# Towards a Research-based Understanding of Effective Online Professional Development for Educators

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*This literature review explores current knowledge in the field of online professional development for educators. The literature reveals a lack of consistent terminology, but highlights features of effectiveness and research-based theories and models. Findings include the capacity of online professional development platforms to provide educators with unique and promising affordances and opportunities that facilitate authentic learning, collaboration, and provide ongoing implementation support. Current research addressing the use of online networking, social media, and devices to support educators with ubiquitous, on-demand access to learning is explored. The literature reviewed identifies the use of technology to address issues of equality of access, teacher voice and choice, collaboration, relevance, and flexibility in educator professional development. Barriers to effective professional development and gaps in the research are identified.*

**Keywords:** *Online teacher professional learning/development, online professional learning/development theories, online professional learning/development models, effective teacher professional learning/development online*

"Nothing has promised so much and has been so frustratingly wasteful as the thousands of workshops and conferences that led to no significant change in practice when teachers returned to their classrooms" (Fullan, 1991, p. 315). In this statement, educator, and author Michael Fullan advocates for change in the design and delivery of in-person professional development towards that which could more effectively support changes in teacher practice and ultimately student outcomes. The Education Development Center predicts ongoing growth in online teacher professional development as the technology to support it continues to develop (as cited in Burns, 2013). Given this anticipated growth in online professional development opportunities, the use of effective design and delivery models is vital to achieve the goal of improved teacher practices that facilitate improved student outcomes (Brooks & Gibson, 2012; Ostashewski, et al., 2011; Teras & Kartoglu, 2017).

In 2011, Ostashewski et al. observed that educators across the world were using technology to provide remote instruction, but many lacked the formal training and background needed to do so successfully. Ostashewski et al.'s observation has been exacerbated in 2020 and 2021 by an ongoing global pandemic. Lay et al. (2020) called for grounding effective online professional development for educators in research based theoretical frameworks and models. Teras & Kartoglu (2017) proposed that professional development providers leverage research-based pedagogy unique to the online learning environment to better support educators and impact student outcomes.

The COVID-19 pandemic required professional development providers to move from the traditional focus on in-person instruction to an immediate pivot to the online learning environment for teaching and learning. In their review of the literature on online professional development, Bragg et al. (2021) observed that this pivot occurred without advance opportunities for providers to learn about the most effective pedagogies, frameworks, and methods, and without time to thoroughly consider the unique opportunities afforded by online adult learning that support effective online learning for teachers. Their review revealed that conversion of in-person professional development to an online format is only

Hensold, L. (2022). Towards a research-based understanding of effective online professional development for educators. *Journal of Learning Design and Leadership, 1*(1), 41-76.

effective when the design includes critical supports and resources for teacher learning. When these supports are present, according to Bragg et al., learners report greater satisfaction with the learning and more learners complete the professional development program. In their review they identified effective learning supports to include program facilitators, technical support, and syllabus information. Helpful resources found in the literature included identified readings, interactive activities, videos, and discussion forums.

Bragg et al. (2021) concluded their review by identifying the need for additional research to these supports and strengthen the design of online professional development given their expectation that online professional development will continue post-pandemic. Lay et al. (2020) observed that in the absence of applicable research online professional development designers all too frequently assume the effective features of in-person professional development can be generalized to the online environment. They further argued that to identify what works for online professional development, research should specifically target this unique learning environment. The purpose of this literature review is to explore definitions of online professional development for educators, the theories and models associated with this mode of professional development, and factors that influence outcomes for educators and students.

## Terminology

Building a common understanding of the terminology and definitions within the field is a first step in uncovering guidance within the literature on theory, pedagogy, and best practice in online professional development. Teras and Kartoglu (2017) defined professional development as activities that are intended to engage professionals in new learning about their professional practice and emphasized the contrast of professional development with the process of professional learning. According to Teras and Kartoglu, professional learning is the desired outcome of professional development and cannot be 'forced or required'. In their article on myths of online professional development, Killion and Treacy (2014) agreed with Teras and Kartoglu and quoted the English proverb “You can lead a horse to water, but you can’t make him drink” to emphasize this idea. Darling-Hammond et al. (2017) also distinguished professional development from professional learning in their definition. In their survey of 35 studies, Darling-Hammond et al. defined effective professional development as "structured professional learning that results in changes in teacher practices and improvement in student learning outcomes” (p. 2).

The literature reviewed focused on online professional development from 2004 to 2020. During this period a variety of terminology was used to describe similar programs or events. Table 1 identifies the terminology used, the affiliated acronym if used, and the author or authors who used each term in their research.

While there is a consensus on terminology within the literature reviewed, there is not any consistency across researchers (Table 1). Kidd (2009), editor of a book containing research on online professional development, proposed this lack of consistency makes building on prior research within the field more difficult. In their mixed methods study of 43 participants, Moore et al. (2011) compared terminology use by asking world-wide developers, instructors, and teachers from 12 countries to describe scenarios as ‘e-learning’, ‘online learning’ or ‘distance learning’. They found no consistent use of terminology by role, mode of delivery, or country. To highlight this lack of consistency, they shared an additional finding: inconsistent spelling of key terminology, e.g., the term for ‘electronic learning’ spelled as e-learning, e-Learning, E-Learning, and elearning. In this research, Moore et al. identified ‘distance learning’ as learning that provides access for learners in separate locations, and ‘computer based’ learning to indicate the delivery of both text based and online media for learning. In addition to inconsistency in terminology use, they also found participants associated ‘distance learning’ with ‘old fashioned’ ideas of online learning. In their 2020 review of the literature on online professional development, Lay et al. also

found a lack of consistent terminology within the field that complicated their systematic review of existing literature.

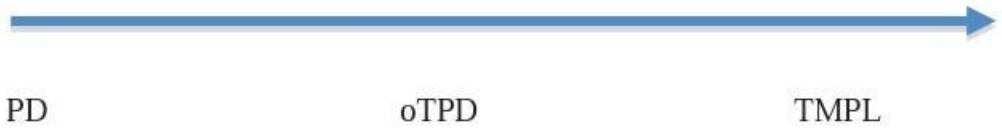
**Table 1.** *Terminology Variety in the Literature*

| Terminology | Literature Citation |
|---|---|
| Asynchronous Electronic Learning for Educators | Holzer, 2004 |
| Online Professional Development (oPD) | Bragg, et al., 2021; Burns, 2013; Dana et al., 2017; Gunter & Reeves, 2017; Holmes et al., 2010; Parsons, et al., 2019; Powell & Bodur, 2019; Reeves & Pedulla, 2013; Teras & Kartoglu, 2017; Yurkofsky, et al., 2019 |
| Online Teacher Professional Development (oTPD) | Dana et al., 2017; Dille & Rokenes, 2021; Lay, et al., 2010; Lebec & Luft, 2007; Ostashewski et al., 2011; Powell & Bodur, 2019; Dede et al., 2009 |
| Online Professional Learning (OPL) | Killion & Treacy, 2014; Killion 2018; Teras & Kartoglu, 2017 |
| Technology-mediated Professional Learning (TMPL) | Brooks & Gibson, 2012 |
| e-Learning | Moore, et al., 2011; Kidd, 2009 |
| Professional Development in an online platform | Stoetzel & Shedrow, 2020 |
| Web-mediated Professional Learning | Darling-Hammond et al., 2017 |
| Online micro-course (oMC) | Howard, 2021 |

Kidd (2009) and Brooks and Gibson (2012) both proposed that changes in terminology over time reflect the progression of the role of technology in online professional development from being considered an additional methodology to being seen as innovative pedagogy. Kidd highlighted the continuum of progress with the larger field of 'e-learning' from early iterations similar to the early interconnected gaming of PLATO in 1962 (UIUC, 2020) and forward to internet based interactive learning available at the time of Kidd's article in 2009. Kidd further identified the evolving context of e-learning chronologically as it moved from predominantly 'drill and practice' in 1975-1985, to 'computer-based training' in 1983-1990, to 'web-based training' in 1990-1995 and to 'e-learning' in 1995-2005 "Given the progression of the definitions, then, web-based training, online learning, e-learning, distributed learning, and net-based learning all speak of each other" (Kidd, 2009, p.49).

Brooks and Gibson (2012) made a similar observation in their review of the development of online learning for educators and its alignment with the development of individualized technologies of Web 1.0 computer-based learning and later the interconnected, networked offerings available on the internet known as Web 2.0. Brooks and Gibson argued that Web 2.0 technologies can provide unique opportunities for professional learning as long as the use of those technologies is considered to be a tool to support learning rather than the goal of the learning. Brooks and Gibson's continuum shows the progression of models from traditional face-to-face professional development to online teacher professional development to technology-mediated professional learning. Brooks and Gibson's continuum of professional development models is shown in Figure 1.

**Figure 1.** *Professional Development Models Continuum*




*Brooks & Gibson, 2012, p. 2*

In addition to terminology development, Brooks and Gibson (2012) also identified two sets of characteristics that differentiate instructor-centered online teacher professional development from learner-centered technology mediated professional learning. According to the researchers, these characteristics include the role of structure in learning, social learning, and content delivery versus content discovery. Brooks and Gibson also introduced another term, 'blurred learning', to describe a hybrid format that includes both face-to-face and online learning environments. Table 2 shows the two sets of characteristics identified by Brooks and Gibson.

**Table 2.** *Characteristics of Online Teacher Professional Development (oTPD) and Teacher Mediated Professional Learning (TMPL)*

| oTPD | TMPL |
|---|---|
| • most commonly cited in the field<br>• structured, internet-based learning, Web 1.0<br>• (e.g. learning management system)<br>• emphasis on content/delivery<br>• individualized modules and cohort models<br>• learning occurs online | • less structured, technology-enabled networked learning<br>• emphasis on interactions occurring between colleagues resulting in constructing knowledge<br>• emerging, teacher-initiated social media-based communities, Web 2.0 (e.g. Facebook)<br>• learning occurs in a "blurred" environment that can include f2f and online interactions |

*Brooks & Gibson, 2012, p. 7*

## Features of Effective Online Professional Development

Bragg, Walsh, and Heyeres' (2021) systematic literature review of 11 studies of online professional development defined 'effective' professional development as any program yielding a positive impact on teachers' content knowledge, pedagogical content knowledge, and beliefs. Killion and Treacy (2014) stated that evidence from online professional development effectiveness research discourages individual professional development 'events' and encourages a planned program of professional development that provides ongoing support. Holmes et al. (2010) used a mixed methods approach to identify factors of online professional development effectiveness and defined 'effective' as professional development that supported learner satisfaction and impacted classroom practice.

In their review of literature on online professional development, Dede et al. (2009) argued that online professional development using technology must move beyond the ideas that access assures learning and that new knowledge necessarily leads to improved classroom practices. Similarly, Powell and Bodur's (2019) multi-case study of teachers' perceptions showed that access to high quality online teacher professional development does not assure its effectiveness in changing classroom practice, especially when it fails to embrace principles of effective design or delivery. Reeves and Pedulla's (2013) correlational study of over 1000 teachers involved in online professional development gathered data on teachers' self-reported changes in knowledge, classroom practice, and student outcomes. From these data they identified teachers' reported changes to instructional practice in the classroom as a mediating factor to effective online professional development that impacts student outcomes.

Teras and Kartoglu (2017) and Ostashewski et al. (2011) agreed that online professional learning can successfully facilitate the type of teacher learning that supports changes in teacher practice. Teras and Kartoglu examined data from the responses of participants in a worldwide online professional development program to support vaccine management. They cautioned that, even though strengthening learner attitudes can be important, the major goal of online professional development is building knowledge and skills to impact practice. They further claimed that reaching this goal requires a clear definition of 'online' as a mode for delivery of professional learning rather than as an end in itself. Ostashewski et al. studied online professional development to support teachers content knowledge in LEGO robotics through online 'courselets' consisting of 10-15 hours of professional development over six to eight weeks. From their data, they concluded that the online courselet design delivered over time was effective in supporting teachers' content knowledge.

Borko et al. (2010), Desimone (2009), and Lay et al. (2020) agreed that online professional development and in-person professional development contain common basic features that support effectiveness. According to these researchers, those basic features include providing an ongoing program of learning, focusing on content, and including active learning, reflection, and collaboration. Lay et al., in their review of 73 studies of online teacher professional development from 2009 to 2019, found that both in-person and online modalities showed comparable learning results, but online professional development had an advantage in terms of access, cost, and ease of delivery. Despite these advantages, Lay et al. argued against the practice of using the same theories and models underlying effective in-person professional development in the design and development of online opportunities.

Ostashewski et al., (2011) and Teras & Kartoglu (2017) proposed that the design and delivery of online teacher professional development should include the unique learning opportunities and affordances available in the online learning environment. In Ostashewski et al.'s research on 'courselets' for online professional development, they described affordances as unique opportunities provided by the online professional development environment and identified greater accessibility, social networking, and on-demand learning as examples of affordances. In analysis of qualitative data from seven participants, Teras & Kartoglu found that using an online format scaffolded inquiry and learning and increased relevance and practicality for teachers involved in their world-wide vaccine management professional development program.

Darling-Hammond et al. (2017) identified 35 studies from existing literature on professional development. From a review of the results of the studies involving tools and formats, they concluded that technology-based professional development could effectively facilitate collaboration, access to expert educators, and inquiry-based learning. In addition, Darling-Hammond et al. proposed that technology-based professional learning can be used to support greater access to high quality professional learning for rural communities. Darling-Hammond et al. and Killion & Treacy (2014) agreed that technology-based professional learning is vital to building teachers' knowledge and skill to teach 21st Century skills that rely on team collaboration, problem-solving, creativity, and perseverance and new and more complex professional learning pedagogies are needed to support teachers in acquiring these skills. Killion and

Treacy also proposed that online professional learning can offer what James Paul Gee describes as "collaboration, collective intelligence, and smart teams using smart tools" (as cited in Killion & Treacy, 2014, p. 18). Yurkofsky et al. (2019) studied the perceptions of 57 teachers participating in an outcomes-based online professional development through a six-week online course or MOOC (Massive Open Online Course). They found situating teacher professional development in the online learning environment facilitated the development of technology skills and built teachers' confidence in using them in teaching.

Powell and Bodur (2019) examined high school teachers' perceptions of effective online teacher professional development provided through viewing and responding to online videos. Interview data from the six teachers who participated revealed they valued relevancy, usefulness, and choice within the program. Powell and Bodur observed that teachers' perceptions of the professional development provided during the study revealed a lack of connection from its content to the context of the teachers involved. They proposed that this sense of a lack of connection to context was one factor contributing to teachers' lack of a sense of relevancy and usefulness of the professional development. These researchers concluded that teacher 'voice' is important in the development of effective online professional development. Reeves and Pedulla (2013) also found that lack of teacher voice in the design of online professional development impacts its relevancy and usage in the classroom context. They analyzed self-report data from 1,231 teachers who participated in online professional development over two school years. A case study of a subset of four participants was used to provide additional qualitative data and insight to the self-report data according to the researchers. Reeves and Pedulla stated the aim was to discover factors that led to changes in teachers' knowledge and instructional practice as well as student outcomes.

Dede et al. (2009), Schlager et al. (2009) and Lay et al. (2020) agreed that much of the current online professional development research failed to meet rigorous design and tended to focus most heavily on 'anecdotal' evidence of effectiveness. Dede et al. (2009) reviewed research current to their time on online professional development and proposed that improvements were needed to research methodology to strengthen its impact. Dede et al. drew this conclusion from a review of nearly 400 research articles combined with the findings of a 2005 Harvard Graduate School of Education Conference on online teacher professional development. Similarly, in their review of current literature on online teacher professional development and networking, Schlager et al. found a lack of rigorous research and a tendency towards research in isolated contexts that hindered generalization. Lay et al. agreed with Dede et al. and Schlager et al. in their review of 73 current studies of online professional development. They stated they observed a developing tendency towards increased rigor and use of empirical design in online professional development research from their more recent 2020 review. Dede et al., Schlager et al. and Lay et al. agreed on the need for rigorous research on online professional development focused on developing new theories and models that may contribute to greater effectiveness.

## Learning Theories in Online Professional Development

In their review of 73 studies on online teacher professional development Lay et al. (2020) found a tendency among developers to rely on the same theories and methods that contribute to effective in-person professional development. Although there is some overlap of in-person and online best practices, according to Lay et al., often online design fails to include online specific features that support effective professional learning. In-person learning theories incorporated into the studies reviewed for this literature review include Adult Learning Theory (Knowles, 1977), Constructivism (Piaget, 1973), Social Constructivism (Vygotsky, 1978), Constructionist Theory (Papert, 1982) and Social Learning Theory (Bandura, 1971). These theories are identified by the researchers reviewed as foundational to and supportive of specific online professional learning models or frameworks and are discussed in the following section.

**Adult Learning Theory**

Powell and Bodur (2019) stated their research applied Knowles' (1977) characteristics of adult learners in their studies on teachers' perceptions of online professional development. Powell and Bodur argued that the design of effective online professional development for teachers must include their needs as adult learners and used Knowles' characteristics of adult learners in their research framework. Lewis and Chen (2010) stated that Knowles' characteristics 'set apart' the adult learners in the e-learning experience and included them within the framework for their research on effective online learning practices at the higher education level. Knowles describes these five characteristics of adult learners in his 1977 article contrasting pedagogy and andragogy:

1. Adult learners prefer to be self-directed.
2. Adult learners bring a wealth of life experience into their learning.
3. Adult learners prefer and are motivated by social collaborative learning.
4. Adult learners prefer learning that is applicable and addresses their problem-based concerns.
5. Adult learners are more often motivated by intrinsic than by extrinsic factors.

Aligned with Knowles' characteristics, from the results of teachers' reflective responses to video-based professional development, Powell and Bodur identified six 'key tenets' that support effective online teacher professional development. These key tenets include relevancy to teacher needs, practical usefulness, opportunities for interaction and collaboration, inclusion of authentic tasks, and opportunities for teacher reflection. Stevenson et al. (2015) found that a learner's perception of Knowles' adult learning characteristics within the online learning environment often depends upon their comfort and confidence using needed technology. Stevenson et al. identified Knowles' adult learner characteristics as aligning with their description of teachers as 'drivers' of their professional learning. From interviews with eight school leaders on teacher-mediated professional development and use of technology, Stevenson et al. identified learners' mindsets as either 'drivers' who were motivated to take ownership of their learning by engaging in active learning online or as 'buyers' who were less confident in engaging online and were looking to receive content more passively from an online source. In this study, school leaders provided multiple opportunities for online professional learning through curating content, creating media, blogging, and using social media across multiple devices and both structured and unstructured (informal) professional learning were offered. Stevenson et al. found that success with newer forms of online teacher professional development required learners to change their mindset from passive recipients or 'buyers' to 'drivers' who were active knowledge producers taking charge of their own learning.

**Constructivism and Social Constructivism**

Rob and Rob (2018) define constructivism as an educational philosophy originating with Piaget (1968) who envisioned learning as an active process where new knowledge is constructed by learners based on their prior knowledge. Lewis and Chen (2010) referred to this process of knowledge construction as 'meaning making' in their study of design factors that lead to effective e-learning. They proposed that online learning can effectively facilitate this type of learning. Liu et al. (2009) described Vygotsky (1978) as a 'social constructivist' who promoted the value of social learning proposing that learners construct new knowledge collaboratively in a social context. In 2002, Huang made the case for shifting pedagogy in online learning for adults from teacher-centered traditional learning to a learner-centered approach through reliance on the pedagogy of constructivism.

Lewis and Chen observed in their review of 20 years of studies of online and blended courses, that online adult learning has followed a progression from behaviorism to constructivism and predicted theory will continue to evolve as educational technology develops further and allows for more socially constructed knowledge. They cited the relative lower costs of online professional development or 'e-learning' and the unique affordances of 'Web 2.0', observing that education technology development has

progressed as a "clear timeline that follows the evolution of learning theory" (p. 105). Lewis and Chen did not find e-learning to always be the best choice and stated that a hybrid of in-person and online teaching and learning are "most valuable when an institution wants to leverage all of the e-learning advantages while still maintaining the nuances that oftentimes face-to-face training provides to the learner" (p. 106).

In their review of 40 studies of online teacher professional development in 2006, Whitehouse et al. found that social constructivism influenced most of the studies they examined and claimed this finding as evidence of the importance of social learning for teachers. They used the term "Learning 2.0 web" to indicate this 'demand-pull' as opposed to traditional 'supply-push' approach to professional learning. They also argued that the 'Learning 2.0 web' provides unique affordances that can be used to support social networking and online professional development. Later in 2019, Powell and Bodur identified constructivism and social constructivism as a basis for their qualitative case study of high school science teachers' perceptions of job-embedded online teacher professional development which resulted in empirical evidence of six features of online teacher professional development: relevancy to teacher needs, practical usefulness, opportunities for interaction and collaboration, inclusion of authentic tasks, and opportunities for teacher reflection.

Liu et al. (2009) described the use of Vygotsky's 'social constructivist' pedagogy in their two-year case study of an online learning community developed to support teacher professional development to integrate engineering into PK-12. The study included video conferencing for modeling and feedback, collaborative Google documents and Facebook to facilitate social learning for the participants. The online professional development was used as an extension of a week-long in person learning session for 36 teachers during the summer. The researchers concluded that using an online learning community to extend professional learning over time provided "highly effective just-in-time and individualized support to in-service teachers in such a pioneering field [engineering]" (p. 12). Participant responses identified time and lack of support as barriers to participation in an online community of practice and access to needed resources and new activities as factors that would encourage their participation. Dixon and Dixon (2010) used a longitudinal study format to examine the effectiveness of a learner-centered constructivist pedagogy within fully online in-service professional development. Their work resulted in the development of the Online Pedagogical Effectiveness Framework discussed later in the following section.

In 2021, Howard stated they incorporated a constructivist approach into their study of online micro-course professional development and identified factors that inhibited ('barriers') and facilitated ('drivers') professional learning. The term 'drivers' in Howard's study refers to factors identified by teachers/learners that supported online professional development, while 'barriers' were factors that impeded or distracted from the effectiveness of the online learning experience. Howard categorized teachers' interview responses into three themes: Enactment of the interventions' features, Institutional context, and Outcomes. Teacher responses within each theme resulted in six subcategories that reflected the identified drivers as accessibility advantages, robust reflexivity, constrained collaboration, barriers as incongruent interests, compelled compliance, and outcomes as promising practice shifts. Table 3 from Howard's work provides specific descriptions of the drivers and barriers revealed in the teacher interview data.

**Table 3.** *Online Professional Development Drivers and Barriers*

| Theme | Enactment of the intervention's features | | | Institutional Context | | Outcomes |
|---|---|---|---|---|---|---|
| | Accessibility advantages | Robust reflexivity | Constrained collaboration | Incongruent interests | Compelled Compliance | Promising practice shifts |
| **Effect** | **Driver** | **Driver** | **Barrier** | **Barrier** | **Barrier** | **Driver** |
| *Category* | *Mode of study* | *Reflexive exercises* | *Working with peers* | *Lack of fit* | *Institution-wide mandate* | *Perceived outcomes* |
| Codes | Materials<br>Time needed<br>Flexibility<br>Greater autonomy | Chance for review<br>Planning for future practice<br>Change ingrained habits | Issues with peer feedback<br>Not taken seriously<br>Specialist role<br>Institution-wide courses | Generic courses<br>Teachers know this already<br>Need for self-selection | Not relevant to teaching<br>Affective filters<br>Ticking the box | Applied learning<br>Increased student engagement<br>Technological / practice courses<br>oMCs after pandemic began |

*Howard, 2021, p.7*

Krutka et al. (2017) claimed that online Professional Learning Networks can support constructivist oriented learning. Their study of online networked professional development for teachers explored the use of social media including Facebook and Twitter among other platforms and noted the recent ability of teachers to network across classrooms, schools, districts, states and even globally. Building on their previous research, Krutka et al. used response data from 537 teachers to develop a 'flexible framework' for strengthening professional learning networking that centers on three common components: people, spaces, and tools. The Professional Learning Network Enrichment Framework includes essential questions to support educators in ongoing analysis and reflection individually or by groups (Table 4).

**Table 4.** *Professional Learning Network Enrichment Framework*

| | People<br>(e.g., *educators, authors, scholars, organizations, and others with whom I interact*) | Spaces<br>(e.g., *face-to-face, online, blended, formal, informal*) | Tools<br>(e.g., *resources, skills, ideas, teaching strategies, curriculum materials, websites, education philosophy, habits*) |
|---|---|---|---|
| Identification<br>*What is my PLN?* | Who are the people in my PLN? | In what spaces do I engage in PLN activities? | What tools do I acquire by engaging in PLN activities? |
| Reflection<br>*How does my PLN shape my professional growth?* | Which people most contribute to my professional growth?<br>• *With whom, how many people, and how often do I share and engage?*<br>• *Which people or perspectives are missing from my PLN?*<br>• *How do I interact* (e.g., *mentoring, collaborating, sharing, engaging in conversations*) *with others in my PLN?* | Which space(s) are most conducive to my professional growth?<br>• *Which spaces best cultivate meaningful engagements, relationships and community?*<br>• *In which spaces have I not yet engaged that might be beneficial?*<br>• *How do the design of these spaces* (e.g., *character limits, algorithms*) *inhibit or enhance interactions and growth?* | How do the tools from my PLN contribute to my professional growth?<br>• *How do I evaluate and organize the tools that I learn about* via *my PLN?*<br>• *How am I experimenting with tools in my PLN?*<br>• *How do these tools, contribute to students' learning?* |
| Intention<br>*What are my PLN goals?* | With whom should I engage to enhance my professional growth?<br>• *With which people should I deepen, enhance, or decrease interactions and relationships?*<br>• *Which people might I add to my PLN -- including those with different perspectives or backgrounds -- to enrich my learning?* | In which spaces should I engage to enhance my professional growth?<br>• *In which spaces should I dedicate more or less time and energy?*<br>• *What new spaces should I seek out to advance my learning and that of my students?* | What tools can best contribute to my professional growth?<br>• *What tools from my PLN do I need to further explore to advance my learning?*<br>• *What new tools am I going to seek out to advance my students' learning?* |
| Action Steps | | | |

*Krutka, et al., 2017, p.249*

## Theory of Constructionism

Papert (1982) defined constructionism as 'learning how to learn' and included the individual or collaborative development of an end product or artifact as integral to the learning experience. Papert further explained that constructionism builds on constructivism by stressing that knowledge development is most effective when a learning by doing or problem solving approach is incorporated into the learning experience alongside reflective discourse. Ostashewski et al. (2011) claimed that in comparison to Piaget,

Papert's theory was a better pedagogical base for online professional development because it was derived from digital media and computer-based technologies learning. The researchers observed that the types of activities and tools available online, including social media, can facilitate constructionist principles of artifact construction and reflection that lead to new knowledge and support Papert's theory of constructivism.

According to Ostashewski et al. (2011), Dille & Rokenes (2021), and Teras and Kartoglu (2017), constructionist pedagogy was incorporated into their studies of online professional development. These studies are described individually in the following section. Ostashewski, et al. found that grounding an online teacher professional development 'courselet' in constructionist pedagogy allowed for 'scaffolding' the teachers' learning and accommodating diverse learners through differentiation. According to these researchers, constructionist pedagogy intentionally moves the focus away from the goal of 'delivering content' in online professional development onto facilitating the construction of knowledge by teachers through the creation of a contextualized artifact. Based on their review of recent literature, Dille and Rokenes developed a model for online community based professional development that included scaffolding as a major component and stressed constructionist pedagogy.

In the development of online vaccine management coursework for teachers, Teras and Kartoglu (2017) emphasized that 'online' is not a framework for adult learning of itself, it is merely a platform for learning and can remain didactic and imitative of the traditional professional development workshop or can be leveraged to facilitate deep collaborative learning. They identified the 'authentic e-learning' framework developed by Herrington, Reeves and Oliver (2010) as the pedagogical basis of the online learning program they explored in their study. This 'authentic e-learning' as described by Teras and Kartolglu supports application of the theory of situated learning as proposed by Lave and Wenger (1991). According to the researchers, authentic e-learning incorporates constructionism through development of a project or artifact applicable to the learners' needs and context by using nine elements that align with Knowles' adult learning principles. Table 5 lists each of these nine elements followed by a brief description.

**Table 5**. *Authentic e-learning Elements*

| ELEMENT | DESCRIPTION |
|---|---|
| **1.** Authentic context | Aligns to a 'real world' use |
| **2.** Authentic tasks | Involves "ill-defined and complex" problems |
| **3.** Access to expert performances and modeling of the process | 'Apprenticed' learning. Learners can observe experts and learn from peers. |
| **4.** Promoting multiple roles and perspectives | Includes dialogue around controversy and critique |
| **5.** Collaborative construction of knowledge | Relies on learner interaction and collaboration |
| **6.** Reflection | Comparison of learner's ideas with others |
| **7.** Articulation | Dialogue and defense of learning (enhanced in online formats) |
| **8.** Coaching and scaffolding | Facilitated learning with ongoing support as needed |
| **9.** Authentic assessment | Integrated authentic assessment |

*Adapted from Teräs & Kartoglu, 2017*

**Social Learning Theory**

The social learning theory of Bandura (1971, 1977) was identified by some researchers in the reviewed literature as part of the framework for their research and by others as cited in the literature they reviewed within the field of online professional development. Bandura described social learning theory as including an emphasis on observational learning and the influence of the social context on adult learning. Bandura identified four elements of social learning: attention, retention, reproduction, and motivation. According to Bandura, attention requires the learner to notice what is to be learned so learning must be designed to capture the focus of the learner as something to be learned. Retention refers to the role of memory in learning as the learner must retain an internal memory of the learning for learning to occur according to Bandura. Linked to retention is Bandura's third element, reproduction, which is determined by the learners' ability to perform the action or cognition. The final element, motivation, requires the learner to see the benefit of using or acquiring the learning.

In their analyses of previous studies, Lewis and Chen (2010) identified the importance of social learning and advocated for the necessity of some form of in-person or online social learning as essential for effective online learning based on the reviewed literature of effective online professional development. At the time, Lewis and Chen limited the definition of online learning to experiences without interaction between learners and used the term 'asynchronous online learning' to define online learning where a discussion board or other online communication platform was used to support learner and instructor interaction. Synchronous learning was defined as 'real time' interaction among the learners that could be supported by technology or could occur in a hybrid format that included in-person opportunities. Lewis and Chen identified hybrid learning as most appropriate when an instructor or program finds the 'nuanced' feedback of in-person teaching to be valuable for the experience. Synchronous learning for these researchers at that time was defined as use of chat rooms or 'real time' discussion boards.

Parsons et al. (2019) and Powell and Bodur (2019) also concluded that some type of opportunity for social learning is essential to effective professional learning. They claimed that technology is uniquely situated to facilitate this opportunity more easily through synchronous online learning platforms that allow real time discussion and interaction without a need for in-person attendance. Researchers Stoezel and Shadrow (2020) made a similar observation from the perspective of K-12 instructional coaches providing coaching support in an online environment. They stated, "the direct interactions with peers and instructors helped to shape meaning, transfer learning to practices, and structure learning activities ...in individualized ways" (p. 9).

Ostashewski and Reid (2010) studied social networking and the effects of social learning through design-based research of an online professional development program using a social networking platform on the 'Learning 2.0 web'. These researchers identified social learning as vital for effective professional development and proposed that online professional development can provide unique opportunities for scaffolding discourse through use of asynchronous discussion boards.

Dana et al.'s (2017) research on the Prime Online program explored the capabilities of online professional development to support social learning. They described Prime Online as a federally funded research project that provided a yearlong program of online professional development. The aim of program for 3rd -5th grade math teachers, according to the researchers, was to incorporate a structured model of inquiry that would scaffold online discussion and result in a deeper understanding of pedagogy and practice for those teachers. Results from their study showed online professional development can effectively support social learning, inquiry, and reflection.

The literature reviewed for this work has identified theories of andragogy, constructivism, constructionism, and social learning within the field of online professional development. According to the researchers reviewed, these theories contributed to the development of models and frameworks that can

support effective online professional development. These models and frameworks are discussed in the following section.

## Online Professional Development Models and Frameworks

In their review of current studies at the time, Darling-Hammond et al. (2009) found consensus that using research proven models of teacher professional development was necessary to ensure its effectiveness. According to Schlager et al. (2009), identifying specific features of online professional development that contribute to its effectiveness is complicated by a lack of appropriate tools. In their proposal of a model of effective interactive online learning, Reeves (2005) pointed out the tendency of instructors to simply reproduce old instruction onto the e-learning environment and stated that this practice fails to take advantage of learning opportunities unique to the online environment. Lay et al. (2020) proposed that as the number of online professional development opportunities increases, identifying and using research-based models for its design and delivery will be vital. Research-based models for effective online professional development and evidence of less effective models identified in the literature reviewed will be described in this section. Specific features identified in the reviewed literature that hinder effectiveness in online professional development are described in a later section.

In 2009, Dede et al. called for more effective research methods for online professional development and identified the need for a common conceptual framework. They found many of the studies reviewed relied on anecdotal evidence, lacked adequate descriptions of programs and participants, failed to provide clear research questions, and did not describe data collection or analysis method adequately. According to Dede et al., this finding complicated the identification of models and features of online professional development that contribute or fail to contribute to its effectiveness. They identified four under-researched areas: program design, program effectiveness, program technical design, and learner interactions.

Lay et al. (2020) pointed out the tendency of online professional development designers to rely on the same theories they used for the development of in-person professional development and identified this tendency as a hindrance to designing effective online professional learning for educators. Similarly, Teras and Kartoglu (2017) stated that historically, online professional development providers often emphasize content delivery over knowledge construction in online learning design. Reeves (2005) stressed that learning using the world-wide-web is not a 'magic box' that assures desired outcomes and shared this analogy, "Actually, the WWW does not guarantee learning any more than the presence of a library on campus guarantees learning" (p. 3). Reeves encouraged online learning designers to consider the online learning environment as a 'resource' rather than a pedagogy and further claimed that effective design requires more than replicating in-person professional development onto an online format. Reeves argued that some content areas and learning goals are better served through 'traditional' teaching and learning methods.

Brooks and Gibson (2012) identified a continuum of online professional development models that illustrated its ongoing development. Their professional development model, shown in Figure 2.1, displayed the progression of models within the field from 'professional development' to 'online teacher professional development', and finally to what they described as 'technology-mediated professional learning'. They noted the movement within the models from instructor-centered to learner centered and the progressive inclusion of social learning into newer models. Parsons et al. (2019) studied teacher's perceptions of online professional development and theorized that online professional learning pedagogy and technology are 'dialectical'. They proposed that teachers' perceptions and feedback inform the development of new technology and that advances in online professional development models can motivate new advances in technology. They further predicted that as technology continues to develop, professional development opportunities will move towards integration of more and more advanced

technology, and therefore it is essential to understand teachers' perceptions of each new iteration. To demonstrate Brooks and Gibson's proposal for the ongoing development and Parsons et al.'s 'dialectical evolution' of online learning models and technologies, this section will present the reviewed models in chronological order:

- Technology Acceptance Model (Davis, 1989),
- Community of Inquiry Model (Garrison et al., 2000),
- WWW-based Learning Model (2005),
- Online Pedagogical Effectiveness Framework (Dixon & Dixon, 2010),
- E-learning Attributes (Lewis & Chen, 2010),
- Network Learning Framework (Ostashewski & Reid, 2011),
- Conceptual Model of Online Teacher Professional Development (Reeves & Pedulla, 2013),
- Framework of Authentic e-Learning (Teras & Kartoglu, 2017),
- Teacher Inquiry Model (Wagner, 2020), and
- Online Professional Development in Online Communities Model (Dille & Rokenes, 2021).

**Technology Acceptance Model**

In 1989, Davis proposed the Technology Acceptance Model and described it as centered on the idea that teachers' success in online learning formats is tied to their relative comfort and confidence with technology or 'acceptance' of the modality. Two key elements of this model are defined as 'perceived usefulness' and 'perceived ease of use'. In Davis' model, perceived usefulness is described as how closely the professional development content aligns with the specific learning needs of the teachers, while perceived ease of use represents how intuitive or user-friendly teachers find the technology to be in use. According to the Technology Acceptance Model, these factors are predictors of a learner's 'intention to use' the acquired knowledge and skills beyond the professional development event or series.

Wasserman and Migdal (2019) stated they incorporated Davis' model into their quantitative research comparing the attitudes of 495 teachers towards online asynchronous courses and traditional in-person professional development. Factor analysis of teachers' questionnaire responses identified four factors related to teacher satisfaction with online professional development courses:

1. Effectiveness and Application
2. Environment
3. Course Assignments
4. Attitudes towards Information and Communication Technology

Wasserman and Migdal identified the factors of 'Environment' and 'Attitudes towards Information and Communication Technology' as significantly different between professional development provided in asynchronous courses and traditional in person professional development. They also aligned questions to each factor (Table 6).

**Table 6**. *Questionnaire Items for Two Significant Factors*

| Factor | Environment | Attitudes towards information & communication (ICT) |
|---|---|---|
| **Questionnaire Items** | There was an atmosphere of attentiveness and openness. | The course website serves as a place for sharing and consultation between the members of the group. |
| | A productive discourse developed among the members participating in the course. | During the course I was exposed to a variety of possibilities for integrating ICT into teaching. |
| | I felt that they believed in my ability during the course. | I will know how to choose ICT tools that suit the learning, teaching, and evaluation process. |
| | The advisor answered the students' questions and responded to their needs. | The advisor uploaded relevant materials to the course website. |
| | There was an atmosphere conducive to learning during the course. | |
| | The advisor helped colleagues when they encountered difficulties. | |

*Wasserman & Migdal, 2019*

Wasserman and Migdal (2019) and Holmes et al. (2010) both found teachers showed a slight preference for online professional development courses when the online learning was provided in the form of an asynchronous course. Similarly, Parsons et al. (2019) surveyed 251 teachers across the U.S. who did not participate in online professional development and found only 27% stated a preference for in-person offerings as the reason why they did not participate. Sixty-five percent of the teachers who did not participate stated their reason as lack of awareness of the availability of online professional development.

According to Davis (1989), the Technology Acceptance Model applies across learning platforms or modalities, but teachers who are unfamiliar with the technology may need additional support. Expanding on this finding in 2019, Wasserman and Migdal identified that the presence of additional technology support may ultimately impact whether the professional development experienced by teachers results in changes to their practice in the classroom.

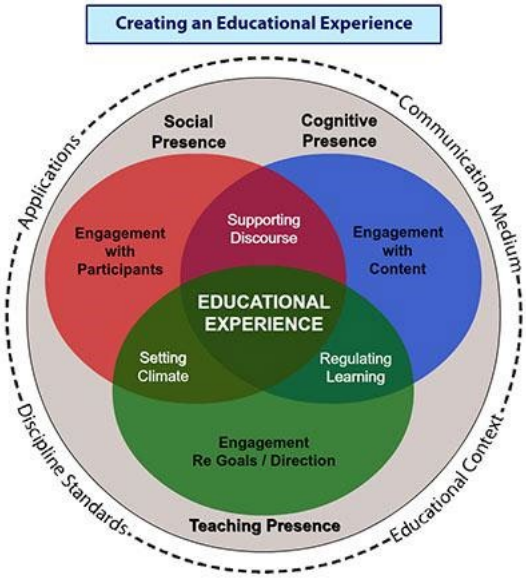
**Community of Inquiry Model**

In 2000, Garrison, Archer and Anderson developed the Community of Inquiry model to support the creation of an effective online learning experience where communication takes place primarily through written text. Garrison et al. analyzed text based 'computer-mediated' communication to identify what they labeled as three essential elements of online learning that contribute to an effective learning experience:

- Social Presence
- Teaching Presence
- Cognitive Presence

Garrison et al. described these three elements as interactive features that contribute to a community of inquiry in an online learning community. Cognitive presence, according to Garrison et al. is the ability of the learner to construct meaning as a result of participating in the community and its communication methodology. Social presence was defined as how well learners can present themselves as real personalities within the confines of the online learning environment. Finally, Garrison et al. defined teaching presence as the result of the design and facilitation of the learning experience a function of both the 'teacher' and the 'learner' interactions. Each presence supports the other and ultimately the educational experience, according to Garrison et al. (Figure 2).

**Figure 2**. *Community of Inquiry model*




http://www.thecommunityofinquiry.org/coi

Liu et al. (2019), Ostashewski and Reid (2011), Holmes et al. (2010), Howard, (2021) and Wagner (2020) all identified the Community of Inquiry model as a basis for their research. Although Garrison et al. (2000) stated that cognitive presence was the most crucial for higher education contexts, Holmes et al. found teacher presence and social presence to be the greatest factors associated with learner satisfaction among K-12 educators. Holmes et al. used mixed methods that included a survey that measured teacher's perceptions of the 'Presences' following a five-week program of professional development. Howard stated that the Community of Inquiry model was foundational to the development of micro-courses they provided for in-service teachers. Howard 's results identified that teachers perceived the inclusion of a requirement for online posting within the course as a barrier to authentic social presence. Wagner found that using a teacher inquiry framework as the basis for online professional development for early childhood teachers facilitated all three presences within the Community of Inquiry model. These results were derived from coding the verbal and written responses of five multilingual teachers across ten sessions totaling approximately 15 hours of online professional learning.

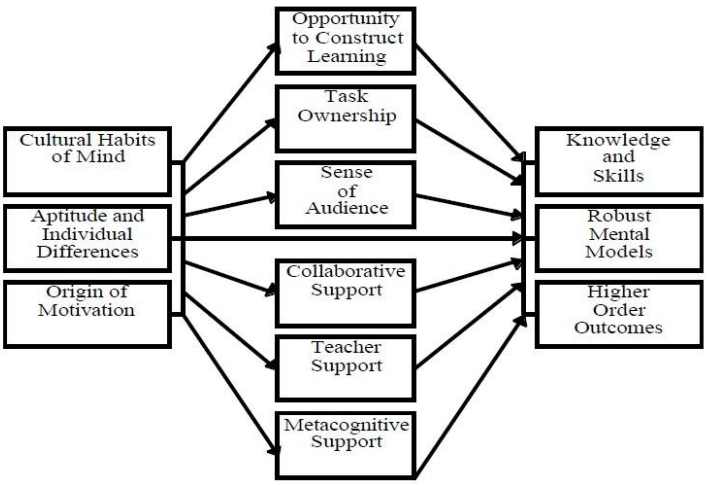
**WWW-based Learning Model**

In 2005, Reeves identified Carrolls' model of 'School Learning' (1963, 1989) as foundational to their 'WWW-based Learning Model'. Reeves argued against the practice of replicating in-person instruction onto an online learning environment and advocated for incorporating its unique 'affordances'

for the benefit of the learner. Reeves claimed their adaptation of the Carroll model incorporated the unique interactive learning environment of web-based learning. Reeves described the WWW-based Learning Model as having three critical aspects to be addressed in the design of effective online learning (Figure 3):

1. What the learner brings to the learning experience.
2. Learning variables within the learning experience.
3. Expected outcomes following the learning.

**Figure 3**. *A Model of WWW-based Learning*




*Reeves, 2005, p. 4*

Reeves (2005) theorized that desired learning outcomes can be achieved by manipulating six variables to bridge the gap from learner aptitude to learning outcomes. These variables are identified in the center of the model pictured in Figure 3. According to Reeves, effective web-based learning can be achieved by first recognizing the learner's cultural habits of mind, aptitude and individual differences, and origin of motivation. Reeves' model identifies mediating variables that can be used within the learning including opportunities to construct learning, task ownership, sense of audience, collaborative support, teacher support, and metacognitive support to achieve the learning outcomes of knowledge and skills, robust mental models, and higher order outcomes. Failure to accommodate these variables in the design on the learning can negatively affect learner outcomes, particularly higher order thinking outcomes, according to Reeves.

**Online Pedagogical Effectiveness Framework**

Dixon and Dixon (2010) stated they built Reeves' model of WWW-based learning into their longitudinal study of in-service teachers participating in online professional learning. Their mixed methods study followed a cohort of 42 learners across 3 years from 2004 to 2007 as they participated in a fully online program. Dixon and Dixon developed their program to rely on a learner-centered approach to accommodate the 'new millennium learner' where "the technology is the environment and for whom the process of learning means different things" (p. 22). Dixon and Dixon compiled their results and proposed the Online Pedagogical Effectiveness Framework. This framework includes nine dimensions of effective pedagogy in an online learning environment and are listed below in Table 7. Each dimension is aligned

with supporting concepts that result in indicators to be considered in design or evaluation. Table 7 describes the components of Dixon and Dixon's framework aligned with Reeves' dimensions.

**Table 7**. *The Online Pedagogical Effectiveness Framework*

| Reeves Dimension | Concept | Pedagogical Effectiveness Indicator |
|---|---|---|
| Philosophy | Instructivist vs. Constructivist | • Learner centred environment<br>• Constructivist approaches to teaching and learning |
| Learning Theory | Behavioural vs. Cognitive | • Teaching and learning strategies<br>• Thoughtful matches between materials, learning styles, and learning contexts |
| Goal Orientation | Sharply Focused vs. General | Model of delivery<br>• Planning<br>• Monitoring<br>• Reviewing<br>• Evaluating |
| Task Orientation | Academic vs. Authentic | • Learning experiences that encourage synthesis and analysis<br>• Opportunities for deep learning |
| Source Motivation | Extrinsic vs. Intrinsic | • Engagement in online materials |
| Teacher Role | Fixed vs. Flexible | Teachers who are:<br>• Imaginative<br>• Flexible technologically competent<br>• Committed<br>• Responsible<br>• Expert communicators |
| Metacognitive Support | Unsupported vs. Integrated | Consistent levels of feedback |
| Collaborative Learning Strategies | Unsupported vs. Integrated | Levels of interactivity |
| Cultural Sensitivity | Insensitive vs. Respectful | Thoughtful matches between:<br>• Materials<br>• Learning styles<br>• Learning contexts |
| Structural Flexibility | Fixed vs. Open | • High quality materials design<br>• Range of navigational choices<br>• Reliable, easy access |

*Dixon & Dixon, in Kidd, 2010 Ed., p.18*

Dixon and Dixon argued that results from their study opposed popular ideas at the time about the importance of instructor influences and the benefits of learner interaction in the online learning environment. According to Dixon and Dixon an unexpected result was that learner interaction on discussion boards and chat rooms diminished as the learners became more adept at navigating the technology. Dixon and Dixon pointed out that one possible explanation was the higher average age of the participants, 39 years, and the fact that they were employed learners spread out over time zones with limited time for non-essential communication.

**E-Learning Attributes**

Also in 2010, Lewis and Chen reviewed studies that assessed the effectiveness of online learning and the online aspect of blended learning for adult learners in the higher education context. Their goal was to propose a pedagogy to support the effective use of technology in online learning. Lewis and Chen concluded that the internet effectively supports a collaborative and social learning environment and proposed nine 'E-learning Attributes' (Table 8) that add the importance of social learning onto Dixon and Dixon's Online Pedagogical Effectiveness Framework (2010).

**Table 8**. *E-learning Attributes*

| E-learning attribute | Example of use in online learning |
|---|---|
| **1.** Communication | Communication beyond 'class time'; daily responses to students; Written response guidelines |
| **2.** Templates for course standardization | Common structure, 'look' and 'feel' across learning platforms |
| **3.** Language | Use common terminology understandable across contexts |
| **4.** Clear expectations | Provide clearly communicated written expectations for participati |
| **5.** Cultural/socioeconomic background | Understand learners' backgrounds and familiarity with communication, technology and their level of access to needed tools |
| **6.** Instructor preparedness | Be fluent with technology and new forms of communication and interaction |
| **7.** Incremental improvement | Engage in continuous course improvement and updating of technology |
| **8.** Collaboration | Provide learners with a sense of belonging through collaborative work or peer feedback |
| **9.** Stand-alone units | Learners prefer independent segments of content that are easily understood |

*Adapted from Lewis, & Chen, in Kidd, Ed., 2010*

In the studies reviewed, they found no difference in effectiveness between online and traditional in-person learning. They cited the comparative lower cost of 'e-learning' and the advantage of greater interaction between teacher and learner in synchronous online learning using the internet.

**Networked Learning Framework**

Ostashewski and Reid (2010) identified the Community of Inquiry model as a basis for their Networked Learning Framework model for designing professional learning within a social networking platform. They cited the affordances unique to online learning and coined the term 'networked teacher professional development' identifying it as a subset of online teacher professional development. Ostashewski and Reid cited the lack of research on online professional learning using social learning and networking on the 'Learning 2.0 web' and proposed seven 'design principles' to support improved research and design of networked professional learning (p. 13).

1. Relevant to teacher professional practice.
2. Easy for teachers to access with flexibility and support.
3. Theoretically and pedagogically sound.

4. Able to provide support for learners with varied experience levels.
5. Providing authentic opportunities for networked skill development.
6. Supportive of sharing and discourse between learners.
7. Able to support learning connections to the broader networked community.

In addition to these seven principles, Ostashewski and Reid identified four 'cornerstone components' that are included in their framework and summarized as:

1. Engage with research and practice.
2. Explore resources and strategies.
3. Discuss ideas and potential strategies.
4. Create new practices and contextualized artifacts as a result of learning.

These components are incorporated into the Networked Learning Framework (Figure 4).

**Figure 4**. *The Networked Learning Framework*


*Ostashewski, & Reid, 2010, n.p.*

## Conceptual Model of Online Professional Development

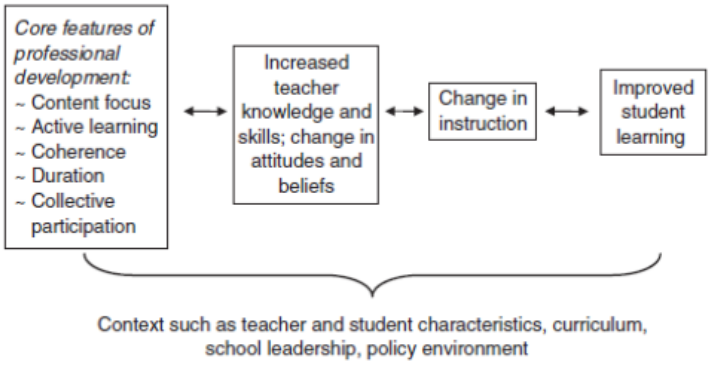
In 2013, Reeves & Pedulla stated their Conceptual Model of Online Professional Development (2013) was built from the foundation of Desimone's Path Model (2009). Desimone's model identified a linear sequential conceptualization of adult learning with three phases. Although not developed specifically for online learning according to Desimone, this model was cited by researchers in several studies of online professional learning in this review, including Reeves and Pedulla. Desimone described their theory of action for teacher professional development as consisting of four phases (Desimone, 2009, p. 184). Phase 1. Teachers experience effective professional development, Phase 2. The professional development increases teachers' knowledge and skills and/or changes their attitudes and beliefs, Phase 3. Teachers use their new knowledge and skills, attitudes, and beliefs to improve the content of their instruction or their approach to pedagogy, or both and Phase 4. The instructional changes foster increased student learning. Desimone (2009) also identified five core features of effective professional development

that result in increased knowledge and skills and changes in attitudes and beliefs of teachers. These core features include:

1. Content focus
2. Active learning
3. Coherence
4. Duration
5. Collective participation

According to Desimone, incorporating these features into professional development facilitates changes to teacher practice that result in changed instruction and support improved student learning outcomes (Figure 5).

**Figure 5**. *Path Model of Professional Learning*

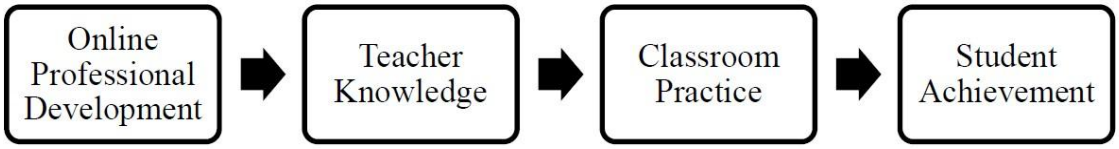



*Desimone, 2009, p.185*

Lay et al. (2020) reviewed 73 studies of online teacher professional development over the past decade and found only 10 of 73 studies they reviewed examined the impact of teacher learning directly on student outcomes in a linear manner similar to Desimone's Path Model. Lay et al. observed that 44 of the 73 studies appeared to assume that if teachers enjoyed the learning and if their knowledge and skills increased, they would necessarily implement changes in their classrooms, and student outcomes would be impacted. Lay et al. questioned this assumption and called for more research on the impact of online professional development on student outcomes. Lay et al. tied Desimone's Path Model in 2009 with the beginning of more rigorous, scientific research of online teacher professional development and an explicit focus on outcomes for both teachers and students.

In 2013, Reeves and Pedulla determined that Desimone's Path Model also applied to the online professional development environment. Reeves and Pedulla conducted a correlational study of 1,231 teachers participating in an online professional development course through the U.S. Department of Education's E-learning for Educators initiative. Survey data were collected from teachers who chose to participate in these fully online, asynchronous courses. Teacher perception data were collected prior to, immediately following, and within six to 12 months following the course. In their model, Reeves and Pedulla identified changes in teacher knowledge and classroom practice as 'intermediate' changes and changes in student outcomes as 'ultimate' changes. Reeves and Pedulla claimed that results from the teacher self-report data reinforced Desimone's linear pathway model of learning for the online environment and shared a diagram of that learning model (Figure 6).

**Figure 6**. *Conceptual Model of Online Teacher Professional Development*




*Reeves & Pedulla, 2013, p. 57*

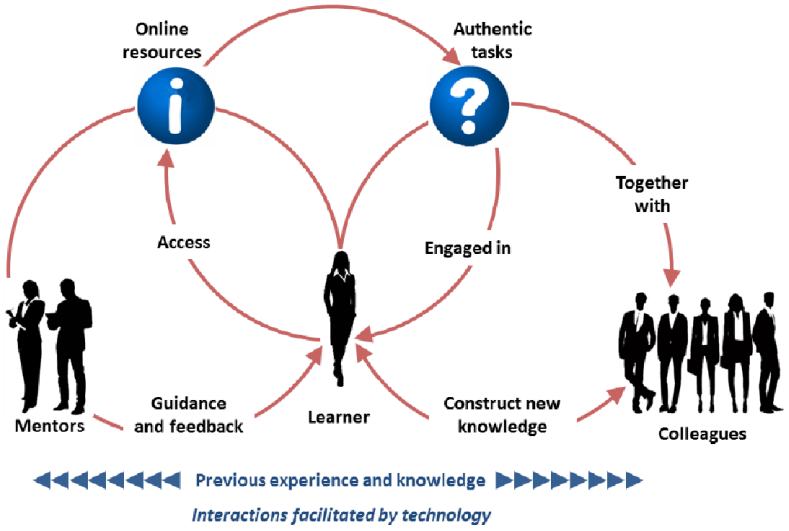
**Framework of Authentic e-Learning**

In 2017, Teras and Kartoglu stressed the need for intentional design of online professional development and proposed a 'grounded' theory that envisions learning occurring through a 'web of interactions' with the learner at the center. The researchers described this model as explicitly shifting the design focus from incorporating features of effective professional development to facilitating conditions that support effective professional learning. Teras and Kartoglu stated their model was grounded in 'authentic e-learning' built from the theory of 'situated learning' (Lave & Wenger, 1991). Their study focused on post-secondary learners participating in an online professional development course in vaccine management. The course consisted of three phases of learning, pre-course, during the course, and a final task to develop a process in a real-world setting. The 'authentic e-learning' framework consists of nine elements.

1. Authentic context
2. Authentic tasks
3. Access to expert performances and the modeling of the process
4. Promoting multiple roles and perspectives
5. Collaborative construction of knowledge
6. Reflection
7. Articulation
8. Coaching and scaffolding
9. Authentic assessment

Teras and Kartoglu incorporated these nine elements of authentic e-learning elements into the online e-learning course. Qualitative data from the study were coded into eight categories and merged to form a e-learning model of "learning as a web of interactions" with the learner at the center (Figure 7).

**Figure 7**. *A Framework of Professional Learning in Authentic Learning Based Online PD*




*Teräs & Kartoglu, 2017, p.200*

Two years later in 2019, Yurkofsky et al. drew a similar conclusion about learner-centered social learning processes through research on an online Massive Online Open Course for teachers. Fifteen teachers were interviewed following their participation in the online programming course and asked what features of the learning were most valuable for them as practitioners. Results reinforced the importance of the 'core features' of professional development for the acquisition of knowledge and skills as identified by Desimone (2009). The researchers reported that the open-ended interview process captured unexpected outcomes of the collaborative constructivist approach of the course and stated that one unexpected finding was evidence against a single linear sequential path where teacher learning leads to changes in practice that lead to improved student outcomes. Interview results showed while some teachers described a linear path to learning, others expressed a greater value for the interaction within the online learning community for discovery of new ideas to enhance their practice or for the validation and encouragement from other teachers that provided the needed confidence to try new ideas or to persist in changes to practice.

## Teacher Inquiry Model

Later in 2020, Wagner defined and used a teacher inquiry model for online professional learning for multilingual early childhood educators. Wagner described the use of the Teacher Inquiry model as incorporated into a synchronous online learning community based on Garrison et al, 2000. This researcher described this model of learning as "structured spaces for sustained and iterative cycles of reflection, action, and evaluation" (p.185). Wagner identified key features of this model to include: teachers as knowledge producers, the classroom as the focus of inquiry, and teacher collaboration focused on changing instructional practice. Results from teachers' journals, focus groups, and interviews revealed six themes. Teachers using the inquiry model in the online learning community felt supported to:

1. Learn about their students,
2. Develop a greater awareness of and intentionality towards instruction,
3. Share their experiences with each other,
4. Try new practices and take 'instructional risks',
5. Participate in the inquiry process,
6. Learn in a 'common context' despite diverse perspectives.

Wagner (2020) concluded that including an inquiry approach in an online learning community can deepen communication and enhance teacher support to use new practices. In alignment with Wagner's conclusion, Yurkofsky et al. (2019) and Teras and Kartoglu (2017) found evidence that using an online platform for learning can support the social context necessary for successful collaboration and inquiry. Yurkofsky et al.'s research involved a 'Massive Online Open Course' for teachers and Teras and Kartoglu focused on post-secondary learners participating in an online professional development course in vaccine management. These researchers noted that some participants found online formats more conducive to deeper levels of communication.

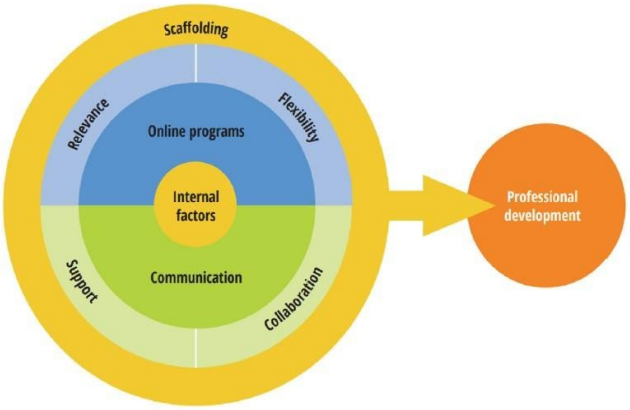
**Online Professional Development in Online Communities Model**

In 2021, Dille and Rokenes developed a model of teacher online professional development for online communities based on their review of current literature. Dille and Rokenes stated the purpose of their literature review was to focus on 'formally organized online teacher communities' and the factors that supported online teacher professional development. They synthesized the results of 52 empirical studies and identified five factors to be supportive of learners' participation and professional development in an online learning community. The authors proposed that the design and delivery of online teacher professional development should consider the importance of:

1. Facilitating a shared understanding within the community.
2. The facilitator's role in scaffolding the learning.
3. The connection of content to learners' contexts.
4. Flexible design to accommodate individual learning goals.
5. Relevant work-related activities within the learning.

Dille and Rokenes (2021) identified teachers' 'internal factors' as crucial to their learning including their readiness to learn, attitudes towards technology, fear of negative reactions from other learners and feeling overwhelmed by the content or technology use requirements. They proposed scaffolding as the overarching feature of effective online teacher professional development (Figure 8).

**Figure 8**. *Categories of Online Professional Development Communities*




*Dille & Rokenes, 2021, p.11*

In addition to the importance of scaffolding other key findings included the complexity of online teacher professional development and the need for differentiation. Based on their findings, Dille and Rokenes claimed that a 'one size fits all' approach will not result in effective online professional learning.

Parsons et al. (2019) suggested that "learning and technology are dialectical in that each new development in either compels advancement in the other. Therefore, PD [professional development] opportunities are inevitably moving in more technologically-oriented directions" (p.35) and as technology continues to develop, newer models of online professional development will also emerge. These researchers surveyed U.S. teachers to explore their perceptions of online professional development and concluded that teachers hold mostly positive perceptions and that those attitudes become even more positive toward online professional development following participation. These researchers stated they envisioned teacher professional development moving forward in the direction of greater reliance on and incorporation of technology.

## Affordances and Opportunities of Online Professional Development

Reeves (2005) advocated for limiting the use of 'web-based- learning' to "when its unique affordances are appropriate to the needs identified…" (p. 4) and offered a model for doing so as shown in Figure 3 above. Ostashweski and Reid (2010) concurred with Reeves and identified affordances of online professional development in their Networked Learning Framework as seen in Figure 4 in the previous section. Some of the unique aspects of online professional learning modality from the literature reviewed include:

- The use of social media and networking
- Collaboration and support
- Ubiquitous learning and access
- Learner-centered professional learning
- Online learning communities

These affordances are discussed in the following section. Killion and Treacy (2014) claimed that "…online learning has tremendous potential to integrate application, analysis of, and reflection on practice…allow[s] learners to personalize their learning, link it to their specific grade level and content area, and use it to support student learning" (p. 18). The affordances of online professional development revealed in the literature are discussed in this section.

### Social Media and Networking

Gunter and Reeves (2017), Krutka et al. (2017), and Fancera (2020) examined the use of social media, devices, and networking to facilitate online professional learning. Gunter and Reeves noted that mobile devices are readily available for most teachers and that the ubiquitous nature of mobile devices might help address the need for ongoing professional development for teachers. They also stated that using devices in their own learning helps teachers better understand how to integrate technology into their instruction to further support student learning and engagement. These researchers described their research methodology as sequential explanatory mixed methods exploring the attitudes of 139 teachers toward mobile learning. Their survey responses revealed four themes: teacher empowerment, self-efficacy, parental involvement, and self-confidence. The study results showed that the eight-week professional development opportunity supported change in teachers' attitudes and beliefs about integrating mobile devices through building their self-efficacy around device use and by modeling ways to integrate its use into their instruction. Gunter and Reeves cited the most significant finding identified from their quantitative and qualitative data as, "an online professional development course using an authentic, integrated, subject-specific curriculum changed teachers' dispositions toward the relative value of mobile learning and empowered them to change their own instructional strategies to integrate mobile learning into their curriculum" (p. 1314).

Krutka et al. (2017) and Fancera (2020) described the use of social media networking as integral to online professional learning that is accessible and personalized. Krutka et al. identified their research

focus as exploring ‘professional learning networks’ that support engaged and ongoing professional development for teachers. They proposed that professional learning networks can incorporate social constructivist and situated learning theory in an ongoing format based on the work of Desimone (2009) who identified similar factors as supportive of effective in-person professional development.

Fancera (2020) researched the use of social media and networking platforms to provide online professional development opportunities for teachers. They described the use of qualitative methods to explore the experiences of six school leaders in charge of providing professional development to their teaching staff. Fancera stated one motivation for this study was a need to find more cost effective and accessible methods for professional development for teachers and hypothesized that social media and online networking might accomplish that goal. As Krutka et al. (2017) did, this researcher incorporated Desimone’s (2009) features of effective professional development. Fancera described applying these features and integrating them with social-cognitive learning theory to support the use of social media and networking for school leaders. They stated their primary finding was that school leaders tended to use social media networking, mainly Twitter, as one part of a multi-faceted program of professional development. Self-report results from the school leaders indicated that using social media and networking in professional development allowed for personalization and eliminated some barriers of in-person professional development including time, cost, and the need for substitute teachers.

Krutka et al. also found that professional learning networks are able to provide needed follow up support for teachers based on the self-report of 537 teachers involved in online professional learning networks. Based on their research findings, Krutka et al. proposed the Professional Learning Network Enrichment Framework that included the three components of an interactive online learning environment: the people/learners, the spaces learners interact, and the tools that support their interaction. Krutka et al. identified four features of a successful professional learning network for educators: Identification, Reflection, Intention and Action Steps.

1. 'Identification' asks, "What is my professional learning network (PLN)?”
2. 'Reflection' asks "How does my PLN shape my professional growth?”
3. 'Intention' asks, "What are my PLN goals?"
4. ‘Action Steps’ identifies what a learner plans to do to enhance their participation in a professional learning network.

In this framework (Table 9) each feature is described by a general question supported by sub-questions and aligned to each of the learning network components; people, spaces, and tools.

**Table 9**. *Professional Learning Network Enrichment Framework*

| | People (e.g., *educators*, *authors*, *scholars*, *organizations*, *and others with whom I interact*) | Spaces (e.g., *face-to-face*, *online*, *blended*, *formal*, *informal*) | Tools (e.g., *resources*, *skills*, *ideas*, *teaching strategies*, *curriculum materials*, *websites*, *education philosophy*, *habits*) |
|---|---|---|---|
| Identification<br>*What is my PLN*? | Who are the people in my PLN? | In what spaces do I engage in PLN activities? | What tools do I acquire by engaging in PLN activities? |
| Reflection<br>*How does my PLN shape my professional growth*? | Which people most contribute to my professional growth?<br>• *With whom, how many people, and how often do I share and engage*?<br>• *Which people or perspectives are missing from my PLN*?<br>• *How do I interact* (e.g., *mentoring, collaborating, sharing, engaging in conversations*) *with others in my PLN*? | Which space(s) are most conducive to my professional growth?<br>• *Which spaces best cultivate meaningful engagements, relationships and community*?<br>• *In which spaces have I not yet engaged that might be beneficial*?<br>• *How do the design of these spaces* (e.g., *character limits, algorithms*) *inhibit or enhance interactions and growth*? | How do the tools from my PLN contribute to my professional growth?<br>• *How do I evaluate and organize the tools that I learn about* via *my PLN*?<br>• *How am I experimenting with tools in my PLN*?<br>• *How do these tools, contribute to students' learning*? |
| Intention<br>*What are my PLN goals*? | With whom should I engage to enhance my professional growth?<br>• *With which people should I deepen, enhance, or decrease interactions and relationships*?<br>• *Which people might I add to my PLN -- including those with different perspectives or backgrounds -- to enrich my learning*? | In which spaces should I engage to enhance my professional growth?<br>• *In which spaces should I dedicate more or less time and energy*?<br>• *What new spaces should I seek out to advance my learning and that of my students*? | What tools can best contribute to my professional growth?<br>• *What tools from my PLN do I need to further explore to advance my learning*?<br>• *What new tools am I going to seek out to advance my students' learning*? |
| Action Steps | | | |

*Krutka, et al., 2017, p.249*

## Collaboration and Support

Ostashewski and Reid (2010), Brooks and Gibson (2012), and Krutka et al. (2017) all identified unique opportunities afforded by online teacher professional development. These researchers cited the online learning environment as uniquely situated to facilitate teacher collaborative discussion, peer support, file (resource) sharing, cooperative planning, technology learning experience, and access to 'just in time' professional development as compared to in-person opportunities.

Brooks and Gibson (2012) identified three 'affordances' of online teacher professional development in their paper on professional learning in the 'digital age'. These researchers propose personalization, practice-focus, and development of a professional learning community are facilitated by online professional learning. These researchers recommend including an online professional learning community or professional learning network as part of the online teacher professional development framework. They cite three types of professional learning networks addressed in the literature along with examples of each (Table 10)

Brooks and Gibson (2012) posit that online networking and collaborative learning opportunities based on the work of Wenger (1998), eventually become part of a "school-wide culture that makes collaboration expected, inclusive, genuine, ongoing and focused on critically examining practice to improve student outcomes" (p. 6). Krutka et al. (2017) concluded that online professional development provides unique opportunities for teachers to engage with diverse colleagues and can support a greater sense of connectedness and provide emotional support. They offered one teacher's example from their study of 537 P-12 teachers' responses regarding their use of professional learning networks, "My PLN [professional learning network] consists of my co-teachers, department, and the growing community of educators I connect with online (and a lot of times in person through edcamps, etc.)" (p. 247).

**Table 10**. *Types of Professional Learning Networks (PLNs)*

| PLN | Example |
|---|---|
| Personally maintained synchronous connections | Virtual meetings with close colleagues contacted through for example, Skype or e-mail |
| Personally and socially maintained asynchronous connections | Comments, questions and discussions occurring in fairly quick succession but not in real-time through for example in chat windows or messages in Facebook |
| Dynamically maintained asynchronous connections | Connections with content sources self-identified as valuable through RSS aggregators such as Google reader or Pageflakes |

*Brooks & Gibson, 2012, p.9*

Lewis and Chen (2010), in a synthesis of an unidentified number of previous studies of online and hybrid online courses for adults, claimed that both forms of online learning can effectively provide a collaborative, social learning environment. In 2020, Wagner explored the interactions of five multilingual Early Childhood teachers through qualitative data including coding of written and verbal responses. Results showed that online professional learning facilitated the inquiry process for these Early Childhood teachers and supported deeper conversation and communication, allowing them to comfortably share their experiences and support each other in trying new strategies in their classrooms. In their reviews of the literature, Dede at al. (2009) and Dille and Rokenes (2021) cited the benefit of additional modes of communication provided in the online environment and identified both synchronous and asynchronous online communication as effective in facilitating deeper discussion and communication.

In their three-year study of 42 online learners, Dixon and Dixon (2010) observed what they called development of the 'maturity' of the learners over time as they became more adept at using the online learning platform. They found that as they provided more flexibility in year two of the constructivist based program, the learners tended to isolate themselves to independent learning where they focused more on task completion than communication. Dixon and Dixon measured the participation of the learners over two years and found less participation in discussion boards and chat rooms and less need for teacher support in the second year. Study results also showed that learners in year two's more flexible format pursued deeper learning through problem solving tasks and case studies and reported greater relevance of their learning over time.

**Ubiquitous Learning and Access**

Ostashewski et al. (2011) used constructionist principles to support online professional development provided as 'courselets'. Teachers' responses collected after the completion of the professional development identified easy access as one of the benefits of this type of online professional learning. In their review of the literature, Dede et al. (2009) also noted the convenience of online teacher professional development as part of a rationale for incorporating it into current professional development opportunities. More recently, Dille and Rokenes' (2021) scoping literature review reported access to resources as one important factor supporting teacher satisfaction with online teacher professional development. Similarly, results from participant interviews in Howard's 2021 study of online professional development provided in a micro-course format identified 'accessibility advantages' as one of the 'drivers' of engagement and learning. Howard focused on teacher identity and agency and identified 'drivers' from the coded and themed interview responses. A 'driver' indicated a feature that supported professional learning within the micro-course.

The Education Development Center (Burns, 2013) also identified easy access to resources as an affordance of professional development using mobile devices and cited use of devices for online professional development to effectively personalize professional development for teachers. This 2013 report concluded, "Together, smartphones and apps allow teachers to capitalize on what many see as the future of the web: 'the fully mobile web', a platform that is mobile and differentiated resides on a teacher's learning device and offers access to a customized menu of PD opportunities via changeable and customizable apps at the time and place of the teacher's choosing" (p. 18).

Ally and Prieto-Blazquez (2014) and Gunter and Reeves (2017) found that online professional development can provide opportunities for ubiquitous learning. Ally and Prieto-Blazquez stated that the ubiquitous nature of mobile technology use in business, government, social services, and healthcare should be replicated for education. They described the 'disruption' that device based learning will create as inevitable and called for additional research to uncover best practice. The key to effective use of mobile learning, according to Ally and Prieto, is incorporating research-based pedagogy into its design and delivery. In their research, Gunter and Reeves explored the use of iPads and iPhones to provide eight weeks of professional development on incorporating mobile learning in the classroom to 139 PK-12th grade teachers. Following the professional development, they surveyed participants using a validated survey of mobile learning. Results from the participants' responses indicated that they saw improvement in each of these four areas: teacher empowerment, self-efficacy, parental involvement, and self-confidence. These researchers noted that this experience changed teachers' attitudes and beliefs about using technology in their classrooms to support instruction.

In addition to devices, Krutka et al.'s (2017) study of 537 P-12 teachers' responses cited the advantages of access to professional learning provided by social media networking on platforms such as Facebook and Twitter. Fancera (2020) studied the experiences of six school leaders and found that by incorporating Twitter into professional development for their teaching staff, school leaders were able to provide greater access and ongoing support. Liu et al. (2009) included an online learning community to extend week-long face to face teacher professional development across the school year using Google document sharing and Facebook as part of the program of learning. These researchers concluded that providing an online learning community was an effective method for providing both 'just-in-time' access and individualized professional development for teachers.

In contrast, Killion and Treacy (2014) and Powell and Bodur (2019) warn that professional development providers should not assume that access to technology-supported professional learning equates to actual learning or leads to changes in adult practice. Killion and Tracy identified this idea as one of the 'myths' of technology-based professional learning in their article synthesizing recent research on online professional development. Powell and Bodur used a multi-case study approach to explore secondary teachers' responses to job-embedded online professional development on differentiation. Powell and Bodur described the professional development as viewing videos and providing written responses. They concluded that one important finding of using this approach was, "mere access to PD and follow-up reflection questions in an online format is inadequate" (p. 26). Both Killion and Treacy and Powell and Bodur highlighted teachers' challenges in accessing quality professional development as one outcome that could be addressed by improving access to high quality online professional development.

**Learner-Centered Professional Learning**

Stevenson et al. (2015) interviewed eight school leaders about their use of technology to support teacher professional learning. They noted the shift from teacher-led to learner-centered professional development and described some online learning participants as 'drivers' of their learning. They distinguished between the terms 'professional development' and 'professional learning' as the difference in the position of the learner. According to Stevenson et al., professional development includes the idea that teachers can be 'developed' from the outside. In contrast, they claimed that professional learning is centered on the learning process that occurs within the learner. They also noted that teachers' responses

highlighted the need for effective online professional learning to move from what they described as a "buyer" to a "driver" design mindset. They defined a 'driver' mindset as learner-led and learner-centered professional learning accessed in a self-directed manner. They also claimed that technology can easily support this type of professional learning by enabling teacher choice through the availability of multiple online strategies and tools. They concluded that lack of teacher autonomy and choice may hinder professional learning.

Parsons et al. (2019) used a self-developed survey and interviews in their study of K-12 teachers' perceptions of online learning. Results from 258 survey responses showed the importance of teachers' agency and choice in online professional development. Survey results revealed that teachers who were required to participate in online learning reported it to be less helpful than those who were able to choose participation. Parsons et al. concluded, "Where a high degree of choice exists, educators arguably have more autonomy to engage in professional learning; restricted choice may perpetuate notions of development" (p. 18).

Similarly, Howard's (2021) qualitative research on online micro-course professional development identified teacher sense of identity and agency as important factors impacting effectiveness. Howard described the study as framed by 'identity in practice' theory and teacher agency. Results from interviews of 11 teachers participating in the programs identified barriers and drivers [facilitators] of online micro-course professional development. Survey results also revealed increased self-efficacy as one of the 'drivers' of effective online professional development for teachers. Other drivers identified by the researcher included accessibility, opportunities for reflection, and ongoing support to change practice.

**Online Learning Communities**

Howard (2021) stated that teachers' perceptions of online professional development revealed that learning within a community supported them to develop their practice overall. In their article on technology-supported professional learning, Killion and Treacy (2014) advocated for collaborative online professional learning as a method for addressing teacher isolation and potentially reducing disparity within student learning. They cited learning communities as powerful designs for online teacher professional learning, "Online professional learning, designed with a learning community model, enables educators to build strong connections with other educators, give and receive feedback, share and analyze student work, collaborate on curriculum and instruction, interact with local and distant experts and colleagues, and engage in reflection in, on, and for practice" (p. 162).

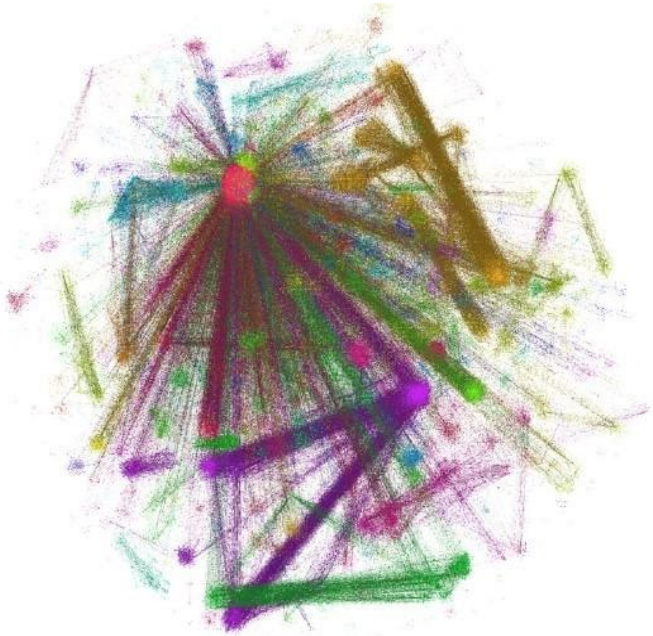
Stevenson et al. (2015) concurred with Howard's observation of the impact of online learning communities on teachers' professional development. Stevenson et al. studied eight school leaders' integration of technology into teacher professional development including tools to support content curation, creation of media, blogging and social media. Results included the finding that technology enabled professional learning can facilitate two types of learning communities. One learning community that is created within the school and the other that develops between schools as technology extends access to the professional learning to other schools' learning communities.

Yurkofsky et al. (2019) in their exploration of 57 teachers' valued outcomes from online professional development identified three domains of teachers' experiences as 'teacher and idea', 'teacher and practice', and 'teacher and world'. One conclusion of their study was that online professional learning communities were able to effectively connect teachers from rural areas with others across the U.S. Holmes et al. (2010) found social 'presence' defined as a sense of community to be closely associated with teacher satisfaction and overall learning in online professional development. This mixed-methods study of K-12 in-service teachers found participants valued social networking and on-demand access to the learning community offered in the online professional learning environment. Ostashewski and Reid (2010) in their study of online teacher professional development in a blended format, identified

the 'Learning 2.0 web' as able to provide unique opportunities for social networking and collaborative learning.

In contrast, Borko et al. (2010) cited the need for skilled facilitators to support the development of a 'tech-based' learning community, although still identifying collaborative online learning as important for teachers. Suthers et al. (2013) made a similar observation in their research using 'associograms' to measure community structures within 'socio-technical' networks in an online professional learning platform for teachers. Suthers et al. described an 'associogram' as a visual of "a network of artifact-mediated associations". They argued that the diversity and breadth of a learning community may hinder the development of deeper and more authentic learning community characteristics as measured by the levels of participation within and across communities within a network. Figure 9 depicts Suthers et al.'s 'associogram' visual where colors indicate connections across communities and width of color bands depict depth of communication within a community.

**Figure 9**. *Example of an Associogram Visual*



*Suthers, et al., 2013, p.4*

## Barriers To Effectiveness

Howard (2021) identified barriers to teacher acceptance of and participation in online micro-course professional development. Results from qualitative surveys of 11 participating teachers' perceptions identified constrained collaboration in asynchronous discussion boards, lack of relevance between content and teachers' needs, insufficient feedback and compliance driven attendance as barriers to acceptance and learning.

Wasserman and Migdal (2019) argued that from the learner's perspective, an online format for professional development has both advantages and disadvantages. They stated the purpose of their study was to compare in-service teachers' attitudes toward in-person and online professional development courses and identified their approach as grounded in the Technology Acceptance Model (Davis, 1989). They provided a questionnaire to teachers participating in required professional development courses

delivered either online or in-person. Responses from 465 teachers revealed both advantages and disadvantages in online course-based professional development. Table 11 shows Wasserman and Migdal's results.

**Table 11**. *Advantages and Disadvantages of Online Courses*

| ***Advantages*** | ***Disadvantages*** |
|---|---|
| Choice of learning provider across distance | Potential for feeling isolated or disconnected |
| Choice of timing and location | Lack of immediate response to questions or help |
| Resource savings: time, transportation, work absence | Inability to use non-verbal cues may affect confidence |
| "Safe" technology mediated social relationships | Less contact with peers |
| Safety in considering opposing opinions | High level of self-discipline needed |
| Supports collaboration | Digital text may be more difficult to read |

*Wasserman, & Migdal, 2019*

In 2007, Lebec and Luft stated, "Designers of online professional development experiences need also to consider factors maximizing engagement, personal accountability, and appropriate extrinsic motivation" (p. 567). They explored the effectiveness and efficiency of an online course that prepared in-service secondary teachers for recertification exams. Results from their mixed methods study showed that participation in the online resources aligned with the attitudes they held towards online learning. Teachers who had brought positive attitudes toward online learning into the experience where more likely to fully engage in the learning. Lebec and Luft also reported teachers' responses identified potential barriers to online learning including teachers' busy schedules, lack of extrinsic rewards, and the lack of accountability measures within the program.

Parsons et al. (2019) compared perceptions of teachers who were required to participate in online professional development with the perceptions of those who were allowed to choose to participate. Analysis of correlated data showed that failure to allow teachers to choose to participate in online professional development negatively affected their perception of its benefit. As a result, Parsons et al. identified compliance-based or mandated participation as a barrier to effective online professional learning.

Howard (2021) studied participant reactions to online professional development provided in a micro-course format as a requirement of ongoing teachers' certification by looking at in-course data and artifacts for 11 participants. Data results revealed both 'drivers' [facilitators] and 'barriers' to online professional development engagement and effectiveness. Participant interviews identified the following as 'barriers' to teacher engagement and learning: 'constrained' collaboration, varied interests among the learners, and required participation.

In their proposed model of the Effective Dimensions of Interactive Learning on the World Wide Web, Reeves (2005) warned that web-based learning should only be used when there is match of the online learning environment with learner needs. Reeves observed that many online learning offerings simply reproduce old instructional pedagogy onto the e-learning environment and identified this as a detriment to its potential effectiveness. Powell and Bodur (2019) identified the design of online professional development as a potential barrier to its effectiveness. In their case study of 6 teachers' perceptions of job-embedded online professional learning, these researchers identified the lack of research-based design as a barrier. They further warned that use of online teacher professional

development "may create a false sense of effectiveness if technology is used merely as a delivery tool void of effective design or implementation principles" (p. 20).

## Gaps in the Literature

In addition to the terminology challenges mentioned earlier in this review, Brooks and Gibson borrowed the term "blurred learning" from the work of Whitehouse (2010) to describe the fluidity of the online learning environment. They stated that online professional learning and collaboration may be synchronous across different locations, synchronous in the same online location, asynchronous and on demand or they may include in-person learning. This literature review found nine different terms used in the field to identify online professional development. In addition, the term 'online professional development' was used by some researchers and the term 'online professional learning' was used by other researchers. It was not always clear whether the terms were interchangeable or if they denoted separate underlying approaches. Lack of consistent terminology and definitions of online professional development or learning within the field seems to be a gap that needs to be addressed to support high quality research, build a common knowledge base that will enable consistency, and justify needed resources for ongoing development.

Kidd (2009) described the interaction of technology and online learning as being driven by technological advances in computers and networks. They stated that technological advances produce new methodologies in online professional learning as educators incorporate the new capabilities and adapt them to an online learning environment. Technology that is developed with the needs of teachers at the forefront of its design is needed. Kidd described the phenomenon of this method for design and noted the prevalence at that time of technology developed for other purposes and then 'adapted' to online professional development for teachers.

Closely related to the gap in online professional learning design is its lack of access and availability for all educators. Grant based funding for technology often fails to plan for sustainability. Several of the studies reviewed were grant funded over one to five years and are no longer available as useable platforms for teacher professional development. This includes the Prime Online Experience (Dana, Pape, Griffin, & Prosser, 2016) and the 2Learn2Gether educator community (Ostashewski et al., 2011; Ostashewski & Reid, 2010). One exception to this is an available archive of the community of education professionals' program 'Tapped In' funded by the National Science Foundation in 1997 (Schlager et al., 2009).

Lack of rigorous, empirical research also represents a gap within the field. Bragg et al (2021) and Parsons et al (2019) cite the prevalence of research that examines learner satisfaction and a lack of detailed research that reveals specific design elements that contribute to effective online professional development. Lay et al. (2020) note the "lack of systematic research, clear guidelines, and general consensus regarding optimal characteristics of online teacher professional development and practices that effectively support teacher change and student learning" (p. 2). These researchers point out that in the absence of clear guidelines, developers and designers tend to apply the same theories and principles to online teacher professional development that have proven successful in in-person offerings without allowing for the impacts and opportunities of the unique online learning environment. Killion (2018) and Parsons et al. (2019) highlight the need for tying student outcomes to research on online professional development.

Burns (2013) and the Educational Development Center call for additional research on social media networking for professional development. Suthers et al., (2013) made the case that evaluating new forms of online networking in professional development requires more effective models and tools. These

researchers propose the concept of 'associograms' to evaluate the type and strength of connections between participants in an online professional learning network.

Similarly, Fancera (2020) called for additional research on online professional learning networks and social media. This researcher highlights the need for research that examines how teacher self-efficacy and collective teacher efficacy might be mediating factors to the effects of social media networking driven professional development. Gunter and Reeves, (2017) call for research on long term outcomes and sustainability of online professional development.

More research is needed on mitigating internal and external factors to effective online professional development. As the field moves beyond Desimone's (2009) Path Model towards the online and more complex learner centered models of Yurkofsky et al. (2019), factors like teacher agency, self-efficacy, self-confidence, motivation, attitudes, and school culture and context will need to be explored. Dille and Rokenes (2021) found "Teachers' internal factors were crucial in their dynamic interactions with the content, facilitators and peers" (p. 1).

## Conclusion

Michael Fullan advocated for change in the design and delivery of in-person professional development to support changes more effectively in teacher practice and student outcomes (Fullan, 1991). The literature reviewed shows that teacher professional development provided as online asynchronous, synchronous, or web-based networked learning can effectively support teachers towards the types of changes needed to improve instruction and support student outcomes. When developed using research based theory and online professional development models, online teacher professional development can support changes to teachers' knowledge, skills, attitudes, and beliefs. In addition, the literature shows that online professional development can support teacher agency, provide ubiquitous learning, expand access for more teachers, provide personalization, build learning communities, deepen communication, offer ongoing support, and successfully scaffold teachers toward new practices.

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