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Designing effective professional development for technology integration in schools

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Abstract

This study aims to explore the critical factors for effective professional development (PD) activities to support teachers' technology integration and suggests a design model: flipped PD. The following questions are investigated: What are the core features of effective teacher PD, what are the implications of core features in effective technology integration PD, and what are the best practices for designing a flipped PD model for preparing teachers to integrate technology into their classrooms? First, we discuss the core features of effective teacher PD: content focus, active learning, coherence, duration, collective participation, and the role of context. Second, we explore design factors in recent technology integration PD studies: learner centred, relevance and reflection, evidence of student learning, support and follow-up, student voice, and initial implementation with teacher leaders. Finally, we present a discussion of our recommendations for a flipped model for technology integration PD.

KEYWORDS
classroom, model development, professional development, teacher, technology integration

1 | OVERVIEW

The change-oriented structure of the knowledge economy of the 21st century adds new dimensions and components to the already complex formulation and delivery of effective teacher professional development (PD). As is the case for many other professionals, emerging dimensions and components place additional demands on teachers to develop multiple professional skills for their everyday teaching activities (James & McCormick, 2009). To be able to address some of these challenges, governments and organizations are making significant investments in teacher PD. Gaytan and McEwen (2010) report that one of the main goals of these efforts is to develop teachers who are prepared to "integrate instructional technology into teaching practices effectively" (p. 77), and several studies recognize the need for additional PD for teachers around the use of emerging technologies in their classroom (Bey, 2012; DeSantis, 2012; Rives, 2012; Wells, 2007).

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Teachers in the 21st century classrooms are expected to know how to use technology for effective teaching and learning (Beauchamp, Burden, & Abbinett, 2015; Jimoyiannis, 2010; Tweed, 2013). Inan and Lowther (2010) use the terms "technology use" or "technology integration" interchangeably for three types of applications: for instructional preparation, for instructional delivery, and as a learning tool for students. These applications include designing classroom activities, instructional delivery through computer-assisted learning applications, and use of software applications (e.g., databases, spreadsheets, and Web 2.0 tools) by students. Barrett-Greenly (2013) supports this definition, arguing that technology integration includes activities such as generating instructional strategies that encourage learners to create their own knowledge. Interactive white boards (IWBs), tablet computers, Web 2.0 technologies, and mobile phones are some of the contemporary technologies permeating classrooms today. Although our review does not focus on any particular technology, we acknowledge that there are various current and emerging technologies that can be used for educational purposes and may have an impact on teaching and learning.

Although there is a general belief that technology use is necessary for high-quality learning (Hew & Brush, 2007; Tweed, 2013), several studies argue that technology use is not at capacity and that more persistent and intentional use are needed (e.g., Ertmer & Ottenbreit-Leftwich, 2010; Lawless & Pellegrino, 2007; Tweed, 2013). Unger and Tracey (2013) identify "barriers" and "enablers" as two of the main components hindering or promoting technology integration. Hew and Brush (2007) identify six categories of barriers to technology integration: resources, knowledge and skills, institutional characteristics, attitudes and beliefs, assessment, and subject culture. Although some of these factors are not under teachers' control (e.g., institutional characteristics and resources), others such as knowledge and skills, and attitudes and beliefs are intrinsic to teachers, and are potentially malleable (Unger, 2012). In fact, teachers' readiness to use technology is reported among the most important steps toward technology integration (Groth, Dunlap, & Kidd, 2007), and a positive association has been found between teachers' technology efficacy and their technology integration (Koh & Frick, 2009; McCormick & Ayers; 2009). Researchers argue that if teachers are well prepared to use technology, their self-efficacy around technology and their use in the classroom are likely to increase (e.g., DeSantis, 2012; Tweed, 2013). PD provides teachers with information and opportunities for integrating technology into the classroom and for supporting their understanding of the connections between the curriculum and technology (Tweed, 2013).

The purpose of this study is to introduce a comprehensive PD model for supporting teachers' technology integration that is based on a systematic review of the literature relating to core features of effective PD and technology integration PD. The present study presents the features and strategies found to be essential for design of an effective PD to support teachers' technology integration and combines these strategies with flipped learning strategies and propose a flipped PD model. We hypothesize that the application of the model would provide teachers with PD experiences that are both relevant and connected to their everyday experiences in the classroom. Rather than focusing on opportunities for teachers to learn about a particular technology, our review of the literature focuses on design of a PD that is devoted to the integration of educational technologies into instruction and practice.

1.1 | Rationale for a flipped PD model

Studies that have examined the effects of PD that focuses specifically on technology integration acknowledge its potential for increasing teachers' technology skills, comfort with technology, and technology use (Barrett-Greenly, 2013; DeSantis, 2012; Hartsell, Herron, Fang, & Rathod, 2010; Keller, Bonk, & Hew, 2005; Kopcha, 2012; Rives, 2012; Tweed, 2013). Several studies also urge organizers of technology integration PD to carefully and thoughtfully plan the design and delivery of the PD so as to maximize the benefits (e.g., Barrett-Greenly, 2013; Gaytan & McEwen, 2010). Drawing upon evidence from the literature, this manuscript proposes a flipped PD model for technology integration that overcomes some of the challenges associated with current models. Flipped model is a form of blended models because it is a combination of online videos with face-to-face meetings.

Current research suggests that an effective PD experience for teachers should be sustained over time and connected to classroom instruction, while requiring active participation from teachers (Belland et al., 2015; Boyle et al., 2004; Dede et al., 2016; Garet et al., 2001; Jao & McDougall, 2015). One way to sustain PD experiences over time is to add online components to face-to-face-only models, thereby providing additional scheduling and programming flexibilities (Belland et al., 2015; O'Dwyer et al., 2007; Owston et al., 2008). Dede, Ketelhut, Whitehouse, Breit, and McCloskey (2008) report that the types of reflection opportunities provided by asynchronous interactions encourage the contributions of teachers who tend be silent in face-to-face situations. Dede et al. (2008) argue that those teachers often "find their voice" through mediated interactions. Access to experts and archival resources are among many of the advantages of online PD components (Dede, 2006). According to Owston et al. (2008), blended programs can support teachers' ongoing dialogue with expert online facilitators and with teachers from other schools and can foster the emergence of school-based teacher communities. Different platforms of rich dialogues are likely to bring new ideas and suggestions for teachers' classroom-based activities. Moreover, blended PD models tend to be more cost-effective than face-to-face-only models (Dede et al., 2016; Owston et al., 2008) and offer teachers and schools more independence (Holmes, Polhemus, & Jennings, 2005). Teachers' beliefs and negative attitudes are frequently reported as significant obstacles to the integration of technology into teaching and learning (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Blended PD models have been found to help teachers develop a positive effect toward, and beliefs about technology integration (Holmes et al., 2005). Therefore, the model we recommend includes a well-organized blended PD system that combines the advantages of face-to-face and online components to promote teachers' connectedness while allowing timing and location flexibility.

The unique aspect of the flipped model is that it blends successful teaching strategies with video and audio recordings using digital technologies that are becoming more and more common (McDonald & Smith, 2013). With this method, learners can watch videos and reach resources, learning the content wherever and whenever they want, and more time can be devoted to practice-oriented teaching strategies, collaborative work activities, and discussions on concepts in a face-to-face classroom environment (Hamdan, McKnight, McKnight, & Arfstrom, 2013). Although the concept of *flipped classroom* is new as a term, many of the teaching approaches adopted by this model, such as active learning, research, and inquiry, learner-centred designs are successful teaching approaches used at different levels of teaching (Bergmann & Sams, 2012) and aligns perfectly with the strategies for an effective technology integration PD. These strategies will be presented in detail in the following sections.

1.2 | Research questions

The need for further research on the key design elements of blended PD programs has been recognized in the literature (Matzat, 2013; Owston et al., 2008). As such, the purpose of this manuscript is to describe the results of a comprehensive review of the literature and to offer a comprehensive model for effective technology integration PD. Specifically, the following research questions guided this study:

RQ1:. What are the core features of effective teacher PD?
RQ2:. What are the implications of core features in effective technology integration PD? RQ3: What are the best practices for designing a flipped PD model for preparing teachers to integrate technology into their classrooms?

2 | METHODOLOGY

2.1 | Article selection

The articles selected for this review were sourced using Education Resources Information Center (Education Research Complete) and Google Scholar. Specifically, researchers focused on articles published between 2000 and 2017, which focused on the key elements of effective teacher PD and models for PD that are designed to effectively prepare teachers to integrate technology into their teaching. Several terminologies associated with teacher PD were used in the search, including teacher PD, teacher training, training to use technology, teaching with technology, and teacher technology PD. Additionally, qualifiers such as teachers and technology were used in the search. In selecting the literature, our review was limited to studies providing evidence relating to the characteristics of effective teacher PD, training teachers for effective use of technology, using technology to train teachers effectively, and parameters for effective use of some current technologies (e.g., IWBs, tablets, Web 2.0).

Approximately 500 articles were returned using the above keywords, and approximately 140 of those studies were identified as being directly relevant. In addition, searches of bibliographies and dissertations resulted in the identification of an additional 20 studies. Detailed examination of the recorded studies resulted in 32 studies being included in the review (See Table 1). Of the selected studies, 18 are empirical studies (three of which are dissertation studies), 7 are review studies, 2 are theoretical works, 3 are research reports, and 2 books. Results from the review are presented in three main sections in the remainder of this manuscript—first, we discuss the core features of effective teacher PD; second, we explore what recent technology integration PD studies tell us about effectiveness; and finally, we present a discussion of our recommendations for a model for technology integration PD.

3 | FINDINGS

3.1 | Core features of effective PD

We acknowledge that variation exists in the characteristics of effective PD programs across studies; however, in examining the PD literature, we were able to identify some common core features.

3.1.1 | Content focus

Research on technology integration PD shows that directly connecting PD activities to teachers' content area can lead to more student-centred use of technology (e.g., Twining, Raffaghelli, Albion, & Knezek, 2013). In addition to the content focus (e.g., Mathematics, Literature, or Science), PD that prepares teachers to integrate technology into their classrooms must also provide technical, pedagogical, and management related content (Curwood, 2011; DeSantis, 2012; Gerard et al., 2011; Polly & Hannafin, 2010; Unger, 2012; Unger & Tracey, 2013). Rather than just offering PD activities in the core functions of the technology, Unger (2012) claims that effective technology integration PD should also provide how-to videos that demonstrate how teachers can successfully incorporate a particular technology into their classroom practices. Moreover, because different technologies will alter the instructional atmosphere and introduce new classroom management challenges, Barrett-Greenly (2013) recommends that teachers are provided with classroom management tips that are particular to the types of technology being integrated. Furthermore, it is important that teachers are offered the necessary resources to help them understand and apply appropriate pedagogical approaches for effective technology integration (Amanatidis, 2015; Bey, 2012).

3.1.2 | Collective participation and active learning

Curwood (2011) reports that when technology integration PD focuses only on the affordances and limitations of particular technologies, it fails to promote improved pedagogy and student learning in the classroom. Instead, time for reflection, exploration, and evaluation of new technologies should be viewed as critical for effective technology integration PD (Rives, 2012). Active participation by teachers during their professional learning process has been recognized as an important component of an effective PD experience in several studies (Borko, Jacobs, & Koellner, 2010; Desimone, 2009; Garet et al., 2001; Patton, Parker, & Tannehill, 2015; Penuel, Fishman, Yamaguchi, & Gallagher, 2007). Common ways for teachers to actively participate include: observing experts or being observed; reflecting on their own practices; creating new material; preparing for the implementation of a new teaching strategy; reviewing student work; and presenting material and leading discussions during PD activities (Desimone, 2009; Garet et al., 2001; Han, 2014; Polly & Hannafin, 2010; Seidel, Stürmer, Blomberg, Kobarg, & Schwindt, 2011). As adult learners, teachers engaging in PD are likely to be more task oriented, preferring to see concrete applications of what they are learning and to connect current learning activities to prior learning and professional

TABLE 1 Articles reviewed: Effective PD

Article reference	Type of article/method	Form of delivery	Subjects studied	Position of the article
Beauchamp et al. (2015)	Empirical: Student and teacher interviews (11 schools, 34 teachers, and 184 students)	Not specified	-How and under what circumstances teachers learn to integrate technology into their daily practices	• Student and teacher involvement • Time and place flexibility • Intuitive and easy to use technology
Belland et al. (2015)	Empirical: One middle-school science teacher	Blended: 1.5-hr seminars, one 8-hr workshop, and 4 weeks of online education activities	-Authentic scientific problems -One-to-one scaffolding -PD for scaffolding	• Advantages of blended design • Online teacher discussions and flexibility
Bey (2012)	Dissertation/empirical: Case study, interviews, observations, and document analysis (two administrators and four teachers)	Not specified	-Negative and positive characteristics of teacher technology PD programs -Which knowledge and skills from IWB PD activities are perceived as beneficial by teachers for teaching	• Too short technology training is inadequate • Additional training is needed on content and embedding technology in teachers' pedagogy • Teachers learned more by themselves from tutorials, videos, peer-to-peer collaborations, peer-coaching, and sharing. • Hands-on time with technology is necessary
Borko et al. (2010)	Review: Six research reports	N/A	-High-quality teacher PD	• PD should be: practice-based, focus on student learning, and collective • Communities of practice and follow-up support are critical
Boyle et al. (2004)	Empirical: Questionnaire, 60 schools (primary and secondary)	Blended classes + mentoring, observation, and sharing practice	-Relationship between the characteristics of PD and change in teaching practice	• The most popular PD activities: observation of colleagues and sharing practice • Longer term PD changed one or more aspects of teaching practice
Collins and Liang (2014)	Empirical: Q methodology (ranking of each sort item relative to the other items; 13 in-service educators)	Online PD	-Which tasks in an online professional development module were ranked by in-service educators as relevant to their work	• Tasks on applications of classroom instructional techniques to be more relevant • Videos of experts telling information, printable downloads, and so forth found to be more relevant • Learners' diverse needs should be considered
Curwood (2011)	Empirical: Case study, 2 schools, 11 English teachers, and 2 library media specialists	Technology-focused learning communities (not specified)	-What makes technology-focused professional development effective?	• PD for effective technology integration should offer "sustained dialogue around teachers' curricular goals and students' learning outcomes; hands-on learning with digital tools; … and a view of knowledge as a social construction" (abstract)
Curwood (2013)	Empirical: Design framework, five teachers	Not specified	-Analysis of using the design framework to identify key practices within the learning community	• Planning PD activities that communicate teacher beliefs and practices and assess the effectiveness of lessons • Informal PD learning communities can connect teachers to university experts in content domains and in pedagogy
Curwood and Cowell (2011)	Empirical: Field notes, digital productions, interviews, 2 10th grade students	Not specified	-Potential ways for students to engage with the digital tools available in a high school multimedia lab	• Technology relates to content and pedagogy • In PD design, teachers' own experience, values, and beliefs should be taken into account

(Continues)

TABLE 1 (Continued)

Article reference	Type of article/method	Form of delivery	Subjects studied	Position of the article
Dash et al. (2012)	Empirical: Randomized controlled trial, 79 teachers from 12 states	Online: Three mathematics courses	-Impact of online PD (fractions, algebraic thinking, and measurement) on teachers' pedagogical content knowledge and pedagogical practices	• Analyses of students' work and peer-to-peer discussions were valuable in learning community model • Intensive, sustained, and content-focused online PD can affect positive change in teachers' pedagogical content knowledge and pedagogical practices
Dede et al. (2016)	Book	Online PD	-An overview of effective online PD models	Key factors of effectiveness: • Sustaining over time and diverse resources • Effective learning communities
Dede et al. (2008)	Review: 40 empirical researches	Online PD	-Key online teacher PD areas in need of research	• Types of reflection opportunities provided by asynchronous interactions encourage the contributions of teachers who tend to be silent in face-to-face situations
Dede, 2006	Book	Online	-Exemplary online professional development programs	• Online PD offer teachers time flexibility, access to experts and resources not available locally, and work-embedded support
DeSantis (2012)	Review	N/A	-Promising PD practices for educators on how to use IWBs effectively	• Effective technology PD: Builds efficacy by scaffolding the instruction of new tasks, establishes collaborative technology culture, and includes positive and student-centred supervision
Desimone (2009)	Theoretical	N/A	-Core conceptual framework for studying the effects of PD on teachers and students	• Both teachers' individual activities and their engagement with the online environment are integral for effective PD • Content focus, active learning strategies, duration, contextual factors, and collective participation are critical
Garet et al. (2001)	Empirical: A formal causal model, probability sample of 1,027 mathematics and science teachers	Face to face	-The first large-scale empirical comparison of effects of different characteristics of PD on teachers' learning	• PD that has positive effects on teachers' knowledge and skills: focuses on content knowledge, employs active learning opportunities, and coherent with other learning activities. • Form of the PD activity, collective participation of teachers, and duration are important
Gerard et al. (2011)	Review: Studies on PD in technology-enhanced science	Technology PD	-How PD enhances teachers' support for students' inquiry science learning	• Providing teachers with classroom applications and good technology integration examples helps in building technical efficacy and to improve teachers' PD experiences
Guskey (2003)	Review: 13 lists of the characteristics of effective PD	Not specified	-Have researchers and practitioners reached consensus about what factors contribute to a successful PD?	• For Effective PD: Focus on content and pedagogical knowledge, time must be well organized, structured collaborative work among teachers, and collaborative efforts between site-based educators and district-level personnel

(Continues)

TABLE 1 (Continued)

Article reference	Type of article/method	Form of delivery	Subjects studied	Position of the article
Han (2014)	Theoretical: Best PD on social competence for early childhood teachers	Not specified	-Key components of best PD on social competence for early childhood teachers	• Best PD: Content should be based on participants' contextual needs, PD aligned with the positive behaviour support framework, providing opportunities for feedback on implementations, guided reflections, embracing socio-cultural perspectives throughout the PD
Holland (2001)	Empirical: Case study exploring three assumptions	Technology PD	-Teachers developmental levels of knowledge and skills in applying technology in classroom	• Staff development for instructional technology needs to be based on best practices for teacher PD • Teacher PD on technology can serve larger goals of school reform
Holmes et al. (2005)	Practice-based theory–A blended model	Blended technology PD	-Exploration of different dimensions of CATIE: A high-resource model to sustain technology-rich learning communities	• Blended PD models -offer teachers and schools more independence -have been found to help teachers develop a positive effect toward and beliefs about technology integration
Lawless and Pellegrino (2007)	Review: 21 research articles	Technology PD	-What is known and unknown about PD to support technology integration in teaching and learning	• Tech-PD activities should include many contact hours that are spread out over time, allowing for follow-ups and consistent feedback • For tech-PD to be effective, strong alignment between the technologies available during the PD and those available in classrooms is necessary
Liu and Kleinsasser (2015) • Administration support and peer collaboration empowers teachers learning to teach with technology.	Empirical: Case study, two schools, 6six teachers	Blended tech-PD	-What factors facilitate or hamper teacher professional learning and technology use?	
O'Dwyer et al. (2007)	Empirical: 26 teachers, teacher surveys, and student achievement measures	Online PD	-Students' experiences in online and traditional classrooms	• Characteristics of the online learning environments (fully or as part of a hybrid model) • The most rewarding part of the PD for local teachers reported as having the online teacher available as a resource for content-related questions and collaborating students learning
Owston et al. (2008)	Report: A synthesis of three program evaluations	Blended PD	-Development of community, changes in teacher practice, and impact on students	• The blended PD provided teachers opportunity for learning on the job and collaborating with other teachers; influenced classroom practice and student learning in some extent; and is a viable model for teacher PD
Penuel et al. (2007)	Empirical: 454 teachers, hierarchical linear modelling, teacher survey	Blended PD	-Effects of different characteristics of a PD on teachers' knowledge and their ability to implement the program	• Critical factor of a PD program for teachers is how coherent the PD experiences for their learning • Proving time for teachers to plan for implementation and provision of technical support promote implementation

(Continues)

TABLE 1 (Continued)

Article reference	Type of article/method	Form of delivery	Subjects studied	Position of the article
Polly and Hannafin (2010)	Review	Not specified	-PD factors related to improvement in teachers' use of learner-centred methods and in student learning	• Learner-centred PD principles: focus on student learning, teacher-owned, develop knowledge of content and pedagogies, collaborative, and ongoing, reflective
Rives (2012)	Dissertation/empirical: Mixed methods, 14 teachers	Technology PD-address ISTE and NETS-T standards	-The effectiveness of a PD approach in increasing the knowledge and use of instructional technology by elementary teachers	• Use of a professional learning community is advantageous • Additional needs for increased education, time, and support in the area of technology integration
Twining et al. (2013)	Main outcomes of EDUsummIT 2011 (technical working group on teacher PD): 21 participants representing 14 different nationalities	Both	-How PD may ensure that teachers are better prepared to use ICT to promote 21st century learning	• Effective teacher PD requires political, institutional, and individual changes • Some key features of PD for better achievement: observation of teaching; feedback to teachers; use of external expertise; and sustaining PD over time; and so forth • Need for PD to be collaborative, experimental and reflective
Unger, K. (2012)	Dissertation	Not specified (Tech-PD)	-The factors of tech-PD that the teachers perceived to be most beneficial	• Beneficial design factors for quality tech-PD: Relevant and contextual learning, incorporate instructional strategies to address any negative attitudes and beliefs, incorporate both individual and collaborative learning activities, clear and easy, and expert instructor
Unger, K. L., and Tracey, M. W. (2013)	Empirical: Qualitative multi-case research study	Not specified (Tech-PD)	-The factors of tech-PD that the teachers perceived to be most beneficial	• Beneficial factors for effective technology curriculum for adult learners: Relevant, learning, access, reactions, interactions, clear and easy, and instructor
Wells (2007)	Report: Evaluation of the PD process used by Trek 21 project	Technology PD	-Key design factors for durable change in teacher practice	• To be effective PD should: -be evaluation-driven, contextual, learner centred, inquiry-based, theory/research-based, collaborative, and sustainable -continue for adequate content contact time, involve active learning strategies, and employ long term, continuous pedagogical, technical, and social support

Abbreviations: CATIE, Capital Area Technology and Inquiry in Education program; ICT, information and communications technology; ISTE, International Society for Technology in Education; IWBs, interactive white boards; NETS-T, National Educational Technology Standards for Teachers; PD, professional development.

experiences (Collins & Liang, 2014). Sustained dialogue and collaboration with colleagues are common ways to promote teacher reflection, allowing teachers an opportunity to consider what they have learned about technology, how their learning impacted their instructional practices, and how student learning has been affected through those dialogues (Curwood, 2011). According to Curwood and Cowell (2011), new literacies differ markedly from old literacies. The authors describe playing video games, modifying wikis, and creating podcasts as being among the new literacy practices and note that such practices tend to be more collaborative and, by nature, require a heightened level of participation (Curwood & Cowell, 2011). Incidentally, several studies have found that PD that includes peer collaboration and active, hands-on learning experiences are more effective for preparing teachers to integrate technology into their classroom practices

(Barrett-Greenly, 2013; Curwood, 2011; Davis et al., 2009; DeSantis, 2012; Gerard et al., 2011; Jones, 2001; Lawless & Pellegrino, 2007; Liu & Kleinsasser, 2015; Tweed, 2013; U.S. Department of Education, 2010; Unger & Tracey, 2013; Walker et al., 2012; Wells, 2007).

3.1.3 | Duration

Several studies have reported on the importance of the duration of PD activities, both in terms of time span and in contact hours, for ensuring effectiveness (Bey, 2012; Boyle et al., 2004; Dede et al., 2016; Desimone, 2009; Garet et al., 2001; Guskey, 2003; Owston et al., 2008; Penuel et al., 2007; Polly & Hannafin, 2010; Twining et al., 2013). Similar to other types of PD, PD that is focused on technology integration should be sustained over time (Carlson & Gadio, 2002; Davis et al., 2009; DeSantis, 2012; Gerard et al., 2011; Lawless & Pellegrino, 2007; U.S. Department of Education, 2010; Wells, 2007). For PD specifically aimed at preparing teachers to effectively integrate technology into their teaching practices, Gerard et al. (2011) recommends that the duration be extended to at least one academic year to maximize teachers' exposure to new technologies and their uses. According to Lawless and Pellegrino (2007), technology-related PD activities should include many contact hours that are spread out over time, allowing for follow-ups and consistent feedback. Carlson and Gadio (2002) recommend that technology integration PD be carried out over at least 80 contact hours. Lastly, in organizing effective PD activities, it is important to remember that an increase in duration alone does not guarantee effectiveness; instead Guskey (2003) argues that "time must be well organized, carefully structured, and purposefully directed" (p. 749).

3.1.4 | Role of context: School environment, teacher needs, and the administration

Contextual factors such as teacher schedules, school budgets, available materials, and school philosophies can either be supportive of the implementation of PD and their effects on teaching for teaching and learning or can act as barriers (Desimone, 2009; Han, 2014; Mak & Pun, 2015; Patton et al., 2015; Penuel et al., 2007; Whitworth & Chiu, 2015). As such, the context within which teachers teach should be considered when planning PD activities to help ensure that teachers are provided with opportunities that are tailored to local or regional needs, thereby promoting teacher buy-in (Dede et al., 2016; Han, 2014). Several studies on effective technology integration emphasize the importance of contextual factors. For example, creating conditions where teachers can receive adequate support from their administration, such as in the form of minimized curriculum scheduling and exam pressures, further bolster the positive effects of technology integration PD (Liu & Kleinsasser, 2015). In addition, effective technology PD is aided by school-wide learning culture and the school's coherence with national policies and curriculum standards (Gerard et al., 2011; Somekh, 2008). Lawless and Pellegrino (2007) argue that for technology integration PD to be effective, there must be a strong alignment between the technologies available during the PD activities and those available in teachers' classrooms.

3.2 | Implication of core features in effective technology integration PD

PD that aims to prepare teachers to integrate technology into their classrooms should embody the core features that we described in the previous section (DeSantis, 2012; Holland, 2001; Lawless & Pellegrino, 2007; Liu & Kleinsasser, 2015; Palak & Walls, 2009; Rives, 2012; Twining et al., 2013; Unger, 2012; U.S. Department of Education, 2010; Walker et al., 2012; Wells, 2007; Unger & Tracey, 2013; Tweed, 2013). In the following section, we describe a set of additional features that provide particular benefits for PD aimed at helping teachers integrate technology into their teaching practices.

Previous research has found that effective technology integration PD requires specific practices beyond those already described (DeSantis, 2012; Holland, 2001; Lawless & Pellegrino, 2007; Liu & Kleinsasser, 2015; Palak & Walls, 2009; Tweed, 2013; Twining et al., 2013; U.S. Department of Education, 2010; Unger, 2012; Unger & Tracey, 2013; Walker et al., 2012; Wells, 2007). This section elaborates on details of how effective technology PD is to support core features, which also embodies distinct specific practices: learner centred, relevant to practice, incorporate teachers' evaluation of student work, follow a constructivist design and include support, follow-up, student involvement, and an initial implementation under the guidance of teacher leaders.

3.2.1 | Learner-centred design

Wells (2007) examined 10 design factors for an effective instructional technology PD model and subsequently identified five elements that are effective for promoting changes in teacher practice, three of which we have already discussed (active participation by teachers, duration of PD, and collaborative work). One of the remaining two recommendations is that teachers' PD experiences should be learner centred. Wells defines learner-centred PD as being "designed around participant concerns, needs, and interests" (p. 106). According to Unger and Tracey (2013), learner-centred instruction during a PD activity should involve teachers in all decisions regarding technology use and implementation, with the goal of leading to positive changes in teachers' attitudes toward technology integration. Likewise, Beauchamp et al. (2015) found that teachers' involvement in the learning process can be supported by providing a space for "learning networks run by teachers" within the PD experience. To bolster teachers' involvement, Curwood (2013) recommends creating a mission statement for the PD activities that focuses on teachers' goals for their students in terms of skills, values, knowledge, and attitudes.

3.2.2 | Relevance and reflection

Several studies provide support for using real-world technology integration case studies to help teachers understand the relevance of their newly acquired skills and knowledge for their classroom practices (Barrett-Greenly, 2013; Carlson & Gadio, 2002; DeSantis, 2012; Gerard et al., 2011; Polly & Hannafin, 2010). For example, studies by DeSantis (2012), Unger and Tracey (2013), and Gerard et al. (2011) each found that providing teachers with classroom applications and good technology integration examples help building technical efficacy and to improve teachers' PD experiences, especially during the early stages of technology integration. DeSantis recognizes building technical efficacy as one of the essentials of effective PD for teachers with different levels of confidence, skill, and beliefs about technology. The author then argues that PD designers can help build teachers' technical efficacy by introducing "new concepts one at a time" and by also providing adequate opportunity for teacher reflection. It is further recommended that after introducing each function, PD facilitators then ask teachers to reflect on how they may apply these newly learned concepts to their own classrooms. Subsequently, they should be given time to actually use the tool in their classroom, and this should be followed by group reflections on the successes and failures of their implementations.

3.2.3 | Evidence of student learning

Curwood (2011) found that having teachers examine student work may act as a catalyst for teachers' technology integration and that sharing student work within the professional learning environment may increase both teaching quality and student learning. Moreover, providing opportunities for teachers to share their students' work within the learning community helps teachers to make connections between their stated intentions and eventual student outcomes (Curwood, 2013). According to Gerard et al. (2011), PD activities may lead to positive changes in instruction through directing teachers' focus to their student ideas on particular subjects and how those ideas are connected to classroom instruction, a process researchers refer to as "inquiry investigations." The authors also argue that when teachers learn new ideas or information in such a way that the material seems disconnected from practice, for instance, via video or presentation, that knowledge is mostly isolated and easily forgotten; however, when new knowledge is connected to teacher practice through evidence of improved student outcomes, the newly learned information becomes more compelling, more easily retained, and, thus, more useful for improving pedagogical practices.

3.2.4 | Support and follow-up

The term "support" has a broad meaning when we use it in relation to technology integration PD; within this context, support refers not only to the types of contextual support teachers receive from administrators and parents, described in the section regarding core features of effective PD, but also to the technology support and follow-up support received during implementation (Barrett-Greenly, 2013; Bey, 2012; Jones, 2001). As it relates to technology integration PD, Wells (2007) defines support as "long-term, continuous, pedagogical, technical, (and) social assistance" (p. 106). Rives (2012) also recognizes the importance of ongoing support for effective technology integration PD experiences. In his study on IWBs, DeSantis (2012) criticized PD models in which technology experts demonstrated the basic uses of certain technologies without further providing the needed support for teachers as they began to translate their PD experiences into real-world classroom practice. The author argues that this approach is ineffective and instead suggests a model in which teachers are given both the time and autonomy to build their technical efficacy and are provided with on-demand support during the implementation phase. Holland (2001) recommends that teacher support takes different forms depending on teachers' level of technology integration stage (as cited in Unger, 2012, p. 25). Although early stage teachers are likely to need more administrative support and support for integrating technology into their classrooms, teachers in higher stages are likely to need more nuanced types of supports, such as technology and peer support for planning integration.

3.2.5 | Student voice/involvement

Beauchamp et al. (2015) urge designers of technology integration PD to consider how contemporary technologies have changed the formation and maintenance of relationships in classrooms. Similarly, in Onguko's (2014) examination of a blended learning approach (which is called as *JiFUNzeni*) in two African locations, one of the important components of effective technology integration PD was found to be the involvement of teenage students in the instructional design processes, not only for content generation but also for supporting the PD tutors for technology stewardship. The author reports that the quality of the PD course content was much higher when there was involvement of students in the instructional design process, and he further argues that parents and teachers ought to learn from the new generation in terms of technology applications and how to teach students technology-related skills. Because most students come to the classroom with technological savvy (Gawelek, Spataro, & Komarny, 2011), 21st century students may be more advanced users of technologies than their teachers. According to Beauchamp et al. (2015), this situation changes the relationship between teachers and students in the classroom; when it comes to technology and the teaching of technological skills, the students now become the teachers and the teachers become the learners. For such situations, recent studies on technology integration claim that student opinions about the use of different technologies in the classroom can be very beneficial (Rives, 2012). As such, PD programs that focus on technology integration may want to consider encouraging student involvement.

3.2.6 | Initial implementation with teacher leaders

As a way to further support teachers' uptake of the knowledge and skills acquired during technology integration PD, Tweed (2013)

recommends rolling out new technologies in stages, starting with a pilot program for teachers who already have high self-efficacy and are willing to implement technology applications in their classrooms. Subsequently, these "teacher leaders" can serve as "coaches" for other teachers as the technology integration program expands. Tweed reports a significant correlation between teacher self-efficacy scores and their technology use in the classroom and suggests that teachers with lower self-efficacy can benefit from seeing their more self-efficacious colleagues' successfully implement new technologies in their respective classrooms. Moreover, offering activities for teachers to mentor other teachers (train-the-trainer) increases the relevance of the PD material and further helps them making connections about how to integrate such material into practice (Rives, 2012).

4 | DISCUSSION

4.1 | Suggested model

A flipped model for PD is a relatively new approach to in-service teacher education and has been investigated by only a limited number of studies (e.g., Conley, 2013; McDonald & Smith, 2013; Razak, Kaur, Halili, & Ramlan, 2016). In this model, learning resources on the basis of learner needs are located on an online platform and learners access the materials and watch videos on their own time. Then, the face-to-face learning sessions are devoted to engagement of learners in the application of content (McDonald & Smith, 2013). Teachers who participate in PD activities embrace different approaches to use and accept technology as a teaching tool (Conley, 2013), and their technology skills and level of technology use in their classrooms differ. Thus, Conley (2013) suggests that availability of resources any time through an online system will allow for personalized learning and timing, and teachers can reach a desired skill and knowledge levels when they attend the face-to-face sessions in the flipped PD model. The model suggested here offers a combination of flipped classroom strategies with effective technology integration PD strategies given in the previous sections. In the following paragraphs, we describe the components and features of the technology integration PD model (Figure 1) that we recommend based on our review of the literature on effective PD and prior work in flipped PD. The model we propose includes elements that support teachers' readiness to successfully integrate technology into their classrooms. Moreover, we suggest that teachers should be involved in all processes and decisions during the application of this model to increase teachers' ownership (Polly & Hannafin, 2010). For instance, although PD activities might include content relating to various technology applications, all decisions relating to which technologies will be used by each teacher should be led by teachers' preferences.

The online modules and asynchronous online discussion forums in the proposed model (See Figure 1) will allow teachers the opportunity to have thoughtful interactions and reflection, as well as provide teachers with increased flexibility and accessibility for personal learning (Conley, 2013; Dede et al., 2008; Owston et al., 2008). Additionally, the proposed PD design supports teachers' development of technical skills through practice with new and available technologies in their particular subject areas (Figg & Jaipal-Jamani, 2013). At the same time, teachers should be provided with technical support in their schools, and district mentors and teacher leaders should provide instructional support as teachers begin to implement in their classrooms. In the following sections, we describe this model in more detail.

4.1.1 | PD activities for district mentors/teacher leaders

Although several studies promote the use of school- or site-based PD models (Davis et al., 2009; Owston et al., 2008; Putnam & Borko, 2000), Guskey (2003) argues that school-based options are limited because they do not include district-level contributions. According to Guskey, collaborative efforts between site-based and district-level educators bring together contextual needs with broader perspectives, thereby providing a more holistic view point and thus delivering a more effective PD experience to teachers. As such, in the proposed model (Figure 1), we suggest a system developed by PD organizers where district mentors/teacher leaders attend activities organized by experienced educators and technology professionals. Trainees will learn how the PD system works and gain valuable hands-on experience, practicing with new and available technologies. Upon finishing, district mentors/teacher leaders will return to their respective schools and conduct PD activities for the other teachers in school. Given research suggests that PD activities led by classroom teachers are highly effective (Penuel et al., 2007); school-based face-to-face sessions will be conducted by teacher leaders or district mentors with the support of PD organizers. Further details regarding the importance of face-to-face sessions and their implementation are presented immediately below.

4.1.2 | Ongoing face-to-face sessions followed by online discussions

Ongoing "face-to-face sessions" for teachers are an integral part of the proposed model (Figure 1). These sessions will allow immediate communication and feedback opportunities among teachers and teacher leaders/district mentors, which have been reported as major advantages of face-to-face learning environments (Yurtseven-Avci & Vasu, 2015). In the flipped model, learners study the materials and watch videos on their own time; in the face-to-face sessions, time will be devoted to active and collaborative learning activities and discussions (Hamdan et al., 2013; McDonald & Smith, 2013). On the basis of the suggestions from DeSantis' (2012) study with interactive whiteboards, the model described here, in ongoing face-to-face sessions, teachers will discuss with teacher leaders/district mentors about which technologies to use in their classroom and how to use them, to acquire important technical skills, and to make instructional design for classroom applications. The face-to-face sessions would be organized in a way that ensure teachers' active participation (Borko

et al., 2010; Desimone, 2009; Garet et al., 2001; McDonald & Smith, 2013; Penuel et al., 2007). Specifically, teachers' participation would be encouraged by first having them observe exemplar classroom applications, having them plan teaching strategies for their classroom applications, and subsequently apply what they have learned in their classrooms (Desimone, 2009; Garet et al., 2001). To encourage ongoing engagement, these in-person sessions should be distributed throughout the school year (i.e., once a month or every 6 weeks) rather than being held once a year, such as during an intense summer institute (Owston et al., 2008; Rives, 2012). In this way, teachers would have time to apply new knowledge and skills throughout the instructional process, while also receiving ongoing feedback about their progress from teacher leaders/district mentors and PD organizers.

Between each face-to-face PD session, teachers would be asked to apply what they planned during the face-to-face session and share their classroom materials and student assignments with colleagues through the virtual system for ongoing dialogue to improve student learning. However, teachers would not be expected to learn and apply the use of all the technologies they learned through the online modules; instead, they will be encouraged to develop unique applications for their teaching area, choosing particular technology applications. In addition, teachers would be asked to record some of their instructional practices or student work and then share these materials with the rest of the teacher participants, teacher leaders/district mentors, and PD organizers. Then, an online discussion will be held on teachers' sharing.

4.1.3 | Online modules

A strong focus on content is one of the most important components of an effective PD program (Curwood, 2011; DeSantis, 2012; Desimone, 2009; Garet et al., 2001; Gerard et al., 2011; Penuel et al., 2007; Unger, 2012; Unger & Tracey, 2013). To build content knowledge across multiple subjects and different technologies, in the proposed model, online modules first should include short videos on different contemporary technology applications and content on the basis of the context and learner needs. Videos can be prepared using widely available software, tablets, smartphones, and video cameras (McDonald & Smith, 2013). McDonald and Smith (2013) also suggest that educators can employ existing instructional materials such as recorded conference presentations or workshop sessions in a flipped learning design.

In the "grounded tech integration" approach, Harris and Hofer (2009) point to preparing teachers to make appropriate pedagogical decisions and select instructional activities, tools, and assessment techniques as being crucial elements of effective technology integration. Researchers also suggest that teachers benefit from being introduced to the theories behind educational technology and its applications and point to the impact of teacher awareness and beliefs on instructional practices (Desimone, 2009; Ertmer et al., 2012; Ertmer & Ottenbreit-Leftwich, 2010). Therefore, in the proposed model, pedagogical modules also should be included such as general educational theories, the history of educational technology, why to use technology in education, and selection of instructional materials. Additionally, particular topics such as classroom management and assessment techniques should be included. One of the affordances of a virtual learning environment is the flexible delivery of information, allowing participants to learn at their own pace (Unger, 2012). Both teachers' individual activities and their engagement with the online environment are recognized as an integral dimension of effective PD (Desimone, 2009).

4.1.4 | Classroom applications

According to Belland et al. (2015), one important component of effective teacher PD is having teachers apply new ideas in their classrooms. Additional studies provide support for having this authentic PD experience and also acknowledge that many traditional PD programs fail to provide teachers with opportunities to make connections between PD content and teachers' everyday experiences (Unger, 2012). In an effort to address this concern, the model we propose emphasizes real-world classroom applications as a way to help teachers appreciate what they are learning in their PD experience while also helping them to connect the material to their actual teaching activities. In the proposed model, teachers will be asked to apply some of their newly acquired knowledge and skills in their classroom. Teachers might be asked to use a new or modified teaching method or to use a technology-enhanced approach for assessing students' performance. Furthermore, we recommend that teachers be asked to complete short-term, one-task-at-a-time types of applications. Because technical and instructional obstacles were often reported during technology integration, especially in the first year (Gerard et al., 2011), short-term applications will help teachers to confront possible problems on a smaller scale and in a more manageable fashion. As such, these experiences may prevent larger frustrations while also preventing teachers from worrying about future integration challenges.

Following classroom applications, teachers would then be asked to share any record of their applications or student work artefacts with peers and organizers throughout the PD system, either during face-to-face sessions or virtually. Regardless of how teachers' experiences are initially shared, follow-up discussions could be conducted through the online platform in an effort to generate additional ideas for successful classroom applications (DeSantis, 2012; Desimone, 2009) and to also provide adequate opportunities for personal and professional reflections.

4.1.5 | Student involvement

Recent studies on technology integration recognize the importance of student opinions and suggestions about the technology integration process for improving technology integration practices (Ertmer et al., 2012; Rives, 2012). Several studies report that students have a considerable level of knowledge and skill regarding new technologies and digital media and also have significant experience with locating and sharing information using those technologies (Barrett-Greenly, 2013; Gawelek et al., 2011). As a result, students often become proficient with the new technology more quickly than their teachers. According

to Barrett-Greenly (2013), this situation may create a role reversal within the classroom, where teachers can learn from their students. Despite students often having stronger technology skills than their teacher, the teacher is the one who is knowledgeable, experienced, and who has expertise in the particular content area. Thus, it remains the teacher's role, with the help of PD, to guide students on how to use their technology skills to build their knowledge. As a result, the integration of technology into the classroom may create a learning environment that is not only new and different but is also more engaging and productive and one in which everybody can learn from each other. To reach this point, it is critical that teachers are exposed to exemplar applications of technology in the classroom and develop basic technology skills that will allow them to guide their students. With the model we suggested, teachers would acquire those skills and gain the requisite experience at a manageable pace. Additionally, after the classroom applications, teachers can collect feedback from students by administering online surveys or questionnaires through the virtual system. This information can subsequently be used to help shape teachers' instructional design development.

4.1.6 | Technical and follow-up support

Several studies have found that teachers require ongoing support and follow-up so that the knowledge they acquire through their PD activities translates into successful changes in their instructional practices (Barrett-Greenly, 2013; Dash, Magidin de Kramer, O'Dwyer, Masters, & Russell, 2012; DeSantis, 2012; Jones, 2001; Rives, 2012; Unger & Tracey, 2013; Wells, 2007). Furthermore, studies on technology PD have found that teachers are likely to face technical and instructional obstacles to integration, especially in the first year of application (Gerard et al., 2011). Some studies also claim that follow-up sessions should be one-to-one (e.g., Zhao & Bryant, 2006) and conducted by qualified personnel (Barrett-Greenly, 2013), and support efforts are most effective when they provide trainees with model scenarios for common problems (Barrett-Greenly, 2013). For the model we suggested, getting administrative support in schools comes first to help teachers feel not lonely through the process of technology integration in their classrooms. This type of support should be ensured by the PD organizers by contacting school administration at the beginning of PD activities and provide them awareness seminars. On the other hand, to help for technical and instructional issues, qualified personnel in the PD organizing team will follow-up with teachers during their classroom applications. In some schools, this support can be provided by district mentors/teacher leaders depending on the number of teachers and their needs. For some of the common problems faced by teachers, there will be sections in the online models such as answers to frequently asked questions, short videos about solutions to some technical problems, and suggestions for instructional obstacles. Additionally, teachers will be asked to talk and discuss about the challenges they faced during the face-to-face sessions and online forums with educators and their colleagues. In this way, some solutions will appear as a result of collective participation.

4.1.7 | Additional considerations

The context and culture within which teachers' work are critical for successful technology integration (O'Dwyer, Russell, & Bebell, 2004; Ertmer & Ottenbreit-Leftwich, 2010; Gemeda et al., 2014; King, 2014). O'Dwyer et al. (2004) found that school and district leaderships as well as policies related to technology are among the important factors related to teachers' use of technology in the classroom. For example, school administrators and district-level educational leaders play an important role in the planning and support of teachers' technology integration PD activities (Whitworth & Chiu, 2015). Moreover, it is important that administrators have a shared understanding and appreciation for the new teaching practices that teachers are likely to apply when successfully integrating technology into their classrooms (Jones, 2001). Other research has pointed to the importance of teachers' schedules, technology access, budget for teaching materials (Penuel et al., 2007), and support from the broader community (Mak & Pun, 2015; Whitworth & Chiu, 2015). In fact, Whitworth and Chiu (2015) argue that these factors are of so much importance that they should be seen as central elements of teachers' PD experiences and should, thus, be handled accordingly. In an effort to address these issues, our model includes awareness sessions for administrators aimed at helping them understand the new teaching strategies that may be used in classrooms and to also ensure their support for more successful technology integration (Carlson & Gadio, 2002).

Positive teacher beliefs and attitudes toward technology integration have been recognized as another essential element for sustaining teachers' engagement with PD activities and for also translating newly acquired skills into classroom applications (O'Dwyer, Russell, & Bebell, 2004; Ertmer & Ottenbreit-Leftwich, 2010; Ertmer et al., 2012; King, 2014). Ertmer et al. (2012) suggest that to support teachers' development of positive beliefs and attitudes toward technology integration, it is necessary to increase teachers' knowledge and skills, especially for the technologies to which they have access in their classrooms. Our model of technology integration PD recommends that PD activities should begin by identifying teachers' needs on the basis of their context. More specifically, we recommend that PD activities be tailored to the technologies teachers have access to and should begin by identifying teachers' beliefs and attitudes about technology integration in their particular context. This information would then ideally be used to shape the content of the face-to-face sessions and online modules.

While acknowledging that it typically takes a long time to observe changes in beliefs, attitudes, and practice (Bebell & Kay, 2010), the theoretical knowledge and practical classroom applications provided through the online modules in our model aim to improve teachers' beliefs and attitudes toward technology integration in a measured fashion. As a result, PD activities under our design will include modules on topics reported to play key roles in shaping teacher practices, such as student-centred learning, role of educational technology in student learning, and problem solving. Furthermore, module content could be tailored to teacher profiles, covering additional topics such as the history of educational technology, nature of knowledge and

learning, and conceptions of teaching (Kim, Kim, Lee, Spector, & DeMeester, 2013). Kim et al. (2013) suggest that negative beliefs come from negative experiences. Thus, it is important to consider the design of PD models and the degree to which it affords trainees an opportunity to positively interact with technology. If teachers can be provided opportunities to have positive experiences with technology, they will eventually develop positive beliefs. Observation, practice, reflection, and social cultural support are often cited as key strategies that can lead to change in teacher beliefs (Kim et al., 2013). We note that these strategies are already included in the suggested model through the use of online modules for observing good technology practices, classroom applications, virtual discussions, and the support system.

Previous research has found that negative beliefs and attitudes typically come from fear and feelings of discomfort with using technology (Ertmer et al., 2012). According to DeSantis (2012), if teachers learn basic technology skills step by step in a sustainable manner, it will help them build the self-efficacy needed to successfully integrate technology into their classroom and instructional practices. We therefore suggest organizing face-to-face sessions in ways that allow teachers to learn new skills gradually and make the material relevant to their teaching practices and situational needs. The constant follow-up and support aim to reduce discomfort they feel and building self-efficacy. Ongoing discussions will help in building a "community of practice" instead of loading new information into their minds without making use of it. At the time, online modules on theoretical background of technology integration, classroom management tips, and so on will provide the background to build positive beliefs and attitudes towards using technology in their classroom. Table 2 summarizes how each dimension of the proposed flipped PD model aligns with the effective tech-PD strategies that are coming from the reviewed studies.

5 | RESEARCH IMPLICATIONS

Our study, being of an exploratory and interpretive nature, raises new opportunities and new questions for future research. It has also

TABLE 2 Summary of how proposed flipped PD model aligns with effective technology professional development strategies

Suggested flipped PD model	Effective tech-PD strategies					
	Learner-centred design	Relevance and reflection	Evidence of student learning	Support and follow-up	Student involvement	Teacher leaders
A train-the-trainer model	Bring together contextual needs with broader perspectives	Increases the relevance of the PD material and helps connection such material to practice		Teacher leaders return to their respective schools and conduct PD		Volunteer teachers with high self-efficacy receive training first
Ongoing face-to-face sessions followed by online discussions	One-to-one instructional design and hands on learning	Acquire important technical skills Immediate communication and feedback opportunities	Teachers' share of classroom applications and student work through virtual system	Asynchronous dialogues with PD organizers and colleagues	Involvement of student opinions in the instructional design processes	Face-to-face sessions by teacher leaders with support of PD organizers
Online modules	Flexible delivery of content allowing participants to learn at their own pace	Content on the basis of the context across multiple subjects and different technologies	Short videos on successful technology integration applications	Supporting teachers with content-based and pedagogical modules	Classroom management and assessment techniques for the changed relationships	Trainers would learn how the virtual PD system works
Classroom applications	Short-term/small task applications help teachers to confront possible problems on a smaller scale	Sharing record of their applications or student work artefacts with colleagues and educators for sincere reflection	Sharing actual student work face to face or online for deep discussions	Classroom observations by PD organizers for genuine feedback	Make use of students' tech skills and collect feedback from students after the classroom applications	
Additional considerations	Identification of teacher needs on the basis of their context and technology access	Pedagogical modules such as why to use technology to build positive teacher belief and attitude		Awareness sessions for administrators to ensure their support		

Abbreviation: PD, professional development.

theoretical and practical implications. Definitely, further research will be necessary for empirical investigation of impacts of application of a flipped model on teachers' professional learning and student outcomes.

First, we believe we have generated an informative list of PD characteristics that aimed at helping teachers integrate technology into their teaching practices. Even if there is almost a consensus on core features of effective PD (content focus, collective participation and active learning, duration, and role of context), our work is original in terms of particularly investigating implications of those core features in effective technology integration PD. On the other hand, our study could be extended to examine the relationship and correlations between the refined characteristics of technology integration PD.

Second, our study offers a design model (flipped PD model) for technology integration PD with multiple aspects. It would require a long-term research to see this model in action with all different aspects taken into account. For example, the idea of starting with teacher needs and interests for determination of content will need further elaboration in terms of new dynamics to be inclusive for all participants.

6 | THINGS TO BE CONSIDERED

It can be hard to find appropriate, ready-to-use exemplar videos on contemporary technology applications for every content area and sensitive to the various instructional cultures of different countries. This can also be an issue for the instructional videos, which is an essential part of flipped learning. A strong research team (PD organizers) should be formed for content creation and that team should work experts from different content areas closely.

It is not always easy to initiate and maintain fruitful online discussions. PD organizers should be aware of the characteristics of the PD participants and develop strategies to encourage virtual participations.

7 | GUIDELINES FOR PRACTITIONERS OF THE PROPOSED MODEL

Proposed PD model suggests that PD organizers should contact with the teacher participants during the planning stage, so that to identify their needs/beliefs/interests and technology access. Thus, teachers would be involved in all decision processes starting from the content of PD. For instance, technologies could be determined that participant teachers need in their classroom and/or technologies that appeal to their interest. This way, the technologies that will be included in the PD activities could be identified based on the predata. Another critical point for teacher involvement is starting PD activities with teacher leaders who were currently actively teaching in actual classroom and following contemporary technology applications. Hence, teachers would feel more connected. Teacher leaders might share exemplar classroom applications with the participant teachers, which could help them to feel those applications are relevant and doable.

Online modules and interactions are very critical in a flipped PD model. Modules should include not only technology content but also pedagogical ideas especially for technology integration related to the particular field. Also, content-specific exemplar classroom videos should be part of the modules. The content for each piece might be shaped based on the need assessment that could be conducted at the beginning. On the other hand, online discussions should be well organized. For instance, discussions can be organized between teachers who teach the same subject so that discussions focus on student learning of particular concepts from that particular field.

A featured issue in existing PD activities is that knowledge and skills that teachers gained are not transferred to the classroom, which prevents the observation of expected outcomes from the PD. To ensure that this translation happens, support plays a key role. This multifaceted support includes instructional follow-up by the organizers (educators) and technical support in schools. Instructional support might happen through classroom observations and providing feedback to teachers for their technology applications. On the other hand, teachers would feel confident that if they have technical problem, someone will be available in their schools or nearby anytime.

In a flipped PD model, participants would learn about the content before they come to the face-to-face sessions. Thus, it is critical to employ active learning strategies during the face-to-face sessions. Especially for successful integration of technology, teachers need to learn technical skills gradually and with hands-on experiences. For example, teachers could develop their own instructional design plans for their classroom. This planning might not cover the whole semester, but it can be on a specific piece of content that is hard to learn for students. Technology can make it easier to learn or make it more interesting for students. Detailed instructional design on their own classroom would encourage participants to apply what they have learned and would provide them a road map.

New generation students are usually exposed to contemporary technology applications more than their teachers, which make them more skillful in terms of using technology. This situation creates a fear for some teachers. However, even if students can be more proficient on technology, the teacher is the one who is an expert of the content. Any technological application is only a tool to teach content to students more effectively. It is important for educators to discuss to teachers about this issue and explain to them that it is normal to learn from their students sometimes. This should not affect their confidence. On the other hand, teachers should be provided basic technology skills to talk the same language with their students and to guide them on how to use technology for educational purposes. Online modules should also support teachers especially in classroom management strategies and assessment techniques for the changed relationships with student involvement.

Another key component of a successful PD experience is creating a supportive environment. If the policies and administrations do not believe the positive contribution of technology in schools, teachers cannot make big changes possible by themselves. Awareness sessions for administrators are a way to share information with them: such as what is aimed in PD, what are the teacher's goals in the classroom

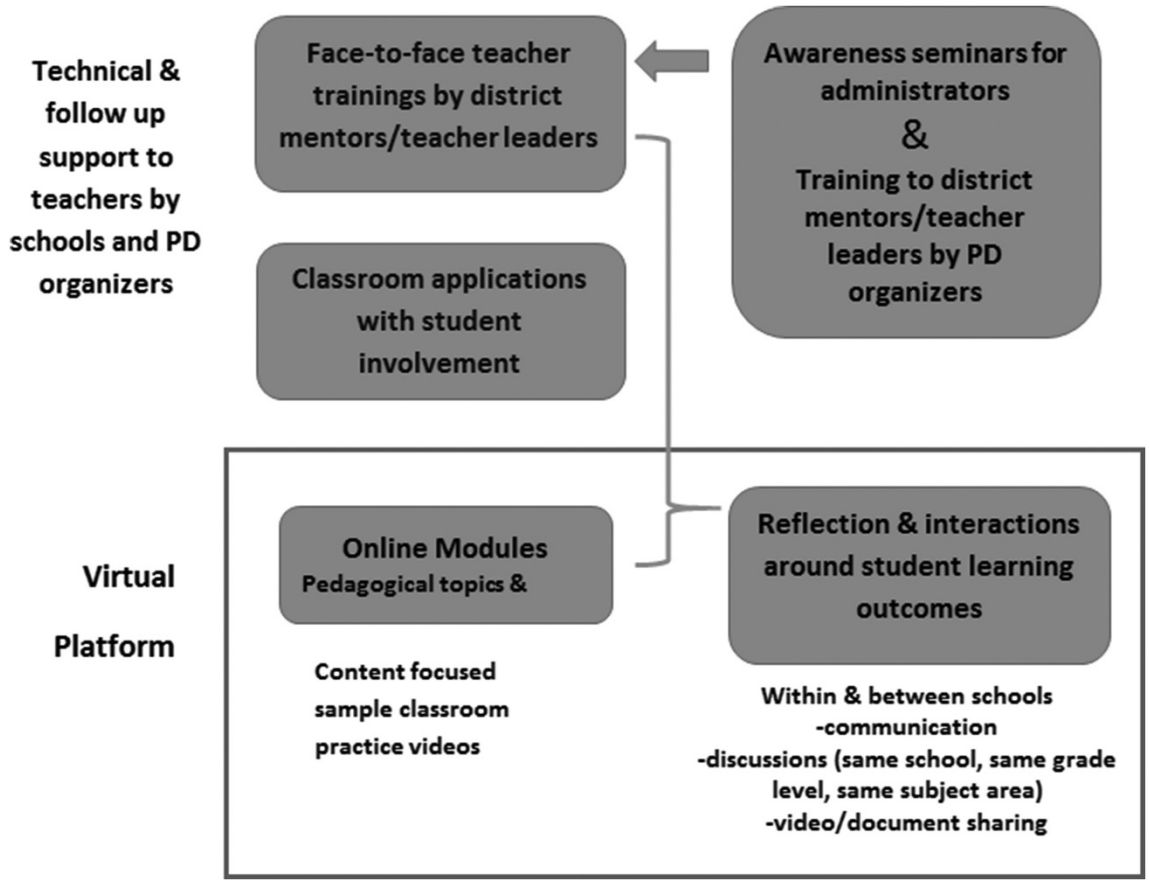

FIGURE 1 Suggested model for the design of professional development for effective technology integration

with this PD activities, what are the expected outcomes, and so on. Creating a common culture around professional dialogue in schools is essential.

8 | CONCLUSION

We believe that teachers are key factors for successful technology integration initiatives. However, due to the myriad of challenges faced by teachers, such as intense schedules and accountability pressures, it is recommended that PD programs be structured and well designed in order to provide the necessary support throughout the integration process. PD activities should provide teachers with adequate time for personal learning, growth, and reflection; furthermore, PD activities should provide ample opportunity for teachers to apply what they have learned in their classroom. Additionally, it is important that teachers remain connected with colleagues and other professionals in order to encourage feelings of motivation and to promote discussion around actual classroom applications. The PD model that combines flipped PD strategies with the implementation strategies of effective PD is a call for action to design PD experiences on the basis of teacher needs. It is important to involve teachers in all decision processes starting from the content of PD. Action research studies can be conducted to involve teachers more in all phases of PD design.

Studies point out that today's students have a considerable level of knowledge and skills regarding digital media. Our model for PD therefore embraces student involvement in the integration process, encouraging student participation both through the instructional process via technology application and through the feedback process by soliciting their opinions and suggestions for innovative technology applications. Because this is a new concept in PD design and technology integration, research is crucial on examination of the student involvement in technology decisions in classrooms. Strategies and future directions should be determined based on experimental data. Qualitative methods with deep investigations would be instructive.

Another important aspect to consider is creating a common culture around professional dialogue in schools. Although ongoing face-to-face sessions and online discussion groups aim to build this professional dialogue, administrative support is crucial to this end. Thus, parallel to the PD programs for teachers, we suggest having awareness sessions for school administrators to ensure their approval and involvement in building a positive school atmosphere around technology integration. Lastly, technical support should be planned and considered at the beginning of the PD program, as teachers will feel more comfortable integrating technology into their classroom practices knowing that they will receive the help they need when faced with technical difficulties. Consequently, the proposed model in this study suggests a comprehensive structure for attentive planning of PD

activities for technology integration for practitioners. Further research can be longitudinal studies that put into practice the proposed PD model with all aspects to acquire experimental data Figure 1.

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CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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