuss teaching practices, address challenges (content knowledge, pedagogical, classroom, or school-related), and reflect together to improve teaching (Ralaingita 2021). Meetings may take place among teachers/PLs within a school or involve teachers/PLs from a cluster of schools. CoPs provide participants with a space to contribute and can help develop a collective sense of shared endeavour. The CoP method helps teachers/PLs not only to engage in TPD opportunities through support from peers but also to apply TPD concepts in the classroom.⁵ The frequency of CoP can vary from ongoing unscheduled discussions to weekly or monthly scheduled discussions among teachers/PLs.

CoP typically is used to supplement other TPD activities, including as a fully offline (in-person) element to facilitate another tech-based or blended TPD. In low-resource settings that often lack access to training and professional development support, CoP also can serve as a standalone method to motivate teachers/PLs to continue learning from one another's successes and challenges.

What type of technology is typically used?

CoP commonly is delivered through internet-based chats that enable sharing of teaching resources, classroom photos of activities, and/or ideas to address teaching challenges. In other cases, teachers/PLs can connect synchronously⁶ through video-conferencing platforms, or even asynchronously through social media groups and applications.

In remote settings in which Internet connectivity is sporadic or absent, teachers/PLs can connect by text messaging or voice calls. Alternately, teachers/PLs can group together in person and leverage technology during CoP, for example, to view multimedia videos from classrooms of their peers or to design technology-enhanced lessons.

How effective is CoP?

Incorporating tech-based CoP method tends to have a high impact on teacher outcomes. This method is particularly beneficial for teachers/PLs in rural areas and contexts that are affected by fragility, conflict, and violence (FCV); and in contexts in which teachers/PLs otherwise could feel isolated or lack the opportunities to access TPD. Use of CoP boosts teachers'/PLs' interest and engagement in teaching

⁵ Access to TPD: TPD opportunities frequently are made available to teachers/PLs through a range of channels. Engage with TPD: Being actively involved in available TPD opportunities; playing a role in the given opportunities to learn and enhance skills. Apply TPD concepts: When back in their classrooms, teachers/PLs use the skills and knowledge acquired during their professional development (Quota and others 2022).

⁶ Synchronous communications are scheduled, real-time interactions by phone, video, or in person. Asynchronous communications happen on one's own time.

because they can share their challenges and ideas with one another, in addition to sharing new learning resources for the students with the aid of technology.

Improved teacher outcomes have been identified in content and pedagogical knowledge as exhibited through pre-post tests and classroom observations. Practices are based on the pedagogical principles that have been taught during the training. This improvement in outcomes is possible because CoP provides the necessary implementation support in the form of peer learning. For example, teachers/PLs can post any challenges faced by them to the chat group or share them on conference calls for feedback and guidance, and other teachers/PLs can respond quickly with inputs based on experience. Participants appreciate the value of getting immediate answers to their queries and exchanging ideas with their peers, thus providing both pedagogical knowledge and classroom strategies. Participants also appreciate different points of view. Moreover, teachers at large reported feeling connected to fellow teachers and shared innovative practices through photos or videos, such as a new way to organize a classroom. Participants also can share learning resources for the students with the aid of technology. Teachers reported that such exchanges were helpful because they were provided with something they could more easily replicate. After seeing a new idea visually, they sometimes felt more motivated to try it.

How secure is the evidence?

The findings are based on moderate evidence as only 3 of the 12 studies were experimentally designed with a sufficient sample of teachers to be able to establish causal claims about the potential⁷ impact of CoP on teachers (appendix C). Very few rigorous experimental designs exist. This lack makes it difficult to establish causal claims about the impact of the CoP approach. However, some evidence comes from five studies based on small sample size of teachers in an experimental design or use a pre-post comparison or an observation instrument to measure teacher outcomes. The remaining four studies are based on a nonexperimental study design with self-reported measures by participating teachers.

What is CoP frequently used with?

- Six of the 12 studies combine the CoP method with either coaching, digital resources for learning, or modeling best practices.

What are the costs?

The average cost to implement a tech-based CoP method is estimated as moderate. Incorporating it typically will involve costs for technological devices such as basic-feature phones, smartphones, and tablets for teachers/PLs to interact with one another. When delivered offline, these devices can be used to view multimedia videos and/or design technology-enhanced lessons. Other factors that could influence costs include the provision of pre-paid SIM cards or incentives to recharge phones with calling, messaging, or data plans, and maintenance of devices. In some cases, these costs also could include costs for facilitators and/or technological devices for them (such as feature phones, smartphones, or tablets). In settings in which teachers/PLs already own phones, CoP can be an affordable low-cost, low-tech solution.

Where has CoP been delivered?

- **Countries:** Bangladesh, India,⁸ Jordan, Kenya, Madagascar, Philippines, South Africa, and Tanzania.

⁷ Potential as the majority of TPD studies incorporate multimodal TPD approaches, and it is difficult to disentangle the impact of these different TPD approaches. The same applies to all TPD approaches in this Navigation Guide. See Limitations chapter preceding appendixes for details.

⁸ For one TPD program in India, enrolment was open to a global audience. Registrations came from 135 countries including 73 Global South countries (Wolfenden, Cross, and Henry 2017).

- **Context:** Studies range across covering urban, rural, semi-rural, semi-urban, and FCV contexts
- **Grade-level of teachers/PLs:** Evidence comes from a mix of primary and secondary education levels
- **Technological Infrastructure:** Six of the 12 studies have an asynchronous component whereas 6 of them have an offline component
- **TPD Characteristics:** Eight of the 12 studies meet at least 3 of the 4 evidence-based TPD principles as outlined in Coach.

What should I consider?

- When feasible, facilitation of CoPs should be considered not only to keep teachers/PLs focused on the agenda but also to address teacher challenges (such as content knowledge, pedagogical, classroom, or school-related) and provide feedback on shared ideas.⁹ The facilitator does not necessarily have to attend CoP meetings but can be a resource to be called on as needed or to periodically touch base with the CoP (Ralaingita 2021).
- Virtual CoP is not a wholesale replacement for in-person school- and cluster-based continuous PD. When possible, it is integral to begin CoP with in-person elements to build rapport before introducing virtual communication models (Ding and Khurana 2021).
- Teachers/PLs often need only a platform to engage and learn from one another and are looking for means to do so. For example, as part of the TESS-India massive open online course (MOOC) program, facilitators and/or participants in several states used social media, creating internet-based chat groups. Participants reminded one another of deadlines and class times, shared ideas and asked for advice, and answered queries. Some of these peer networks and communities survived “post MOOC” (Wolfenden, Cross, and Henry 2017).

Box 1. WhatsApp-Supported Communities of Practice in Rural India

In rural India, where lack of quality teachers and teacher absenteeism are major challenges for rural schools, technology, specifically WhatsApp, provided professional development opportunities that otherwise were unavailable and was used to support and monitor teachers. Online communication was designed with three specific goals: to improve teacher and student attendance, improve the quality of teaching through remote support of materials, and adhere to planned activities and monitoring student performance through the assessment apps. All teachers in each geographic cluster were added to a WhatsApp group with central coordinators and cluster coordinators and were trained to use the WhatsApp installed on their tablets.

WhatsApp supported ongoing training of teachers as well as sharing of content and experiences. Teachers posted videos of themselves teaching a concept and received support and feedback from peers and central coordinators. Teaching resources also were posted in WhatsApp so they could be downloaded by teachers onto tablets and shared with students. The central coordinator also helped plan lessons and sent lesson plans and short instructional videos by WhatsApp in addition to providing supporting feedback on teaching and learning in the classroom after watching class videos.

Source: Nedungadi, Mulki, and Raman 2018.

⁹ For example, teachers in Tanzania suggested having a team leader plan and lead the TPD team meetings (Kafyulilo, Fisser, and Voogt 2016).

Modeling Best Practices

High impact for moderate cost, based on high evidence



The modeling best practices (MBP) method is defined as showcasing the “how” of instructional or pedagogical approaches to teachers/PLs. The variety of tech-based modeling includes demonstration lessons delivered by experts or pedagogical leaders (PLs), exemplars of interactive practices, or observations of peers. Audio demonstrations (such as sound clips of the phonic sounds) and curriculum materials that include sample assessments and sample student work also are example of modeling techniques (Darling-Hammond, Hyler, and Gardner 2017). The method helps teachers/PLs to access TPD opportunities through support from PLs in some cases but at the core of this method is the support system to help teachers/PLs *apply* TPD concepts in their classrooms. The frequency can vary from weekly or monthly to continuous access to digital resources.

MBP can be used as a stand-alone TPD method or supplemented with other TPD methods. Either way it is an active learning strategy, and as a hallmark of adult learning theory, it can allow teachers/PLs to transform their teaching and not simply layer new strategies on top of the old (Trotter 2006).

What type of technology is typically used?

MBP is commonly delivered asynchronously through self-help multimedia videos of good practice or teaching vignettes, which can be accessed through technological devices such as tablets, computers, and smartphones. Teachers/PLs also can learn asynchronously through videos of teaching from classrooms of peers of beneficiary teachers/PLs or other similar context classrooms. Some studies highlight synchronous modeling in which beneficiary teachers/PLs can learn by observing more experienced distant teachers/PLs in a satellite-classroom set-up that requires a projector, screen, a webcam or laptop, and satellite transmission of live lessons.

In low-tech settings, teachers/PLs can access the multimedia content offline wherein the content can be pre-loaded on devices or teachers/PLs be handed secure digital (SD) cards, CDs, or DVDs. In other cases, modeling can include electronic unit or lesson plans, or teachers/PLs can share photos (instead of videos) of their classrooms via internet-based chats.

How effective is MBP?

Evidence indicates that the overall impact of incorporating the tech-based MBP method consistently is positive. This evidence is in line with adult learning theories that highlight the significance of active learning strategies to aid not only the retention of acquired knowledge (TPD learnings) but also its application.

As exhibited through pre-post tests and classroom observations, improved teacher outcomes have been identified in pedagogical knowledge and skills. On average, MBP has a strong, positive, and

statistically significant effect on teaching practices in which the amount of direct instruction (DI) goes down. In other words, lessons become more student centered. Teachers also report moving away from the traditional or conventional teacher-centered teaching style to include more games, storytelling, and active student participation. This style includes encouraging students to share ideas, lead activities, and find information on their own. In some cases, teachers can adapt their teaching based on a student's existing knowledge. In the scenario in which modeling took place through live satellite teaching, some anecdotal evidence suggests that new teaching methods and approaches were introduced in classroom instruction through learning by the facilitator teachers through their interactions and observations of studio teachers. This learning through interaction can serve as a channel for continuous teacher training in which teachers/PLs learn by observing the live lectures.

How secure is the evidence?

The findings are based on high evidence. Years of rigorous research have provided consistent evidence of the benefits of MBP. Half of the MBP studies (N: 6 of 12) in our evidence base are experimentally designed to establish causal claims about its potential impact on teachers (appendix C). Four other studies use a pre-post comparison or an observation instrument to measure teacher outcomes. The remaining two studies use teachers' self-reported measures in a nonexperimental study design.

What is MBP frequently used with?

- Seven of the 12 studies combine MBP method with digital resources for teaching.
- Six studies also combine it with coaching and communities of practice.

What are the costs?

The average cost to implement tech-based TPD method of modeling best practices is estimated as moderate. Incorporating this method typically will involve costs to develop multimedia materials and costs for technological devices such as smartphones, computers, or tablets for teachers/PLs to access resources at their own convenience. Other factors that could influence cost include maintaining the devices. In the event of satellite classes, these costs also will include costs for satellite connectivity and equipment such as projector, webcam, and a screen.

Where has MBP been delivered?

- **Countries:** Brazil, Bangladesh, Ghana, India, Kenya, Pakistan, Philippines, South Africa, and Zambia.
- **Context:** Studies range from urban, rural, and semi-rural to semi-urban contexts.
- **Grade-level of teachers/PLs:** Except for four studies of secondary school teachers, evidence at large comes from primary school teachers.
- **Technological Infrastructure:** Four of the 12 studies have an asynchronous component; 6 have an offline component; and the remaining 2 use synchronous technology.
- **TPD Characteristics:** Eight of the 12 studies meet at least 3 of the 4 evidence-based TPD principles as outlined in Coach.

What should I consider?

Contextualize content by using local language to the extent possible and/or multimedia videos from local classrooms.

Box 2. Audio-Visual Materials to Model Teaching Practices for Bangladeshi Teachers

English in Action's (EIA) robust school based professional development (SBPD) model is designed to achieve results at scale. The model uses the “trainer in your pocket”-approach through a low-cost mobile phone with innovative audio-visual (AV) materials stored on micro-SD cards. AV resources include authentic videos of communicative language teaching (CLT) practices carried out by Bangladeshi English teachers in their own classrooms with their own students. Audio files have been developed linked to the national textbook series, for classroom use via a small rechargeable speaker-amplifier. These materials act as **in-school support** and always are “on hand” to the teacher. Materials include teaching resources to be used directly within the new classroom activities, and professional development resources for teachers to engage with in preparation for, or reflection upon, carrying out the new classroom activities. In addition to an extensive bank of AV resources on micro-SD memory cards, accessed through mobile phones, teachers also are provided with physical resources such as classroom posters, flash cards, and teacher guides.

The in-school support through AV materials is complemented by beyond school support, which is provided through workshops and bi-monthly “cluster meeting” (over a 16-month cycle) where groups of teachers from local upazilas (sub-districts) meet face-to-face, to reflect upon their experiences in school and highlight issues related to project implementation and prepare to carry out planned classroom activities back at school.

Source: Shaheen and others 2013.

Coaching

Moderate impact for high cost, based on high evidence



Coaching is defined as facilitating changes in teaching practices through support from a PL. At its core, this method involves PLs observing teachers and providing feedback to help improve behaviors and practices in the classroom. By the way of an observation-feedback mechanism, coaching includes the necessary implementation support for teachers to apply acquired TPD learnings. The human connection provided by PLs enhances the engagement of teachers with TPD offerings. Moreover, tech-enabled coaching programs enable expert PLs to reach teachers in relatively inaccessible areas or FCV contexts, which otherwise could be hard to travel to and/or lack TPD offerings.

Coaches play an important role and are critical to TPD program's success and for encouraging teachers to implement strategies. In certain other cases, PLs also can encourage teachers to share experiences, help clarify concepts, solve implementation challenges, offer teaching tips, reinforce TPD concepts, or assist teachers to contextualize learnings. With some training, school staff and project coordinators also can act as mentors to teachers in low-resource settings. PLs, too, can share useful resources such as instructional videos with the teachers to aid learning.

The elements of a coaching program can be adjusted to suit the needs and context. Frequency of coaching can vary from weekly or monthly to ongoing. Whereas the ratio of PLs to teachers can vary from 1:1 or 1 to many, 1-1 coaching sessions enable PLs to work individually with teachers to help them achieve specific professional development goals and provide personalized support (Wilichowski and Arengé 2022). This method can be a stand-alone ongoing activity or can be used to supplement other TPD activities.

What type of technology is typically used?

Coaching commonly is delivered through high-tech devices such as tablets and smartphones for coaches to observe live classroom teaching (synchronous), or for teachers to record their classroom teaching videos and share with coaches (asynchronous). In cases in which observations are not involved, PLs support teachers by facilitating meetings with individuals or groups of teachers to discuss teaching challenges, including applying acquired TPD learnings such as using new teaching software or pedagogic concepts. In such cases, PLs and teachers can connect through regular voice calls; use data to connect via social media applications such as internet-based chats; or use other conference platforms for audio or video calls to share feedback and discuss ongoing issues.

In low-tech settings, teachers/PLs can connect over voice calls through basic feature phones. PLs also can share weekly tips through SMS. Teachers/PLs can be supported with access to a helpdesk (phone and/or SMS) to address either technological or delivery challenges. As an alternative to video observa-

tions, PLs can review teachers' lesson plans or monitor teacher activity on internet-based chat groups on which teachers share activities and photographs from classrooms.

How effective is coaching?

Evidence indicates that, on average, the impact of incorporating tech-based coaching in a TPD program appears to be positive but moderate. Traditional in-person coaching is more impactful than tech-based coaching (see considerations below). Nevertheless, technology is effective in facilitating frequent interactions, especially in areas that PLs could not or would not reach.

Improved teacher outcomes have been identified in time-on-task¹⁰ and in teacher attitudes toward technology, resulting in uptake of technology for teaching. Studies report improvements in teachers' self-awareness of personal development, understanding the importance of lesson plans, and inclusive teaching. Teachers also improve their knowledge and practices such as familiarity with varied teaching methods, including activity-based teaching and learner-centered approaches that use technology in the classroom. For example, on average, teachers trained in participatory pedagogical approaches, such as shifting students into small groups and inviting them to actively participate in the lesson, adhered to the planned activities and used technology as intended. These improvements were evidenced by teachers spending less time on direct instruction (DI) as lessons became more student-centered. Studies also report teachers' increased school attendance, which some attribute to the increased adherence and attendance to perceptions of increased accountability. Moreover, teachers improved performance by receiving learning modules from PLs and getting immediate answers to their queries. Use of technologies encouraged teachers and PLs to share resources and pedagogical suggestions with one another, thus decreasing feelings of isolation and increasing the feeling of empowerment among teachers.

How secure is the evidence?

There are 5 experimentally designed studies (5 of 11) with a sufficient sample of teachers to establish causal claims about the potential impact of coaching program on teachers (appendix C). Four other studies either are based on small sample size of teachers in an experimental design or use a pre-post comparison to measure teacher outcomes. The remaining two studies are based on a nonexperimental study design with measures self-reported by participating teachers. The self-reports make it difficult to establish causal claims so the impacts reported in these studies may be difficult to achieve in practice.

What is coaching frequently used with?

- Seven of the 11 studies combine coaching with the digital resources for teaching method.
- Six of the 11 studies combine coaching with modeling best practices and communities of practice.

What are the costs?

The average cost to implement a TPD method is estimated as high. Incorporating it in a TPD program typically will involve costs to train PLs, time (salaries), and logistics (travel or technological devices). Implementation also would entail costs for technological devices to enable teachers to interact with PLs, such as smartphones, laptops, or tablets. Other cost factors could include providing data bundles and maintaining devices.

Where has coaching been delivered?

- **Countries:** Bangladesh, Brazil, India, Kenya, Madagascar, South Africa, and Zambia.

¹⁰ The biggest driver of this change was a decline in the share of time spent outside the classroom, time off task, classroom management, and administrative activities.

- **Context:** Studies cover urban, rural, semi-rural, semi-urban, and FCV contexts.
- **Grade-level of teachers/PLs:** Except for two studies of secondary school teachers, evidence at large comes from primary education levels.
- **Technological Infrastructure:** Six of the 11 studies have an asynchronous component; 5 of them have an offline component.
- **TPD Characteristics:** Six of the 11 studies meet at least 3 of the 4 evidence-based TPD principles as outlined in Coach.

What should I consider?

- Coaching programs affect teaching practices only if the quality of support or coaching is high. In other words, PLs have to be trained to support teachers effectively.¹¹
- Virtual coaching can lead to improvements in learning that are large compared with many other types of intervention. Nevertheless, programs that use in-person coaching typically have larger improvements because in-person contact enables more accountability and support (Cilliers and others 2021; Jukes and others 2017). Similarly, blended coaching models have shown better results over fully remote models. PLs cannot be replaced by technology but coaching certainly can be supplemented by technology to increase teacher effectiveness and reduce costs (relative to in-person coaching).
- To protect trust, PLs should not simultaneously support teachers and act as their evaluators. Relationship building serves as the necessary foundation for the coaching cycle.¹²

¹¹ For details on structuring 1-1 support, including the profile of a PL, refer to the “Structuring Effective 1-1 Support Guidance Note” (Wilichowski and Popova 2021).

¹² For details on the coaching cycle, including facilitating 1-1 observations and providing effective feedback, refer to the “Facilitating Effective 1-1 Support Guidance Note” (Wilichowski and Arengue 2022).

Boxx 3. Classroom Observation and Coaching via Skype to Improve Teacher Performance in Brazil

In Brazil, a 9-month (1 school year) training course and coaching program was designed to promote: (1) professional interaction among teachers; and (2) good practice techniques for lesson planning, classroom management, and keeping students engaged. The intervention had 4 components, 1 of which was expert coaching. Through this, the pedagogical coordinators (coaches) were trained by an expert trainer to observe and coach classroom teachers.

Expert coaching support via Skype. One expert trainer interacted regularly with each school's pedagogical coordinator (coach) via Skype. Each coach supported 31-36 schools and was responsible to deliver 4 coaching sessions over the period to each school. Treatment schools accessed a private website with good practice videos, their own uploads, and other materials. The website required weekly online feedback from every coach about the number of classroom observation and feedback activities that s/he had implemented in the school in the preceding week, specific issues identified and addressed, and a progress assessment. The site encouraged teachers and coaches to post video examples of good teacher practices in their school--both classroom teaching examples and coaches giving teachers specific feedback after observing their classes.

Face-to-face interaction with high-skill coaches. Technology support was complemented with face-to-face interaction with high-skill coaches. Three different 1-day workshops were delivered by the ELOS coaching team.¹³ The workshops exposed school directors and coaches to the goals of the program and how to understand the feedback bulletins and use the results. The coaches were trained to observe teachers in the classroom and to hold individual coaching sessions with teachers to provide specific feedback on their teaching practice. Coaches also were trained to film themselves providing feedback to teachers and to upload and share these videos with their coaches (expert trainers), for additional feedback. The workshops stressed that coordinators were responsible for using an online logbook to report weekly on their activities and the implementation of the program in their school.

Other components included self-help materials wherein each school's principal, coach, and teachers received a translated copy of *Teach Like a Champion*, which describes "high-impact" teaching practices that stimulate student learning. The book includes practical descriptions of useful techniques and access to online video examples. The Lemann Foundation website includes examples of the same techniques filmed in Brazilian classrooms. The treatment schools also received performance feedback reports--anonymized by teacher names--on teacher practice based on classroom observations.

Source: Bruns, Costa, and Cunha 2017.

¹³ For ELOS, see <https://eloseducacional.com/about-us/>.

Digital Resources for Learning

Low impact for moderate cost, based on moderate evidence

Studies	Impact	Cost	Evidence
11			

Digital resources for learning (DRL) is a TPD method wherein teachers/PLs receive digital materials for self-study. The learning materials can include any instructional or pedagogical content on varied topics, including child development theories, content knowledge, pedagogical skills and practices, or national standards. The materials can include multimedia (sound and/or video) or print-based resources for teachers/PLs to learn these concepts; or can include activities, quizzes, assignments; and handouts to practice what they learn. Approaches can include audio visuals, print materials for teachers/PLs to start where they are in their learning journey, OER, or MOOCs. Another DRL approach can be to engage teachers/PLs in the process of developing or adapting instructional content such as designing technology-enhanced lessons for teaching (Blimpo and others 2020; Kafyulilo, Fisser, and Voogt 2016). Teachers/PLs can engage either in teams or individually. Either way, the opportunity to develop/adapt instructional content is an approach in which teachers/PLs learn by doing. The DRL method provides necessary flexibility for teachers/PLs to access TPD opportunities continuously, in many cases through experts to whom they otherwise do not have access.

DRL can be integrated within a blended-learning TPD model or can work as a stand-alone learning model in which teachers/PLs can feel stronger ownership of their TPD process. The method enables teachers/PLs to exercise self-directed learning through flexibility not only in the content (what) but also the delivery (how) or time (when) of TPD (Quota and Bhatia 2022).

What type of technology is typically used?

DRL is commonly delivered through technological devices such as tablets and computers/or laptops with learning materials. Self-study materials (such as multimedia, MOOCs, OER, training website) can be accessed via the internet or can be pre-loaded on the devices.

In low-tech settings, teachers/PLs can access content on smartphones or through shared devices in a computer lab. The content, in turn, can be pre-loaded and accessed offline. Teachers/PLs also can be handed out SD cards, CDs, or DVDs with pre-loaded content.

How effective is DRL?

Overall, the impacts of DRL on teacher-based outcomes appear to be positive but with mixed evidence. Because it is difficult to disentangle the effects of a multi-modal TPD, in some cases, the positive impacts also may be attributed to other methods. These impacts are in line with existing literature highlighting that self-study usually requires a support system in the form of a facilitator, PL, or peers to clarify any concepts, discuss ideas, and apply learnings in the classroom. Nevertheless, the method provides flexibility (to participate) that is appreciated by teachers (Pouegevara and Khan 2007).¹⁴

¹⁴ For example, one of the evidence-base studies highlights that the majority of the participants were convinced of the power of technology in bridging the rural and urban gap. Participants were in favor of distance learning because it allowed them to remain in the schools and with their families during the training period, and the training content could be immediately applied. An additional benefit of the technology was that trainees could solve problems instantly over the phone. Sixteen of 18 trainees said they would choose a technology-based distance learning program over face-to-face training, if given the choice (Pouegevara and Khan 2007).

Improved teacher outcomes have been identified in teacher content and pedagogical knowledge, including technological knowledge and usage. Teachers' perceptions of their knowledge and teaching methods improved as well. For example, teachers learning digital pedagogy for literacy instruction felt that their teaching methods were better addressing student reading problems by the study's end. On average, teachers were able to use active teaching strategies that were more learner centered. Regarding content, in some studies, teachers improved their language proficiency. In some cases, pre-loaded content and applications further aided teaching and learning in schools. For example, a teaching and learning software application had the audio capability to practice letter sounds, which teachers found helpful. When teachers learned during the instructional design process, they reported spending more time preparing for their classes and going through the same material. They also reported some difficulties as they did not have access to a facilitator or exemplary lessons.

How secure is the evidence?

There are only a few rigorous experimental design studies (3 of 11), making it difficult to establish causal claims about the potential impact of DRL on teachers (appendix C). However, some evidence comes from studies that use either a pre-post comparison or an observation instrument to measure teacher outcomes (N: 5 of 11). The remaining three studies are based on a nonexperimental study design with self-reported measures by participating teachers.

What is DRL frequently used with?

- Six of the 11 studies combine DRL with the communities of practice method.

What are the costs?

The average cost to implement DRL is estimated as moderate. Incorporating it typically involves costs to develop self-study materials (such as multimedia, MOOCs, OER, and training website) and costs for technological devices to access digital content. Other cost factors could include data bundles and device maintenance.

Where has DRL been delivered?

- **Countries:** Bangladesh, Costa Rica, Ethiopia, India,¹⁵ Ghana, Kenya, Madagascar, Nigeria, Philippines, The Gambia, Tanzania, Uganda, and Zambia.
- **Context:** Studies cover urban, rural, semi-rural, and semi-urban contexts.
- **Grade-level of teachers/PLs:** Evidence comes from a mix of primary and secondary education levels.
- **Technological Infrastructure:** Three of the 11 studies have an asynchronous component; 8 of them have an offline component.
- **TPD Characteristics:** Seven of the 11 studies meet at least 3 of the 4 evidence-based TPD principles as outlined in Coach.

What should I consider?

- Blended models of self-paced TPD are preferred and more effective. Consider supplementing this low-tech method with other TPD methods such as communities of practice and modeling best practices, both of which are avenues to bring alive the content through discussions or multimedia.
- Align the digital content to the school curriculum or national standards so that teachers/PLs could optimize the use of learning resources.

¹⁵ For one of the TPD programs in India, enrolment was open to a global audience. Registrations came from 135 countries including 73 Global South countries (Wolfenden, Cross, and Henry 2017).

Box 4. Philippines' Blended Learning Model with Self-Paced Learning Materials

Blended learning model. The early language, literacy, and numeracy (ELLN) Digital course comprised two main components, which together can be considered a blended learning model. The components were:

1. A CD, which contains an interactive multimedia self-study course (courseware)
2. A collaborative school-based learning component (communities of practice) in the form of Learning Action Cells (LACs).

The **CD courseware** included 5 modules with 15 lessons based on Education Department's 10-day, face-to-face training course on early language, literacy, and numeracy instruction for K-3 teachers. Four of the modules were on teaching literacy; the fifth concerned teaching numeracy. The courseware was designed so that teachers would access each lesson in their own time in the week prior to the LAC session. Each lesson was anticipated to take 1-2 hours. Designed for self-study, the lessons within each module had the following features:

1. A structured discussion of the lesson topic, that is, the key concepts, principles, and teaching approaches and strategies
2. Video and audio demonstrations and examples
3. Exercises to master the key concepts
4. Handouts, templates, and worksheets
5. Activities and assignments to practice skills and apply the principles and strategies taught.

LAC sessions were intended to run at least once each week for 90 to 105 minutes. The purpose was to promote collaborative learning among the teachers while completing the courseware. LAC Facilitators were provided with a set of guidelines on how to facilitate each session. These guidelines should include elements of sharing, reflection, discussion, application of knowledge, and the development of action plans for practical implementation of the content in each teachers' own classroom.

Source: Oakley, Scarparolo, and King 2018.

Digital Resources for Teaching

Low impact for high cost, based on high evidence



Digital resources for teaching (DRT) is a TPD method wherein teachers/PLs receive digital teaching materials for delivering classroom lessons and/or are trained on using a teaching software. Teaching materials include any instructional or digital content for teachers/PLs such as multimedia resources, OER content for lesson use, teacher guides, lesson plans, activities, or assessments for students. These can be structured (mapped to the curriculum) or unstructured (broader but topic-based for teachers/PLs to leverage as the need arises). The teaching software can be any technology that facilitates teaching (such as smartboard, mobile application). The DRT method provides the necessary flexibility for teachers/PLs to access TPD opportunities continuously.

DRT can be a stand-alone engagement with the objective of improving teachers'/PLs' technological expertise or digital pedagogy. It also can be used to supplement other TPD activities, especially when teachers/PLs are required to teach using a new pedagogy (software, technology, computer-assisted learning) or curriculum.

What type of technology is typically used?

Like Digital Resources for Learning, the DRT method commonly is delivered through technological devices such as tablets and computers/or laptops with teaching materials. In addition, the DRT method includes a television (TV)/or projector to project those teaching materials to the classroom. In high-tech settings, classrooms can have interactive whiteboard (IWB) software and a smart projector (smartboard) to project the teaching materials. The digital content (mobile applications, software, multimedia content) can be accessed via the internet or can be pre-loaded on the devices.

In low-tech settings, teachers/PLs can access content on smartphones or through shared devices in a computer lab. In turn, the content can be pre-loaded and accessed offline and can be projected on classroom walls, instead of smartboards, using a projector. Teachers/PLs also can be handed out SD cards, CDs, or DVDs with pre-loaded content.

How effective is DRT?

Overall, the impact of DRT on teacher outcomes appears to be positive but with mixed evidence. In some cases, gains were not sustained over time due to technical issues such as unscheduled power outages or permanent technical challenges.

Improved teacher outcomes have been identified in the use of technology to prepare and teach lessons (such as with the use of videos, simulations, projectors, and tablets). In scenarios in which teachers were trained to use digital pedagogy, teachers grew increasingly comfortable with technology and software,

and exhibited a positive shift in their attitudes toward using it for teaching. On average, teachers attempted to integrate technology and employ recommended activities for teaching, thereby showing positive effects on active teaching through increased familiarity with innovative teaching methods (activity-based teaching, use of technology in the classroom). Their commitment to teaching seemed to increase as well, as indicated by their attendance numbers. This finding contrasts with the concerns that teachers would be more likely to be absent as the teaching videos can be virtual substitutes. In some cases, owing to digital content access, teachers indicated that time was saved in preparing the lessons and in drawing or cleaning the blackboard, thereby enabling more teaching time.

How secure is the evidence?

The evidence strength is high because half of the DRT studies (6 of 12) in our evidence base are experimentally designed to establish causal claims about DRT's potential impact on teachers (appendix C). Four other studies either use a pre-post comparison or an observation instrument to measure teacher outcomes. The remaining two studies either are based on the small sample size of teachers in an experimental design or use self-reported measures in a nonexperimental study design.

What is DRT frequently used with?

- Seven of the 12 studies combine DRT with coaching and modeling best practices.

What are the costs?

The average cost to implement DRT is estimated as high. As with Digital Resources for Learning, incorporating DRT typically will involve costs to develop multimedia materials and costs for technological devices to access digital content. Other cost factors could include data bundles and device maintenance. In addition, DRT typically includes costs for devices to project the content to the classroom and for software development, installation, and maintenance.

Where has DRT been delivered?

- **Countries:** Angola, Bangladesh, Costa Rica, India, Kenya, Pakistan, Senegal, South Africa, and Zambia.
- **Context:** Studies cover urban, rural, semi-rural, and semi-urban contexts.
- **Grade-level of teachers/PLs:** Except for three studies based in the secondary level, evidence at large comes from the primary education level.
- **Technological Infrastructure:** Three of the 12 studies have an asynchronous component; 9 of the studies have an offline component.
- **TPD Characteristics:** Five of the 12 studies meet at least 3 of the 4 evidence-based TPD principles as outlined in Coach.

What should I consider?

- Align the digital content to the school curriculum or national standards so that teachers/PLs could optimize the use of teaching resources.
- Consider providing DRT or employing information and communications technology (ICT) for PLs rather than for teachers (or even pupils) to limit the cost as well as to target it on a more manageable instructional improvement problem. Moreover, ICT for PLs displays higher effects, which could be because teachers are required simply to teach better, rather than use ICT, which for them proves a challenge (Piper and others 2015).

- Technology is not a replacement for teachers/PLs. Rather, we should leverage technology to continue to engage teachers/PLs and be better facilitators. Some studies highlight that both teacher and student outcomes are better when teachers, as opposed to students, are in charge of the technology (Beg and others 2019; Piper and others 2015). For example, without the ability to project the content watched by students on individual devices, teachers cannot learn from student feedback about the effectiveness of their teaching style, receive immediate feedback on student understanding through questions, or model these two effective components in the teachers' remaining class time (Beg and others 2019).

Box 5. Multimedia Content Delivery in Pakistan

Video lectures. To increase student learning, the eLearn intervention increased the availability of high-quality, subject-specific content through technology and a two-day teacher in-service training. The main component of the intervention was *video lectures*. Each video lecture was developed and presented by subject experts to explain a particular mathematics or science concept. To see and display these video lectures and other multimedia content, teachers were given small pre-loaded tablets. Teachers could use these tablets to watch the videos when preparing for lectures and project them on installed LED television screens. These tablets also contained 3 to 5 multiple choice assessment questions and answers, which teachers could use to engage the class after each video as well as suggestions for additional in-class activities relevant to each topic. This classroom technology was designed to complement and augment teachers' existing teaching techniques. To display this content to the class, 40-inch LED televisions were installed above the existing chalk or whiteboard, enabling teachers to continue to use the board in an interactive way with the videos.

Mapping. Moreover, all videos were *mapped directly to the units of the official curriculum*. A single presenter appeared in all videos related to a particular unit. These lectures contained spoken Urdu with an occasional English word. Moreover, all words were written in English, as is typical in Pakistani middle schools in which textbooks often are in English while instruction occurs in a mix of English and Urdu. Paired with some videos were an additional 3-5 minutes of multimedia content that the teacher could play to reinforce the content of the videos, for example, an interactive animation of photosynthesis. The tablets also contained digital versions of the official textbook.

Blended learning. Teachers received a two-day in-service training session that oriented them on the new technologies and *introduced a blended (student) learning approach* that combined their own face-to-face teaching with technology-enabled multimedia content. The training encouraged the teachers to use technology to enhance their role in the classroom and trained them how to use the videos, related assessment tools, and activities on their tablets for more effective teaching.

Source: Beg and others 2019.

Instructional Tips and Strategies

Low impact for low cost, based on low evidence



Instructional tips and strategies (ITS) is defined as sharing teaching tips and strategies with teachers/PLs. Often PLs or research teams are responsible for sending these messages, the themes of which can vary from lesson plans, curricular reminders, and feedback for students to reflection reminders and encouragement for specific practices. This method also can provide motivational nudges to teachers/PLs through messages such as “X percent of teachers/PLs already have implemented and found a particular strategy helpful.” The ITS method helps teachers/PLs to engage in ongoing TPD opportunities or apply TPD learnings. The frequency can vary from daily to weekly and spans the period of the training but often continues beyond TPD for a few months or years.

ITS typically is used during ongoing TPD to reinforce the learnings and ideas. It also can be used as an independent support in low-resource settings. To make the method even more engaging, the communication can be two-way so that teachers/PLs can respond to messages.

What type of technology is typically used?

ITS is an affordable low-tech method through which SMS text messages can be used as a medium to share tips and strategies with teachers/PLs. Relevant information also can be shared via internet-based chat messages with teachers. In low-resources settings in which teachers/PLs do not already own a smartphone, they can be provided with one to make use of this otherwise low-tech approach.

How effective is ITS?

Evidence is very limited that the instructional tips and strategies method can be used reliably to identify genuine differences in the teacher outcomes. However, that limited evidence suggests that ITS can be a promising low-cost method to reinforce TPD concepts and/or nudge behavioral changes. Additional research is needed to establish links between using ITS and improved teaching practices.

Improved teacher outcomes have been identified in teaching practices in which teachers were trained. Teachers found text messages to be a good source of new teaching ideas. In one study, text messages created a sense of community, made teachers feel valued and listened to, and were an important mechanism for feedback and improving the program. These positive outcomes were possible because teachers were given the opportunity to respond to the text messages. In another study, teachers shared messages with other teachers from the control group, thereby implying that the teachers found value in the messages.

How secure is the evidence?

The findings are based on 3 experimental studies, but 1 of them has high contamination¹⁶ effects (appendix C). Thus, the evidence base on ITS is very limited. More rigorous studies are required to establish a causal relation between the method and its impact on teachers, particularly focusing on isolating its impact from other methods. This lack of strong evidence does not mean that impact is not achievable, but practitioners considering ITS cannot assume that it necessarily will increase teacher outcomes or should rather consider supplementing it with other methods.

What is ITS frequently used with?

- Two of the 3 studies combine ITS method with communities of practice and modeling best practices.

What are the costs?

The average cost to implement ITS method is estimated as low. Incorporating it typically will involve costs for basic feature phones for the operational team to send and for teachers/PLs to receive messages. It also will involve costs for sending messages, either via data bundles (such as internet-based chats) or phone credits (SMS). In the event of two-way communications, the costs for sending messages will apply to teachers/PLs to incentivize them to use the technology.

Where has ITS been delivered?

- **Countries:** Kenya, Malawi, and South Africa.
- **Context:** All three studies have a focus on teachers/PLs in rural areas.
- **Grade-level of teachers/PLs:** Evidence comes from lower primary education level.
- **Technological Infrastructure:** All three studies have an offline component.
- **TPD Characteristics:** All three studies meet 3 of the 4 evidence-based TPD principles as outlined in Coach.

What should I consider?

- Consider implementing a two-way communication, in which teachers/PLs also are given an opportunity to respond to text messages. Two-way communication can help create a sense of community, make teachers/PLs feel valued and listened to, and be an important mechanism for feedback and improvement of an ongoing TPD. The responses also can be selected to communicate with the rest of the group.
- Text messages have the advantage that they can provide support in areas that PLs cannot or would not reach.

¹⁶ Contamination occurs when an intervention administered to an intervention group of an experimental study filters into the control group. For Evidence Strength scoring scales, see table B2, appendix B.

Box 6. Improving Literacy Instruction in Kenya through Text Messages Support

Ongoing support. After the initial workshop, Kenya's literacy intervention as part of Health and Literacy Intervention (HALI) offered ongoing support for teachers for two years through weekly text messages providing brief instructional tips and motivation to implement lesson plans. **Moreover**, teachers were given the opportunity to respond to text messages, and responses were selected for communication to the rest of the group.

The **text messages suggested further instruction** (for example, please remember to have children finger-point as they track the text); shared instructional ideas (for example, teacher X at school X uses the pocket chart to display the 'Be the Sentence' activity for pupils to use independently); or helped to monitor progress and understanding of lessons (for example, please tell us which lesson you like using). A response was required to receive a small top-up for their mobile phones, which facilitated use and provided an incentive for further communication. Teachers received credit of \$0.50—around 50 Kenyan shillings—each week for their mobile phones.

The intervention **also included** an initial 3-day professional developmental workshop and two 1-day follow-up workshops. To facilitate implementation of the program with minimal direct interaction with teachers, teachers were provided with a teacher manual with partially scripted lesson plans and other basic instructional materials.

Source: Jukes and others 2017.

Lessons and Other Considerations



Lessons and Other Considerations

The Navigation Guide includes a comprehensive revision and systematization of research that documents various types of technologies and methodologies to support teachers/PLs (27 studies included in the final analysis; selected from a review of over 100). The experiences documented in this Guide span 20 countries¹⁷ across high- and low-resource contexts in low- and middle-income countries (LMICs). As the evidence indicates, no single technology-based TPD method is equally effective in different contexts. The capacity to adapt to the nuances of a particular context will play a major role in the success of a TPD program intended to change teaching and learning.

The effectiveness of different programs documented here varies significantly. Considering TPD that can include high- and low-tech solutions is likely to benefit diverse types of teacher-communities. Although access to technology is not something that all teachers/PLs have, this Guide provides a range of options to consider for a combination of low- to high-tech solutions. Combining technology with a close and systematic human connection can be a game-changer to better support teachers/PLs.

Here are some **lessons from the literature review and considerations for adapting any of the six TPD methods** elaborated in this Guide to your context:

- **Technology-based TPD is not a replacement for in-person TPD.** Technology should be leveraged to supplement, optimize, and provide ongoing and relevant support to teachers/PLs.
- **Multimodal methods increase flexibility and inclusion.** A combination of two or more TPD methods can be considered an opportunity to enrich the effectiveness of the support to teachers/PLs. Moreover, there is not enough evidence to support standalone TPD methods, that is, changes in teaching practices driven by only one TPD method as opposed a combination of several (table 2).
- **Digital skills are a transversal aspect relevant for all types of technology (low- or -high-tech), irrespective of the TPD method(s) employed.** When choosing the technology to be incorporated in a TPD program, it is essential to keep in mind the existing digital skills of participating teachers/PLs. Using technology with which teachers are familiar increases adoption and engagement. Moreover, if necessary, train teachers/PLs to use the technology and consider the time needed to build the capacity of participants at all levels to use hardware and software and to implement the instructional content augmented by technology. When designing a tech-based TPD program, this transversal aspect demands implementors to develop, select, and/or adopt one or more of the existing digital skills frameworks that respond to the context's requirements.¹⁸
- **Disconnected or sporadic TPD does not work. Disconnected or sporadic TPD is not as effective as systematic and regular support.** Short-term training is useful to deliver guidance and information. However, sustained changes, such as adopting new skills and changing attitudes and behaviors, require ongoing support. Tech-based TPD programs also must consider the time needed to build the capacity of participants and provide support or reference materials as needed.
- Changes in teaching practices will not necessarily translate into gains in learning because learning is also the result of student-teacher interactions. **It is essential to ensure that the quality of student-teacher interactions does not deteriorate in the presence of technology.** In contrast teachers/PLs should be trained to facilitate teaching through technology.

¹⁷ Angola, Bangladesh, Brazil, Costa Rica, Ethiopia, Ghana, India, Jordan, Kenya, Madagascar, Malawi, Nigeria, Pakistan, Philippines, Senegal, South Africa, Tanzania, The Gambia, Uganda, and Zambia.

¹⁸ For details on skills frameworks, see Freeman and Raigosa Montoya 2022.

Table 2. Frequency of Standalone and Multi-Modal TPD Methods

	N:	N: Stand- alone	N: Coaching	N: Communities of Practice	N: Digital Resources for Learning	N: Digital Resources for Teaching	N: Instruction- al Tips and Strategies	N: Modeling Best Practices
Coaching	11	0	NA	6	3	7	1	6
Communities of Practice	12	1	6	NA	6	4	2	6
Digital Resources for Learning	11	3	3	6	NA	3	0	2
Digital Resources for Teaching	12	2	7	4	3	NA	1	7
Instructional Tips and Strategies	3	1	1	2	0	1	NA	2
Modeling Best Practices	12	2	6	6	2	7	2	NA

Notes:

a. N = The number of studies or frequency

- 1) The column N (Total) = the number of studies that employ given TPD method, either stand-alone or in combination with other TPD methods.
- 2) The column N (Standalone) = the number of studies that employ that particular TPD method as standalone, not in combination of other TPD methods.
- 3) The other column heads = the number of studies that combine two TPD methods.
- 4) NA = Not Applicable.

b. The cells highlighted in **yellow** depict the frequency of the combination of two TPD methods that are applied together most frequently. For example, Coaching is most frequently employed with Digital Resources for Teaching (DRT) to deliver a TPD program, here in 7 of the 27 studies.

Limitations

This Navigation Guide enables you to select from a variety of TPD methods that have proved effective or can be adapted to low-resource settings. However, this Guide does not detail how to develop a TPD program (its content, how to train trainers, and/or how to run assessment). This lack of detail is driven primarily by lack of information in studies or lack of enough studies to draw an insight. Some reasons driving these limitations and scope are:

- **Multi-modal TPD.** The biggest limitation is that TPD programs often combine multiple methods to deliver training. It is difficult for evaluation studies then to disentangle the effects. In this regard, complementary TPD methods have been tagged (refer to “What is X frequently used with” subsection under each TPD method).
- **Impact.** Only a limited number of peer-reviewed empirical studies focus on isolating the impacts of technology on changed teaching practices.
- **Teacher Profile.** Studies do not provide information on an individual teacher’s/PL’s profile such as initial digital skills, knowledge levels, or motivation to learn. Therefore, this Guide does not have enough studies to isolate what works for which kind of teacher/PL. That said, methods have been categorized based on teacher grades and regions (urban, semi-urban, semi-rural, or rural).
- **Training Content.** Similarly, studies do not provide information on the training content other than high-level TPD goals. The number of studies in the analysis is not enough to identify which method is more suited for a given TPD goal.
- **Implementation Diversity.** Only 3 of the 27 studies in the evidence base for this Guide have a national or international focus. The rest are pilot programs.
- **Resources.** Most studies do not provide information on additional resources needed to provide the training such as training of trainers, training of coaches, distribution, and availability of materials. These supporting conditions are instrumental in the success of technology application.

Appendixes

Appendix A. Detailed Methodology for Evidence Review

From December 2020–March 2021, our team conducted a review of existing evidence that detailed how technology could be used to facilitate in-service TPD in LMICs. The review included studies that showed how technology was applied across broader professional development needs. Other activities and external factors that influenced teachers'/PLs' willingness, student learning outcomes, and home environment were not within the scope of the review. A key challenge was the limited number of peer-reviewed empirical studies that focused on isolating the impact of technology on change in teaching practices.¹⁹

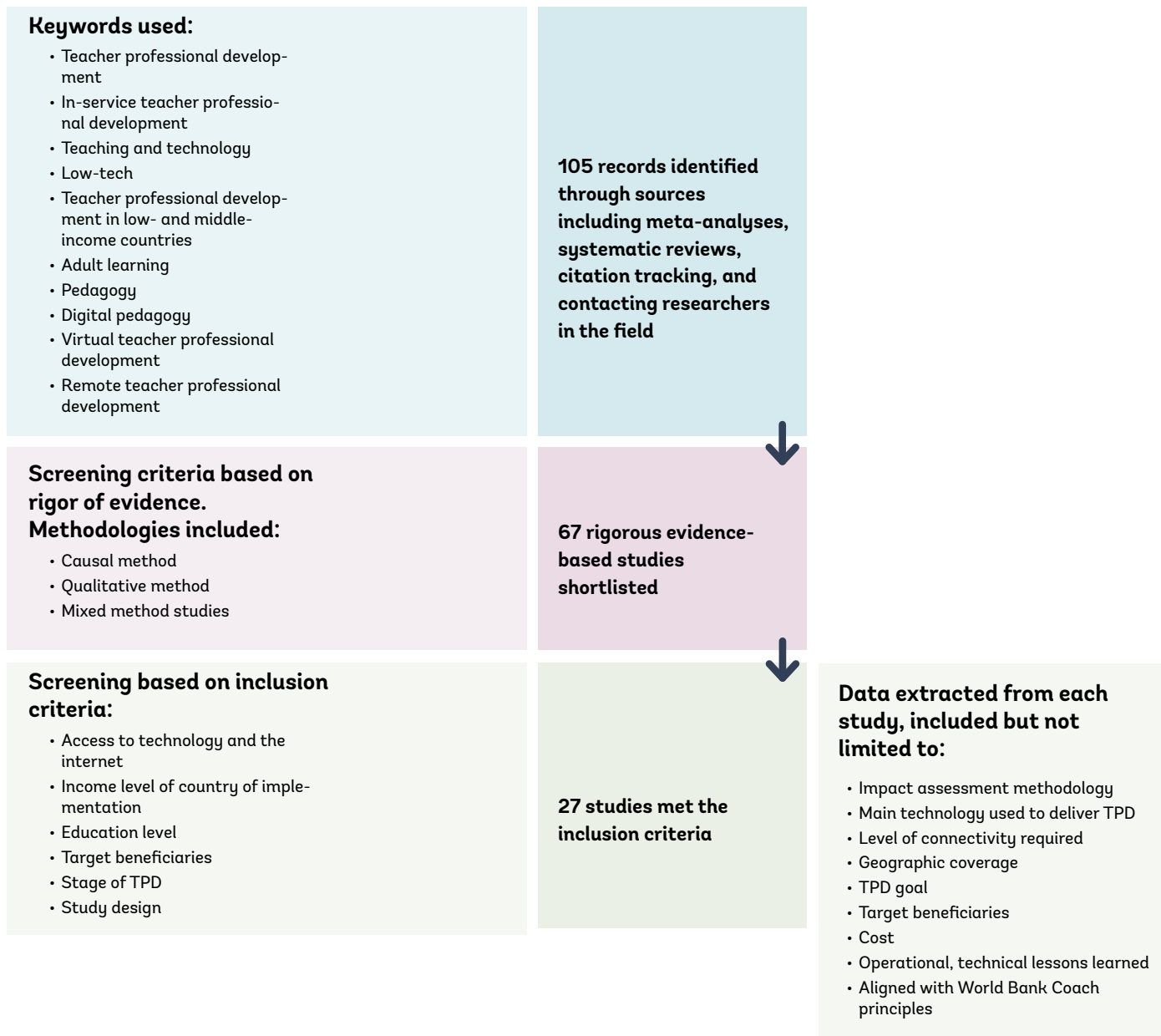
Methodology

This Guide takes into account the results of the 2021–22 review of in-service TPD programs for LMICs intended to influence practices and/or processes. (1) **Practices** refer to teacher-based outcomes such as content knowledge, digital skills, and pedagogical practices. (2) **Processes** refer to the mechanisms that make the programs and/or teachers/PLs more effective by reducing costs, reaching more teachers/PLs, and reducing teachers'/PLs' dropping out of a program.

The methodology for the 2021–22 review (figure A.1) was as follows:

1. **Search** for relevant studies using meta-analyses, systematic reviews, citation tracking, and contacting researchers in the field, yielding over 100 studies. The keywords were teacher professional development, in-service teacher professional development, teaching and technology, low-tech, teacher professional development in low- and middle- income countries, adult learning, pedagogy, digital pedagogy, virtual teacher professional development, and remote teacher professional development. Of the studies reviewed, 67 were evidence based (and published as working papers or in peer-reviewed journals). The remainder were anecdotal reports with non-rigorous analyses.
2. **Screen** the 67 shortlisted studies using the inclusion criteria below (table A1). Screening resulted in 27 studies, which were made part of the Evidence Matrix. See [T4T Evidence Matrix](#) for a summary of the 27 studies.
3. **Extract** methodology to assess impact, main technology used to deliver TPD, geographic coverage of the intervention, TPD goal or outcome and target beneficiaries of the intervention, and (where available) implementation cost (table A2). Researchers were contacted to provide details not explicit in the published or working papers.
4. **Judge** how much confidence to place in the findings of each study. Each study was evaluated for methodological quality and relevance to teacher-based outcomes.
5. **Summarize** the findings of each study, grouped by the broad topics of policy challenge, TPD outcome, and technology used.

¹⁹ Additionally, the research approach was “subject agnostic.” In other words, we did not differentiate between the technology used when the goal was teacher knowledge vs. when the goal was attitude or skills. Similarly, we did not differentiate between the technology used when the content was subject specific (for example, mathematics or science) vs. when it was pedagogy related (for example, grouping or continuous assessment). However, as the literature and experience base grows, we may find that technology is more suited to certain kinds of content improvement than to others.

Figure A.1 2021-22 Review of Global Literature on Tech-Based TPD Programs

Inclusion Criteria for Selecting Studies

The studies in the T4T Evidence Matrix were selected according to the inclusion criteria given in table A.1.

Table A.1 Inclusion Criteria for T4T Evidence Matrix

Selection Criteria		Included	Excluded
Technology	Access to technology and the internet	Interventions that operate in contexts with low or irregular connectivity. Interventions that operate in contexts with high connectivity (for example, online learning platform, video streaming) are given secondary priority.	Interventions that do not use any form of technology to train and/or support teachers /PLs.
	Income level of country of implementation (per World Bank country classification by income)	Low-income, LMIC, and upper-middle-income countries.	High-income countries (HICs).
Context	Education level	K-12.	ECE, Higher Education.
	Target beneficiaries	Interventions that 1. Use technology to deliver training and/or support to teachers and PLs. 2. Use technology to improve student learning outcomes and provide training and/or support to teachers/PLs and report the impact on teacher-based outcomes.	Interventions that include the use of technology only for students.
Design	Stage of TPD	Interventions for in-service TPD.	Interventions for pre-service TPD.
	Study design	Interventions in which a quantitative estimate of the impact is given (experimental/quasi-experimental). Interventions with observational studies are given secondary priority.	Interventions that are not evaluated or have only published self-evaluated reports.

Table A2. Data Extracted

Primary – Directly Extracted	Secondary – Directly Extracted	Derived
Title of the Paper	Level of education	Level of connectivity required: low-tech vs. high-tech
Authors	Geographic region (such as AFR, MENA)	Technical Lessons Learned (What features of program design led to success?)
Year of Publication	Geographic coverage of program (country, state, district)	Operational Lessons Learned (What features of program implementation led to success?)
Evidence Type	Monetary cost of program	Alignment with Coach principles (ongoing, focused, tailored, and practical)
Abstract	Time commitment to program	
Target Beneficiaries	Additional considerations	
Main Technology Used	Language	
Brief Description of Technology	Is tech the primary medium of support to teachers or is it a supplementary program?	
Type of TPD	Scale of program (number of teachers/PLs and/or schools)	
Goal of TPD	Year(s) of implementation of program	
Brief Description of TPD	Duration of program (standalone/ ongoing)	
Impact/Effectiveness	Access requirements	
Evidence Strength	Contact of author/ implementing organization/ researcher	
	Additional comments	

Appendix B. Scoring Methodology for Individual Studies

The four dimensions used for scoring are evidence strength, impact, technological infrastructure, and TPD characteristics. These four were selected to gain insight into considerations for scaling up and/or replicating a technology-based TPD program. Table B1 provides a rationale for the selection of each dimension. After extracting the necessary information from shortlisted studies, the studies were scored on two dimensions: evidence strength and impact. Table B2 elaborates the scales used for scoring.

Table B1. Rationale for Selecting Dimensions

No.	Dimension	Rationale
1	Evidence Strength	<p>To draw a causality between the program implementation and its outcomes.</p> <ul style="list-style-type: none"> Studies with a randomly selected comparison group (experimental) or a carefully matched counterfactual (quasi-experimental) rank high on evidence because they can help see what would happen in the absence of a program. Studies with data for only one point in time and from only one set of participants rank low on evidence because definitive claims about the outcomes cannot be made. The outcome can result in more changes in the participants' environment.
2	Impact	To identify whether the program meets intended results in both type (changes in teacher practices, knowledge, and attitudes) and strength of outcomes.
3	Technological Infrastructure	To identify whether the technological infrastructure (technologies, devices, connectivity) required for a TPD method will meet the infrastructural context of a school/cluster of schools that would like to scale up or replicate the program. The more analog (low-tech) technology used, the more relevant the program is to this study.
4	TPD Characteristics	To identify whether the program meets the requirements for an effective TPD. To respond to the key weaknesses demonstrated by TPD programs at scale, the Coach team has outlined four research-based principles.

Table B2. Scoring Dimensions and Scales

No.	Dimension	Scale		
		Low = 1 ^a	Medium = 2	High = 3
1	<p>Evidence Strength</p> <p><i>Definition:</i> Captured by methodology of study and its soundness in establishing the causality of whether technology added value to the TPD objective.</p> <p><i>Details:</i> 1. For mixed method studies, the highest relevant metric has been scored for. For example, if there is an impact evaluation (IE) that also collects survey data, the score has been given to the IE.</p> <p>2. When the methodology used to obtain results is unclear, the study is rated as 1.</p> <p>3. Anecdotal studies are not a part of “Evidence” hence are not scored in this Guide.</p>	<ul style="list-style-type: none"> Meets criteria for 2 but the sample size is fewer than 5 teachers/PLs, or Self-reports by participants (open/closed question surveys, focus group discussions (FGDs), interviews, or internet-based chats) in a nonexperimental study. Subjective observational data in a nonexperimental study, or Qualitative or descriptive analysis of qualitative data. 	<ul style="list-style-type: none"> Meets criteria for 3 but the sample size is 5 to 20 teachers/PLs, or Authors of a study rated 3 identify significant internal threats to its validity for example, contamination. Pre/post comparisons with the same participant group, or Instrument-based observational data are used for nonexperimental studies. 	<p>Experimental or quasi-experimental study design (does not include pre/post comparisons with the same participant group). Studies have a:</p> <p>Sample size of at least 20 teachers/PLs and</p> <p>Lower than 40% attrition. Studies in which attrition is not reported are highlighted with an asterisk.</p>
2	<p>Impact</p> <p><i>Definition:</i> Did the program show evidence of improvements in teacher behavior or practices?</p> <p><i>Details:</i> The improvements can be either inside or outside the classrooms and can impact either the practice and/or process of TPD. Studies that report only student outcomes—even if they trained teachers/PLs to use the technology or trained them using the technology without reporting any impact on teachers/PLs—are out of scope.</p>	<p>Shows evidence of teacher satisfaction or proof of concept, increased participation, or uptake feasibility but without measured teacher outcomes. This is classified as “Potential for Impact.”</p> <p><i>Details:</i></p> <p>For a score of 0:</p> <ol style="list-style-type: none"> If there is a significant negative impact on teacher outcome or If the control is superior and significant in the results, even if the overall impact was positive relative to baseline; or If no statistically significant differences between treatment and control teachers/PLs either before or after the program. 	<p>Shows some “indicative evidence” of changes or a “perception of change” in teacher-based outcomes: teacher content knowledge; teacher’s skills; teaching practices, attitudes, and behaviors. Essentially, the impact is more than increased participation or uptake but is not quantified.</p> <p><i>Details:</i></p> <ol style="list-style-type: none"> If there are mixed teacher outcomes with a positive and a null/no impact, the study is classified as 2. 	<p>Shows strong, statistically significant, and meaningful evidence of changes in teacher-based outcomes: teacher content knowledge; teacher’s skills; teaching practices, attitudes, and behaviors.</p> <p><i>Details:</i></p> <ol style="list-style-type: none"> Mixed secondary impacts do not downgrade the evidence.

<p>3</p> <p>Technological Infrastructure^b</p> <p><i>Definition:</i> Captured by the “minimum” level of technology and connectivity required to deliver any of the components of a TPD program.</p> <p><i>Details:</i> Level of technology and connectivity can be categorized into two--low-tech, and high-tech--to determine the level of relevance for the purposes of the study.^c The more low-tech used, the more relevant the program is to this study.</p>	<p><i>Synchronous:</i> Delivered using high-bandwidth mobile or wired and synchronous communications (capabilities exceeding 3G mobile Internet) and/or advanced broadcast technologies (such as satellite television, satellite Internet).</p>	<p><i>Asynchronous:</i> Delivered using up to 3G bandwidth (~350Kbps to maximum of 1.5Mbps), using two-way asynchronous communications technologies likely readily available: cellphones with IM or internet-based chats, Smartphone, visual interface.</p>	<p><i>Offline^d:</i> Delivered primarily offline, using resources likely available to teachers/PLs (such as radio, TV), printed materials, pre-loaded content, or very low bandwidth two-way communications (for example, Packet Radio or GPRS^e), regular telephone calls (not over data), and regular SMS (not IM). Also included are feature phones, simple phones, or materials that do not require ongoing internet connection for day-to-day use by teachers/PLs.</p>
<p>4</p> <p>TPD Characteristics^b</p> <p><i>Definition:</i> Captured by the extent to which the TPD program includes four characteristics of evidence-based TPD.</p> <p><i>Details:</i> Effective professional development should be tailored, ongoing, focused, and practical as outlined by the Coach principles.</p>	<p>TPD program features only 1 or 2 Coach principles.</p>	<p>TPD program features 3 Coach principles.</p>	<p>TPD program features all 4 Coach principles.</p>

Notes:

- '1' under the defined scale does not always mean less desirable. Rather, it means a lower score. However, users can assess their context to identify which levels they need in each of the dimensions. For example, a user may assess that, in her/his context, something with a high impact is needed, but it can have a low technological infrastructure score. The user then can align her/his choices with the needs of the context.
- Scores for the 2 dimensions, “Technological Infrastructure” and “TPD Characteristics,” are used only to inform the description of the 6 TPD methods and are not used for the aggregation.
- Technology can include (1) “Low-tech”: Technology designed to be as simple as possible. “Low-tech” also can be associated with higher availability, lower learning curve (easier to use), and more affordability. Examples of “Low-tech” solutions are traditional television and radio, landline phone calls, basic feature phones, and printed materials. These “devices” require connectivity but can work in contexts of irregular-sporadic access to connection or no connection; (2) “High-tech”: Relatively new technology that incorporates advanced features. In the past, it was often assumed that “High-tech” is always better than “Low-tech.” However, as “High-tech” has proliferated, so has its inherent complexity associated with features and a steeper learning curve. In most cases, “High-tech” tends to be fully customizable but is more difficult to acquire, use, or maintain (requires additional training for individuals to use). Some examples of “High-tech” solutions are web, podcast, radio/TV via internet, and smartphones. These offer different forms of synchronous and/or asynchronous interaction but require regular connectivity or access to high-speed broadband.
- “Offline” includes TPD programs with software that runs offline and programs that require systemic technological infrastructure (such as nano stations) that is essential for the content to be ultimately available offline.
- General Packet Radio Service (GPRS) is a packet-oriented mobile data standard on the 2G and 3G cellular communication networks’ global system for mobile communications.

Appendix C. Aggregation Methodology for TPD Methods

Post-categorization of TPD methods, each method bucket was given an aggregation score based on evidence strength and impact dimensions. The other two dimensions were not aggregated on because they are more individual program traits and do not mean much at the method level. However, each method description shares a narrative on these dimensions based on findings from studies that fall within an approach.

The scoring technique employed for aggregated methods is norm-based: each dimension scale (evidence or impact) is scored relative to the general population scores/norms. In other words, dimensions for a TPD method are scored relative to other methods. Given that the aggregation scale is defined based on the current set of studies and their spread, it will change if more studies are added and/or if the composition of studies in the analysis changes. This variability is worth noting in scoring more studies based on the methodology described in this Guide. Refer to table C1 for the scoring of individual studies by TPD methods and table C2 for details on aggregation methodology to score TPD approaches.

Table C1. Scoring for Individual Studies by TPD Methods

TPD Methods	Total no. of Studies	Evidence (no. of studies)			Impact (no. of studies)			
		High = 3	Moderate = 2	Low = 1	High = 3	Moderate = 2	Low = 1	Negative/Null = 0
Coaching (such as observation, feedback, or conference calls with PLs)	11	5	3	3	3	5	1	2
Communities of Practice (such as internet-based chats)	12	3	5	4	5	5	0	2
Digital Resources for Learning (such as AV materials)	11	3	5	3	3	3	2	3
Digital Resources for Teaching (such as teaching software, AV materials)	12	6	4	2	4	3	2	3
Instructional Tips and Strategies (such as SMS text messages)	3	2	1	0	1	0	0	2
Modeling Best Practices (such as multimedia videos or demonstration lessons)	12	6	4	2	8	2	0	2

Table C2. Aggregation Methodology to Score TPD Methods







	High	Moderate	Low/Mixed
Impact	<p><i>Evidence of promise:</i></p> <p>Five or more studies with a high impact on teacher-based outcomes.</p>	<p><i>Indicative impact:</i></p> <p>Three studies with a high impact on teacher-based outcomes, and at least 3 studies with indicative/moderate impact on teacher-based outcomes.</p>	<p><i>Low or mixed impact:</i></p> <p>Fewer than 3 studies of high impact, or at least 3 studies of negative impact on teacher-based outcomes.</p>
Evidence	<p>At least five studies with a valid counterfactual on teacher-based outcomes (experimental or quasi-experimental).</p>	<p>At least 3 studies with a valid counterfactual on teacher-based outcomes, and at least three studies rated medium.</p>	<p>At least one study with a valid counterfactual on teacher-based outcomes.</p>

Note: The rating on impact and evidence referred to in table C2 is based on scales given in table B2 and scores in table C1.

Appendix D. Cost Categorization for TPD Methods

Not all studies report on implementation cost to enable infrastructure and other program components or provide information for a standardized period to draw cost comparisons. When studies do report this cost information, it is mostly for enabling technical infrastructure or from a student lens rather than for teachers/PLs or the full TPD program. To account for this gap, studies with cost information were referenced to understand the cost breakdown across TPD methods. A component-based approximation approach was used to categorize TPD methods under H/M/L cost scores (table D1). The regional variations in costs have not been accounted for.

Table D1. Cost Categorization for TPD Methods

TPD Methods		Cost Components
Coaching (such as observation, feedback, or conference calls with PLs)		High: Cost for training, time (salaries), and logistics (travel or technological devices for PLs; cost for technological devices (such as phones, laptops, tablets,) with teachers/PLs; data bundles and device maintenance
Communities of Practice (such as internet-based chats)		Moderate: Cost for devices (such as phones, tablets) and data bundles for teachers/PLs; in some cases, complemented by cost for PLs and/or technological devices for them
Digital Resources for Learning (such as AV materials)		Moderate: Cost to develop self-study materials such as multimedia, MOOCs, OER, training website; cost for devices (such as phones, tablets) with teachers/PLs
Digital Resources for Teaching (such as teaching software, AV materials)		High: Cost for software, installation, and maintenance, development of AV materials; cost for devices (laptops, computers, tablets; projectors, smartboards; or SD cards)
Instructional Tips and Strategies (such as SMS text messages)		Low: Cost for data bundles to send text messages, devices for operational teams (who send messages), devices for teachers/PLs (optional)
Modeling Best Practices (such as multimedia videos or demonstration lessons)		Moderate: Cost to develop AV materials; cost for devices (such as phones, tablets) with teachers/PLs; in some cases, cost for satellite connectivity

Appendix E. Data Sources for Measuring Teacher Outcomes

The studies use data ranging from instrument-based classroom observations and analysis of coded teacher chats to technology uptake data (such as server statistics, tablet usage, call records) and self-reported instruments (such as questionnaires, interviews, focus group discussions) to measure teacher outcomes.

Table E1. Data Sources to Measure Teacher Outcomes

Observations	<ul style="list-style-type: none"> Pedagogical quality was assessed using a classroom observation tool (instrument) or semi-structured observation notes. Observations also could be conducted indirectly through analysis of lesson plans, teacher logbooks, or journals; lesson recordings, teacher portfolios, and audio diaries; or videotaped instructions.
Tests	Pre and post assessments of teacher knowledge.
Reported Changed	<ul style="list-style-type: none"> Self-reported: Internet-based chats, FGDs, structured or semi-structured interviews, questionnaires, or surveys. Stakeholder-reported: Same instruments have been used with other stakeholders to identify impacts on teachers/PLs.
Uptake of Technology	Tablet usage, call records during and after training period, attendance data, server statistics.

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Links of Interest



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