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# Lifelong learning processes in professional development for online teachers during the Covid era

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**Introduction:** Lifelong learning encompasses four pillars: (1) learning to know; (2) learning to do; (3) learning to be; and (4) learning to live together. These four pillars, which are expanded upon within the current study provide a lens to examine relationships between professional development, use of technology for remote online teaching, and pedagogical efficacy in the age of COVID-19.

**Methods:** The study examined survey responses from 372 primary school subjects representing six different districts, and interviews with 16 teachers. The responses were analyzed using correlation and MANOVA statistical tests.

**Results:** Teachers' professional development processes were found to have a positive impact on the teachers' pedagogical efficacy, by means of positive perceptions toward the use of technology for remote online teaching. Learning foci predicted the use of technology, and the use of technology predicted learning assessment measurements.

**Discussion:** The study's findings reinforce the need for professional development processes based on systematic identification of pedagogical needs that arise in the field, their analysis and the understanding of the added value of pedagogical tools that can support enhanced implementation of teaching - learning - evaluation. The study's findings point to epistemological elements related to the types of acquired knowledge and to learning methods, which make it possible to differentiate between various processes in teachers' professional development as well as processes in the use of innovative pedagogical technology.

## KEYWORDS

COVID, remote learning, teacher training, pillars of learning, evaluation measurements of learning efficacy, lifelong learning

## 1. Introduction

The Covid pandemic has motivated numerous changes. For example, students and teachers transitioned to online learning from their homes (Mittal et al., 2021) causing anxiety, concerns about instructional quality, and educators' teaching success (Engzell et al., 2021; Paliwal and Singh, 2021). To mitigate issues, teachers participated in professional development processes aimed to develop pedagogical practices using technology (Bragg et al., 2021). These online professional development processes, similar to traditional learning ones, require effective approaches (Ross, 2011). Recommended approaches have been characterized in past research and may include online classes, workshops, resource material, video presentations, podcasts, wikis, blogs, and various downloadable artifacts. Venues may be synchronous, asynchronous,

or blended, and may include social media components (Roth et al., 2011). Often these venues provide interactive discussion forums or capabilities to review solutions to previously address teaching issues (Prestridge, 2019). For purposes of this research, we adopt the Sancar et al. (2021) framework and definitional view of professional development and agree that professional development is difficult to define due to its multidimensional structure and its changes across a teacher’s professional life. Further, it must be “attentive to assessment, research scale, duration, comprehensiveness, dissemination, context, support and control, and collaboration” (Sancar et al., 2021). We agree with Ragan et al. (2012) that the transition from face-to-face to online classrooms requires thoughtful adaptation of a wide variety of skills and competencies (Ragan et al., 2012). Since professional development can take many forms and requires special considerations for online teachers, particularly those that may not have taught this way previously, additional research is required (Ragan et al., 2012; Leary et al., 2020).

As such, the main goals for our study were to enhance pedagogical output (Brunetti and Marston, 2018; Ran and Josefberg Ben-Yehoshua, 2020), explore Professional Development Practice (PDP), and understand how training helps achieve better outcomes using technology (Watson and Rockinson-Szapkiw, 2021). Another approach to integrating technology into teaching is called learning by Design (LDL). LDL promotes collaboration and peer learning while helping teachers effectively integrate technology into the teaching process (Yeh et al., 2021). Yeh et al. (2021) offer a framework that leverages the reciprocal knowledge exchanged between individual teachers’ technological pedagogical content knowledge (TPACK) and collaboratively developed knowledge. This approach, in context of designing technology-enhanced instruction, provides teachers with methods to acquire knowledge from colleagues in different teaching areas. This perspective of learning ties into earlier theory that posits attitudes toward technology impact user acceptance and the

effectiveness of implementation (Davis, 1989; Kao et al., 2020). Therefore, our study’s research question becomes: To what degree does a teacher’s professional development process influence pedagogical efficacy *via* formulating positive outlooks of remote teaching technologies. The following Background sections describe details relevant to this question.

## 2. Literature review

Many studies on the integration of technology into education help researchers understand the importance of interconnections between technological knowledge and the teachers’ professional knowledge. These studies help move the research focus from the technology tool (what to use – computer, tablet, etc.) to how the tool contributes to the teaching and learning process, and how it can be utilized (Watson and Rockinson-Szapkiw, 2021). Various approaches have emerged in order to increase the likelihood that teachers will integrate technology into the teaching process. We examine different approaches from perspectives that can be organized into clusters. Table 1 provides an overview of theoretical elements covered in the following sections broken into three clusters: pedagogical input, technological mediating, and output each of which is further decomposed for this study.

### 2.1. Professional development

Teachers must be highly professional, up-to-date on changes and innovations, and desirous of developing and advancing at both personal and professional levels (Arinaitwe, 2021). Over time, traditional professional development processes in the form of one-time, face-to-face workshops, have revealed limitations which have become more significant in light of Covid-19’s impact (Tang,

TABLE 1 Research clusters.

Cluster	Cluster elements	Cluster sub-elements
Pedagogical input	Professional development	
	Lifelong learning and teachers’ training	<ul style="list-style-type: none"> <li>• Learning to know</li> <li>• Learning to do</li> <li>• Learning to be</li> <li>• Learning to live together</li> </ul>
	Continuing professional Development for online teaching (RAMA, 2018)	<ul style="list-style-type: none"> <li>• Data-driven instruction</li> <li>• Empathy-based pedagogy</li> <li>• Experiential learning</li> <li>• Differentiated learning</li> <li>• SRL – self regulated learning method</li> <li>• Assessment of learning method</li> </ul>
Technological mediating	UTAUT model	<ul style="list-style-type: none"> <li>• Performance expectancy</li> <li>• Effort expectancy</li> <li>• Social influence</li> <li>• Facilitating conditions</li> </ul>
Output	Teachers’ performance assessment	<ul style="list-style-type: none"> <li>• Teachers’ commitment to the students and school</li> <li>• Expertise in content knowledge and pedagogical content knowledge</li> <li>• Teaching and education management</li> <li>• Teacher as learner</li> </ul>

2021). To be in step with innovations, education must develop reforms (Pichardo et al., 2021). Theory-based reforms require significant contextualization to change education in significant, sustained ways. Deep changes in implementation and comprehension of reforms are required to maintain pedagogical practice that responds to changes (McLaughlin and Mitra, 2001; Kim, 2019). Professional development approaches have emerged to address these requirements. Various researchers have suggested approaches for professional development and conducted research to better understand effectiveness. For example, are professional development programs better suited focusing on subject matter or pedagogy (Scher and O'Reilly, 2009)? What are features in effective programs (Bray-Clark and Bates, 2003)? How should professional development be offered (Gumbo, 2020)?

Teachers' professional development is not acquired only during their academic training; it begins before and continues throughout a career. Ongoing learning, which the literature refers to as Lifelong Learning (LLL), includes the ability to adjust to new and changing situations and enables the transition from theory to practice (Alt and Raichel, 2020). The current study focuses on this area of professional development for teachers.

## 2.2. Lifelong learning and teachers' training

While no consensual definition for LLL exists, the literature offers many commonalities to help describe this area of study. Among these are a near-universal belief that LLL is key to remaining effective and relevant through the course of a career and that LLL is essential to personal development. For purposes of the current study, we draw on several synergistic definitions which support Delors et al. (1996) research depicting four pillars which form a solid basis for LLL (El Mawas and Muntean, 2018; Smith, 2018).

According to Longworth and Davies (2014, p. 22), "lifelong learning is the development of human potential through a continuously supportive process which stimulates and empowers individuals to acquire all the knowledge, values, skills and understanding they will require throughout their lifetimes and apply them with confidence, creativity, and enjoyment in all roles, circumstances, and environment." LLL is ongoing learning throughout a teacher's lifetime (Berkhout et al., 2018). As knowledge is acquired, ideas, skills, talents, education and knowledge develop (Ran and Josefbeg Ben-Yehoshua, 2020). In pedagogical training programs, teachers learn how to transmit the importance of LLL to their students, accumulating knowledge, and learning on their own (Sunthonkanokpong and Murphy, 2019). People faithful to the process succeed in organizing and controlling their learning needs (Erdogan and Ayanoglu, 2021).

LLL encompasses four pillars: (1) *Learning to know*. Acquisition of theoretical knowledge and expertise in learning tools (Brown, 2018). Relates to ability to obtain new and diverse information, comprehend this knowledge and adjust accordingly. (2) *Learning to do*. Procedural knowledge where teachers acquire and process information and then implement it using various practices or strategies that must be stable and dynamic (Hunter, 2013). (3) *Learning to be*. Relates to teachers' need to be free of prejudice/shallow thinking and be open to different cultures, religions, ethnic groups and political positions. This is rooted in psychological-social concepts and social-emotional learning (Soland et al., 2019). (4) *Learning to*

*live together*. Teachers must continually engage in self-discovery, examining harmony or disharmony between their personal and social lives. Acquired skills devoted to learning are shaped by teachers in ways such as self-directed and peer learning, and community-based participatory research (Admiraal et al., 2021).

The LLL model's pillars represent principles of thinking: the "what." In order to translate conceptual principles into practice, teachers use a range of pedagogical methods for continuous professional learning (Brunetti and Marston, 2018) and represent the "how."

## 2.3. Continuing professional development for online teaching

Continuous professional development (CPD) encourages in-service teachers to share knowledge, experience, resources, and effective teaching practices with peers (O'Toole, 2019). Solutions for applying professional development to teachers' training in remote learning (Ministry of Education, 2020), based on a map of assessment measures (RAMA, 2018), include the following six pedagogical methodologies related to the LLL pillars.

### 2.3.1. Data-driven instruction

Educational Data Mining (EDM) studies data patterns emerging from pedagogical environments' databases (Romero and Ventura, 2020). This approach focuses on technological challenges in education and seeks patterns to develop new models that aid teaching and learning processes (Margaliot and Gorev, 2020; Romero and Ventura, 2020). The popularity of EDM has grown since the outbreak of COVID-19, due in part to increased uses of online learning, instrumental auxiliary programs, and the Internet for learning (UNESCO, 2020; Mukuka et al., 2021). New systems facilitate interaction between teachers, students and educational data or provide enhanced access to administrative data (Romero and Ventura, 2020). In the practical application of "learning to know," teachers acquire theoretical knowledge in order to use technological tools appropriately. According to Seufert et al. (2021), they must determine the best context for each technology. In applying the "learning to do" pillar, the teacher translates knowledge into practice (Ndukwe and Daniel, 2020). The application of "learning to live together" in data-driven instruction can promote a professional learning community (Thornton and Cherrington, 2019).

### 2.3.2. Empathy-based pedagogy

Lyu et al. (2021) defined empathy as an ability to understand the circumstances and point of view of the other, in imagination and in reality. The lack of empathy can increase aggressiveness, bullying, and failure to connect emotionally (Soliman et al., 2021). In the sphere of education, empathy helps achieving cooperation and a sense of belonging in the classroom, engaging the students' inner motivation to learn (Soliman et al., 2021). Building a meaningful empathy-based relationship places the student in the center. Empathy is related to attachment theory (Bowlby, 2012), which is defined as behavior that preserves or achieves closeness with a person that allows him to better deal with the world (Swan, 2021). The translation of empathy-based methodology into perceptual ideas in the context of LLL includes the acquisition of theoretical knowledge – "learning to know" – by

exploring students' differentness in order to estimate how they deal with disturbances or challenges that confront them (Wink et al., 2021). The pillars "learning to do," "learning to be" and "learning to live together" ideally are translated by teachers into empathetic behavior and environmental emotional intelligence (Wink et al., 2021).

### 2.3.3. Experiential learning

Experiential learning is a constructive process that explains how knowledge is acquired and proposes that the learner create meaning from experiences (Kolb, 2015; Watson et al., 2019). The teacher must recognize that every student may have a particular path and pace over the learning cycle (Gittings et al., 2020). The shared idea is to learn through action (Fromm et al., 2021), which dovetails with the LLL pillar "learning to do" and application of procedural knowledge. Students who were active during in the learning process succeeded in expressing themselves, more enjoying during the learning and felt a sense of group belonging (Elyakim et al., 2019), strengthening the pillars of "learning to be" and "learning to live together."

### 2.3.4. Differentiated learning

Differentness in the classroom is manifested in differences in language, culture and/or ethnic features. One of the most significant challenges that teachers face today is the need to reduce academic gaps between different students (Flanagan et al., 2020). Vantigham et al. (2020) defined differential instruction as a framework of teaching that aims to address individual learning needs and maximize students' learning opportunities. The implementation of differentiated learning within the context LLL assumes students are different and require different learning and teaching practices (Griful-Freixenet et al., 2020; Pozas et al., 2020). These concepts support "learning to know" and "learning to live together," while "learning to do" can be implemented into different types of educational practices adopted by teachers in order to addressing their unique needs (Griful-Freixenet et al., 2020).

### 2.3.5. SRL – Self regulated learning method

SRL often occurs beyond formal school boundaries. The means of learning to learn must be an important goal of educational systems (Kadioglu-Akbulut and Uzuntiryaki-Kondakci, 2021). This practice demonstrates the LLL pillar "learning to know." Another important aspect of continuing learning, "learning to do," is demonstrated by the flipped classroom (Tsai et al., 2020) which changes traditional educational focus into one where students are introduced to subject matter at home and practice it using high order thinking skills at school. "Learning to be" can be translated in this context into the teacher's ability for self-evaluation, leading him to develop a sense of autonomous professional competence and aid in making pedagogical decisions such as how to teach (Wilson-Daily et al., 2021). Teachers apply the "learning to live together" pillar *via* continuous learning by means of participation in professional communities which encourage their autonomous learning process (Ran and Josefborg Ben-Yehoshua, 2020).

### 2.3.6. Assessment of learning method

Modern learning methods encourage students to achieve learning at their own pace (Pang, 2020). Past studies show formative assessment can reduce the gap between the student's current progress and aspirational processes (Brooks et al., 2021). Until recently, this was the norm in traditional education and the idea behind "learning to know"

in the LLL paradigm. By understanding the learning habits and outcomes for a student, the teacher can reach conclusions about which learning processes were the most successful (Yan and Brown, 2021) and this applies to the "learning to do" pillar. In contrast to the traditional type of assessment, which focused on psychometric achievements, this type of assessment is based on the daily learning process that occurs in the classroom. In the practical application of "learning to be," teachers and students can use information provided by assessment in order to synchronize learning and teaching and thus promote students' success (Wu et al., 2021).

## 2.4. Technological mediating cluster – UTAUT model

As demonstrated by the COVID-19 pandemic, the transition to online learning demands the use of various digital tools and platforms (Nikolopoulou et al., 2021). Various theoretical models attempt to explain the use of technology-based systems. Among these are the Unified Theory of Acceptance and Use of Technology (UTAUT), which examines factors that influence technology use (Venkatesh et al., 2003) and is operationalized using the UTAUT model.

The UTAUT model, developed by Venkatesh et al. (2003) is based on four theoretical components: which influence the behavioral intention of the user and the degree/extent of use behavior (Dwivedi et al., 2020; Mittal et al., 2021). These are: (1) *Performance expectancy*: The extent the user perceives technology as effective (Yan and Brown, 2021) and relates to the mental/intellectual perception of the user in which the use of technology can help, in the current study, the teacher achieves better performance, through the use of remote teaching technologies (Hu et al., 2020; Shah et al., 2021). (2) *Effort expectancy*: The ease that the use of technological tools are perceived as lending to the learning process (Alghazi et al., 2021). Effort expectancy is considered to be a significant factor in predicting the intention of the user to adopt a technology in the learning or teaching process, because it helps the user estimate the amount of effort he will have to invest in using a particular technology (Kim and Lee, 2020). (3) *Social influence*: How the user perceives the way other appreciated people in his social network think about his use of technology (Yuan et al., 2021). Xu et al. (2021) found social influence is one of the central factors in behavioral intention, and with the mediating variable of peer communication has a synergetic impact on teachers' intention to use technology. (4) *Facilitating conditions*: The extent to which the user believes that suitable organizational and technical infrastructures exist that can support the teacher during use of the technological system (Venkatesh et al., 2003). Kim and Lee (2020) measured the predictor of factors seen as helpful from the point of view of the teachers. When teachers believed that they had access to the necessary resources and training, technical support and a suitable infrastructure, there was a higher likelihood that they would adopt/use the technology (Bauwens et al., 2020).

These four components influence teachers' *behavioral intention* to use and integrate technology in their teaching (Wiziack and Dos Santos, 2021) which refers to the extent to which the teacher will express intention to use technology (van der Spoel et al., 2020) and the extent of the *actual adoption of the behavior* which refers to the actual use of technological aids for teaching purposes (Nikolopoulou et al., 2021).

## 2.5. Output cluster – Teachers' performance assessment

Assessment processes play an important role in the pedagogical world, bringing a comprehensive viewpoint learning progress (Saeed et al., 2018). Assessment processes are important at the interpersonal level of teacher-student, and at the systemic-organizational level. In order to set a standard of quality for educators, the Israeli Ministry of Education's National Authority for Measurement and Evaluation (RAMA) developed an assessment map, and built a training program with 4 dimensions (RAMA, 2018). These are teachers' commitment to the students and school, expertise in content knowledge and pedagogical content knowledge, teaching and education management, and teacher as learner.

### 2.5.1. Teachers' commitment to the students and school

This dimension considers the relationship that the teacher builds and supports with students' achievements (RAMA, 2018). This is the foundation of the emotional and professional wellbeing of the teacher, influenced by students' behavior. Building a positive, stable relationship becomes a major goal of teachers (Aldrup et al., 2018). From a systemic viewpoint, the teacher is a key player in the school environment and the factor with most influence on the students' scholastic level, academic development and emotional wellbeing (Hawthorne et al., 2019). The second aspect of this dimension is the teacher's ability to respond to variance among learners in the classroom. This differentness is also manifested in ethno-cultural and socio-economic and other characteristics of identity in the classroom. This impacts the quality of teaching and presents teachers with an ongoing challenge to develop learning methods suited to students' needs (Ashraf et al., 2021). The ability to provide advanced education and support for all students is a significant challenge that can be resolved through collaboration and joint work (Griffiths et al., 2021). The third aspect of this dimension is the extent of the teachers' partnership with external or internal stakeholders. For example, strengthening and improving the relationship and cooperation between teachers and parents can be essential to a student's personal and academic progress (Myende and Nhlumayo, 2022). Collaboration between schools can contribute to teachers' professional development (Wong and Dillon, 2020) as can collaboration among classmates (Veldman et al., 2020).

### 2.5.2. Expertise in content knowledge, technology, and pedagogical content knowledge

Assessment in expertise in CK and PCK refers to the acquisition and development of knowledge and thought processes. Development and increased use of technology in education led to a growing need among teachers for technological knowledge (TK). This knowledge ties in with skills and capabilities, the how and for what purposes (Sundqvist, 2020).

The biggest challenge for teachers was to change their teaching approach in order to meet the demands and needs of the current generation of students, who use multiple technological tools (McHaney, 2011). Teaching millennials demands that the teachers know how to use technology (Prasojo et al., 2020). The quick transition to online learning due to the COVID-19 outbreak caused significant pressure within teachers' work. The transition was not only

about transferring the instructional content to an online format; teachers also had to navigate new technological systems (Allen et al., 2020).

The TPACK (Technological Pedagogical Content Knowledge) model concerns the integration of content, pedagogical and technological knowledge (Mishra and Koehler, 2006). This model reflects the dynamic integration of these three areas of knowledge (content, pedagogy, and technology) and their importance in effective integration and mediation of technology in the teaching and learning processes (Schmid et al., 2020; Yeh et al., 2021).

The second content-related aspect of assessment relates to development of emotional and social skills. This helps determine which knowledge is acquired from various sources. According to Toker Gökçe (2021), teachers do more than transmitting specific knowledge and teaching skills required for a particular profession; rather, they must advance, lead forward, raise and enhance students' ability to develop ideas and aptitudes that will enable them to explore the world independently. Teachers with psycho-pedagogical knowledge can use it to understand their students and build interpersonal relationships, thus empowering them (Blândul and Bradea, 2017).

The third aspect of assessment in this component connects the previous ones to the moral aspect of education. This can generate positive change in students and pass on social norms and values of the environment (Butera et al., 2020).

### 2.5.3. Teaching and education management

The first aspect of the teaching and education management dimension of assessment combines technological and frontal learning environments to deal with increases in available technologies. Integrating learning environments are connected to comprehensive cognitive processing, higher learning reception, better self-examination ability, and satisfaction from the learning process (Müller and Wulf, 2021). A varied but stable environment can be developed when teachers organize the learning process to provide clarity about teaching content and expected learning sequence. The second aspect in teaching education management is clarity that aims to ensure the learning process is goal-oriented, mediated by the teacher, related to the subject and correctly scaled (Ainley and Carstens, 2018; Wiens et al., 2022). Clarity includes paying attention to the classroom climate (Corwin Smart Brief, 2017; Li et al., 2021).

The third and last aspect of education management dimension is performance of assessment and feedback in order to advance the learning and teaching process (Brown et al., 2021). Assessment can serve as an educational tool, thanks to the learner's active participation in the learning process.

### 2.5.4. Teacher as a learner

The teacher as a learner assessment dimension reconnects to the professional development cluster. According to the LLL pillar "learning to know," offers teachers as agents of change to acquire, complete or expand their knowledge and skills, for the sake of successfully promoting their teaching (Sailer et al., 2021; Seufert et al., 2021) with the goal of personal or professional advancement (Garzón-Artacho et al., 2021). The first aspect notes the importance of learning and professional development throughout a teacher's career. According to Özdemir (2020) and Özdemir et al. (2021), more time invested by teachers in their professional development results in

significant changes in the quality of their teaching. In other words, the teacher, like the student, is in a constant learning process. The second aspect of teacher as learner is learning by self-action research. In their study, Sailer et al. (2021) examined teachers' self-assessment of teaching skills connected to technology. They found that teachers' assessment of their learning methods helps them identify areas of excellence, progress, and improvement in the professional process that continues throughout their lives. The third aspect of teacher as learner relates to peer learning. Online professional development has gained momentum. This includes professional training courses that make remote collaborations among peers possible (Dille and Røkenes, 2021). In addition to evaluating students' performance, teachers use assessment for learning for self-feedback. Teachers can evaluate students' learning processes to measure their teaching performance (Zhang, 2020).

## 2.6. Background summary

Taken holistically, the three clusters, pedagogical input, technological mediating, and output, provide a framework to organize our study. The pedagogical input cluster comprises three elements: professional development, LLL and teachers' training, and continuing professional development for online teaching elements. LLL in this cluster is composed of learning to know, learning to do, learning to be, and learning to live together. The continuing professional development element uses the RAMA (2018) map of tailored assessment measures for organization and considers data-driven instruction, empathy-based pedagogy, experiential learning, differentiated learning, SRL method, and assessment of learning method.

The second cluster, technological mediating measures, relies on the UTAUT model, and considers performance expectancy, effort expectancy, social influence, and facilitating conditions for measurement. In the third and final cluster, called output, we examine teachers' performance appraisal. Here we consider teachers' commitment to the students and school; expertise in content knowledge and pedagogical content knowledge; teaching and education management; and, teacher as learner. Together these elements provide a framework for our study.

## 3. Methods

### 3.1. Research question and hypothesis

The COVID-19 pandemic stimulated a need to expand pedagogical knowledge to include technology as well as professionalization in the teaching process (van der Spoel et al., 2020). The unexpected transition to using more technological teaching tools caught many teachers unprepared (van der Spoel et al., 2020). Some claimed remote teaching was not as effective as teaching in the classroom; however, it was important that students had continuity and the learning process continued uninterrupted (Hebebcı et al., 2020). Some claimed when teachers and students are not in the same physical environment, learning suffered. Further, some students may not have access to technological systems and some teachers may have difficulties operating the software (Hebebcı et al., 2020).

The current study illustrates the relationship between variables impacting pedagogical training aids used to achieve better teaching outcomes considering technology use by teachers. This study focuses on a hypothesis that examines direct and indirect influence, *via* the use of remote learning technology, on professional development considering the pedagogical outputs (teachers' commitment to the students and school, expertise in content knowledge and pedagogical content knowledge, teaching and education management, and teacher as learner) defined by the National Authority for Measurement and Evaluation (RAMA, 2018).

As stated earlier, our research question is: To what degree does a teacher's professional development process influence pedagogical efficacy *via* formulating positive outlooks of remote teaching technologies. This question integrated variables and created a research model as shown in Figure 1. As shown, the integration essentially created three clusters: professional development which comprises structures, LLL, and methods; the UTAUT model to investigate the use of technology based on theoretical antecedents; and finally, assessment measures including commitment to students and schools, expertise in subject content and its teaching, management of teaching and education, and learning and professionalization throughout career.

The research question was operationalized as the following hypothesis: *The teacher's professional development processes will have a positive effect on the teacher's pedagogical efficacy by forming a positive outlook on the use of remote teaching technologies.*

### 3.2. Participants

The study included 372 participants from Hebrew-speaking schools' communities in the state secular and religious school systems. These communities are ongoing in each of 6 districts in the country. The participants were selected randomly by the managers of each district. Participants were provided with an email inviting them to complete a questionnaire comprising questions related to the teacher learning center, remote learning technologies, and assessment measures. Sixteen randomly selected participants from this group also completed a qualitative interview. Average age of teachers in the sample was 46.14 (SD = 8.88); the youngest was 22 and the oldest, 64. Average seniority was 18.72 years (SD = 9.59) with a range from 1 to 35 years. Table 2 shows most were women (88.2%) and taught in state schools in regular education. About half study in online training courses at Pisga (teachers' training centers) (Pisga, 2022), about a third study in a professional teachers' community, and the rest study independently.

Two one-way ANOVAs examined differences regarding age and seniority of respondents in different districts. No significant statistical differences were found regarding age,  $F(5,366) = 1.24$ ,  $p = 0.292$ , or seniority,  $F(5,366) = 1.07$ ,  $p = 0.377$ . Independent sample t-tests examined differences between men and women regarding age and seniority. No significant statistical differences were found in age,  $t(370) = 0.30$ ,  $p = 0.761$ , Cohen's  $d = 0.049$ , or seniority -  $t(370) = -0.82$ ,  $p = 0.416$ , Cohen's  $d = 0.131$ .

Differences between men and women in the breakdown of professional development were tested using the Chi-Square Test of Independence. No statistically significant difference was found,  $\chi^2(2) = 1.61$ ,  $p = 0.447$ . Calculating the power analysis with G\*Power in a regression analysis based on  $f^2 = 0.15$  (a medium effect power),

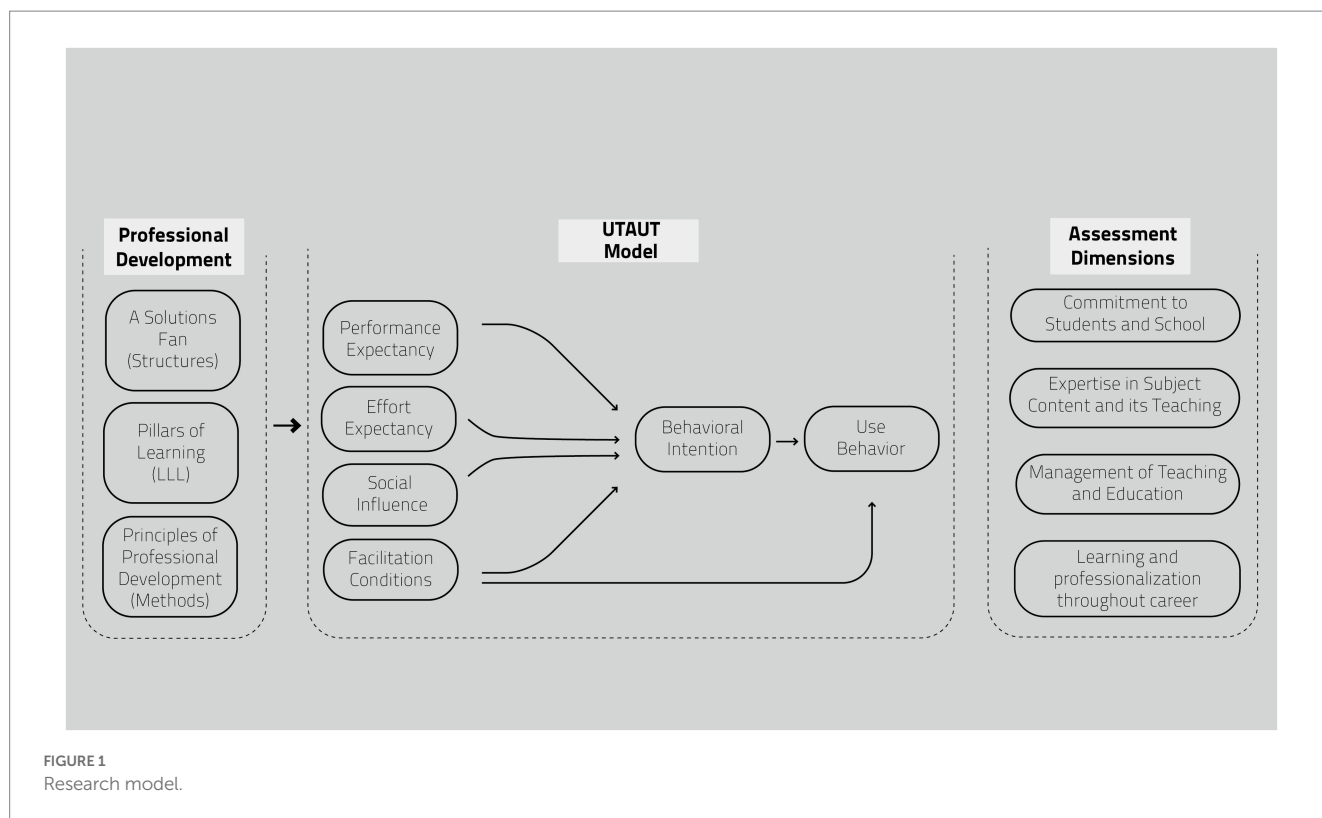


FIGURE 1 Research model.

TABLE 2 Breakdown of the teachers.

Variable	Frequency	Percentage
<b>Gender:</b>		
Male	44	11.8
Female	328	88.2
<b>Supervision:</b>		
State (secular)	270	72.6
State religious	102	27.4
<b>Type of education:</b>		
Regular	344	92.5
Special education	28	7.5
<b>District:</b>		
South	39	10.5
Central	35	9.4
Jerusalem	32	8.6
Tel Aviv	182	48.9
North	54	14.5
Haifa	30	8.0
<b>Professional development:</b>		
Online training course at Pisga center	189	50.8
Community of professional teachers	120	32.3
Autonomous learning	63	16.9

Power = 0.95, alpha level *a-priori* significance level of 0.05 with 20 predictors, requires a sample of at least 222 participants. A MANOVA

analysis, based on  $f^2 = 0.0625$ , Power = 0.95, alpha level *a-priori* significance level of 0.05, with 6 groups and 6 dependent variables, requires a sample of at least 120 participants. Power was calculated on the most complicated planned analyses making a sample of 372 participants sufficient.

### 3.3. Procedure

The study was conducted in response to a call for a proposal on 23 November 2020, by the Chief Scientist of the Ministry of Education of Israel, to perform short-term studies on educational topics connected to the COVID-19 period. The teacher learning centers questionnaire used in the study was developed by the researchers, aided by educators with expertise in the field of professional development (e.g., directors of Pisga training centers and a district supervisor for professional development), in a series of meetings intended for consultation, for defining common learning methodologies in professional development during COVID-19, and for the precision of the questionnaire. This questionnaire comprised 24 statements that reference the interaction of the four pillars of learning of LLL using six different learning methodologies (data-driven instruction, empathy-based pedagogy, experiential learning, differentiated learning, SRL, assessment of learning method) defined and authorized by experts in the field of educator professional development (RAMA, 2018). The questionnaire was composed of four factors that characterized teachers' methods in the framework of professional development during the COVID-19 crisis: teacher alone; teacher and peers; teacher and students; and teacher and curriculum planning.

The study was approved by the Chief Scientist of the Ministry of Education of Israel. The questionnaire was distributed digitally by

directors of Pisga centers throughout Israel, to all teachers meeting the study's criteria (e.g., Hebrew-speaking primary school teachers). The questionnaire was distributed from May to August 2021.

### 3.3.1. Correlations between 4 assessment dimensions, technology use, and 4 learning foci

In order to test whether a link existed between the four assessment dimensions (RAMA) and technology use (UTAUT), and the four learning foci (LLL and four pillars), Pearson Correlations were conducted. All correlations were statistically significant.

### 3.3.2. Differences between districts

Influence of district on the 4 learning foci: in order to determine whether district made a difference with regard to the four learning foci, a one-way MANOVA was conducted. The dependent variables in the analysis were the four learning foci (teacher alone; teacher and peers; teacher and students; and teacher and curriculum planning), and the independent variable was district. No statistically significant differences were found between the districts in measuring the four learning foci,  $F(20,2,464) = 1.29$ ,  $p = 0.174$ ,  $\eta^2 = 0.017$ .

In order to determine whether district affected positions regarding the use of technology for online teaching, a one-way MANOVA was conducted in the six districts. The dependent variables in the analysis were the seven positions regarding the use of technology for online teaching: performance expectancy, effort expectancy, social influences, facilitating conditions, intention to use, actual use, and actual daily use. The independent variable was the district. No statistically significant differences were found between the six districts in a simultaneous measuring of the seven positions,  $F(35,1815) = 1.36$ ,  $p = 0.080$ ,  $\eta^2 = 0.025$ .

Similarly, no statistically significant differences were found between the six districts with regard to demographic variables. This indicates that the districts were not essentially different, and the sample was not biased by district. It can be assumed that there were no differences in the relationships between the variables in the various districts.

## 3.4. Tools

The tools used in this study comprise the questionnaire supplied to the participants. Among these are the teacher learning center questions, UTAUT questions focused on remote teaching technology use and behaviors, and the assessment measures questions. Each of these tools are described in more detail. We also describe the procedure followed with qualitative data acquisition in this section.

### 3.4.1. Teacher learning centers questions

The questionnaire contained 24 statements referring to interaction with the four pillars of LLL (El Mawas and Muntean, 2018; Smith, 2018) using six different learning methodologies (e.g., data-driven instruction, empathy-based pedagogy, experiential learning, differentiated learning, SRL, assessment of learning method) defined and authorized by experts in professional development (Ministry of Education, 2020). The questionnaire comprised 4 factors: learning foci that characterized teachers' methods in the framework of professional development during the

COVID-19 crisis: teacher alone; teacher and peers; teacher and students; and teacher and curriculum planning. Participants rated agreement with each statement using a 5-point Likert scale (1-strongly disagree, to 5-strongly agree). Unrestricted factor analysis using varimax rotation of the questionnaire was conducted. The objective of the factor analysis was to identify factors that characterized learning methodologies. Results (Table 3) show 4 factors that explain 73.17% of the variance.

### 3.4.2. Remote teaching technology (UTAUT) questions

The UTAUT questionnaire examined teachers' perceptions regarding acceptance and use of technology for remote teaching and learning and was on research by Venkatesh et al. (2003). The questionnaire included 27 statements divided into seven factors: performance expectancy, effort expectancy, social influence, facilitating conditions, intention to use, actual use, and actual daily use. Respondent rated agreement with each statement using a 5-point Likert scale (1 – strongly disagree to 5 – strongly agree). A reinforcing factor analysis (varimax) was conducted, which limited the number of factors to six (two concerning actual use and daily use were merged). Likewise, two items were removed due to the lack of suitability for the environments examined. The factor analysis identified factors that should make up the questionnaire and explored the positions vis-à-vis remote online teaching technology. The results of the factor analysis (Table 3) show 6 factors that explained 78.47% of the variance.

### 3.4.3. Assessment measures questions

The questionnaire included 12 statements divided into 4 factors: commitment to students and school; expertise in content and content instruction; instruction and education management; and career-long learning and professionalization (RAMA, 2018). Respondents rated each question, using a Likert scale, considering the extent to which professional development contributed to improvement of personal professional capabilities during the COVID-19 (1–not at all to 6–very much). A varimax reinforcing factor analysis was performed, limiting the factors to 4. The objective was to identify assessment dimensions. Results of the factor analysis (Table 4) show a division into 4 factors that explain 80.90% of the variance.

### 3.4.4. Analysis of qualitative data

Sixteen semi-structured interviews also were conducted with teachers that participated in a professional development process during COVID-19. The analysis process was qualitatively-interpreted, where each analysis unit represented a statement with one meaning. In total, 200 statements representing meaningful units were analyzed. Content analysis was performed in two stages: the first, top-down, was done in accordance with Venkatesh et al. (2003) regarding user acceptance of technology. The second, bottom-up stage, used an inductive, constructivist process to test features from each category. In addition, during the inductive analytical process, new, simple categories formed that did not appear in the research literature (Lincoln and Guba, 1985) and touched on measures of teachers' professional development quality. The researchers also used the etic approach (Morris et al., 1999) for terminology and category simplicity to verify responses to report recipients. Reliability was achieved by using rich descriptions and



TABLE 3 Factor analysis and loadings of questionnaire on teachers' learning methodologies and types of knowledge acquired.

Subject	Learning foci			
	Teacher alone	Teacher and peers	Teacher and students	Teacher and curriculum
To do – differentiated learning	0.765	0.264	0.166	0.219
To do – self-directed learning	0.765	0.210	0.148	0.285
To know – self-directed learning	0.750	0.163	0.100	0.304
To know – differentiated teaching	0.709	0.263	0.187	0.226
To be – differentiated teaching	0.696	0.323	0.269	0.204
To be – self-directed learning	0.679	0.260	0.302	0.311
To do – experiential learning	0.654	0.145	0.420	0.042
To be – experiential learning	0.581	0.235	0.486	0.172
To know – experiential learning	0.526	0.214	0.434	0.231
To live – experiential learning	0.272	0.815	0.204	0.055
To live – differentiated teaching	0.433	0.795	0.075	0.126
To live – empathy	0.157	0.773	0.457	0.132
To live – self-directed learning	0.411	0.767	0.024	0.265
To live – data learning	0.070	0.757	0.384	0.325
To live – assessment	0.271	0.739	0.115	0.455
To do – empathy	0.277	0.204	0.783	0.206
To know – empathy	0.210	0.165	0.777	0.252
To be – empathy	0.305	0.199	0.751	0.274
To do – assessment	0.489	0.215	0.175	0.700
To know – assessment	0.447	0.214	0.156	0.675
To do – data learning	0.226	0.229	0.381	0.626
To know – data learning	0.172	0.200	0.424	0.615
To be – assessment	0.471	0.287	0.289	0.586
To be – data learning	0.201	0.177	0.555	0.559
Explained variance	23.96%	18.80%	15.96%	14.45%

direct quotes of the interviewees. Research process transparency was achieved by recording and transcribing the interviews. Finally, the selection process was performed simultaneously by two expert researchers, giving validity to the matching statements to appropriate categories (Shkedi, 2003). The analysis used GoogleDocs' highlighting feature.

## 4. Results

The research hypothesis examined relationships between variables in the study. The model based on the hypothesis included the four learning assessment measures as dependent variables and the four learning foci and professional development items as predictor variables. Between them was the remote online teaching technology items, which mediate the array of relationships between the predictor variables and the dependent variables. The hypothesis was tested using two path analyses. The first analysis included all the variables in the study and related to the measure of remote online teaching technology as one general measure. The second analysis focused on measures of

remote online teaching technology. This analysis examined the UTAUT model, which posits that four parameters – performance expectancy, effort expectancy, social influences, and facilitating conditions – predict the intention to use the technology, while the intention predicts the actual use.

### 4.1. General model

A path analysis tested whether the learning foci predicted learning assessment measures through the use of remote teaching technology. The analysis included the four learning assessment measures, the general measure of remote online teaching technology usage, the four learning foci, and two professional development variables. The model that appears in Figure 2 shows high correlation values, suggesting a good data-model fit. All four learning assessment measures are predicted by the learning focus “teacher alone” as was the use of remote online teaching technology. The assessment measure “career-long learning and professionalization” was also predicted by the learning foci: the teacher and his peers, and the teacher and the

TABLE 4 Analysis of factors and loadings of assessment questionnaire.

Subject	Learning and professionalization	Commitment	Management	Expertise
Learning and Prof 10	0.833	0.280	0.180	0.220
Learning and Prof 12	0.823	0.311	0.208	0.190
Learning and Prof 11	0.715	0.269	0.420	0.195
Management 9	0.595	0.209	0.573	0.195
Commitment 1	0.248	0.816	0.177	0.180
Commitment 3	0.352	0.723	0.360	0.127
Commitment 2	0.270	0.710	0.259	0.378
Management 7	0.219	0.292	0.754	0.311
Management 8	0.375	0.220	0.661	0.406
Expertise 6	0.295	0.544	0.637	0.052
Expertise 5	0.257	0.445	0.519	0.495
Expertise 4	0.308	0.261	0.310	0.807
Explained variance	24.44%	22.33%	21.53%	12.60%

Loadings above 0.300 are shaded.

student. Similarly, the variable, autonomous learning, predicted the three learning assessment measures: expertise in content and content instruction; instruction and education management; and career-long learning and professionalization. In addition, use of remote online teaching technology was predicted by the three learning foci: the teacher and his peers; the teacher and the student; and the teacher and the learning plan. Finally, the use of remote online teaching technology mediated the link between the learning foci – the teacher and his peers; the teacher and students; and the teacher and the learning plan – and the four learning assessment measures. Finally, higher values of the learning foci “the teacher and his peers” and “the teacher and the learning plan,” predicted higher values in the use of remote online teaching technology, and the use of remote online teaching technology as well as higher values for the four learning assessment measures. See Figure 2.

## 4.2. UTAUT model

The research model developed for this study included use of remote online teaching technology as a general measure. Path analysis examined relationships between performance expectancy, effort expectancy, social influences, facilitating conditions, use intent and actual use as well as the relationship between intent and actual use related to preparing pedagogical tasks and teaching students. High correlation values indicated good data-model fit (Figure 3). Three variables, performance expectancy, effort expectancy, and facilitating conditions, predicted intent to use teaching technologies. Intent predicted actual use. Performance expectancy and facilitating conditions predicted actual use of teaching technologies.

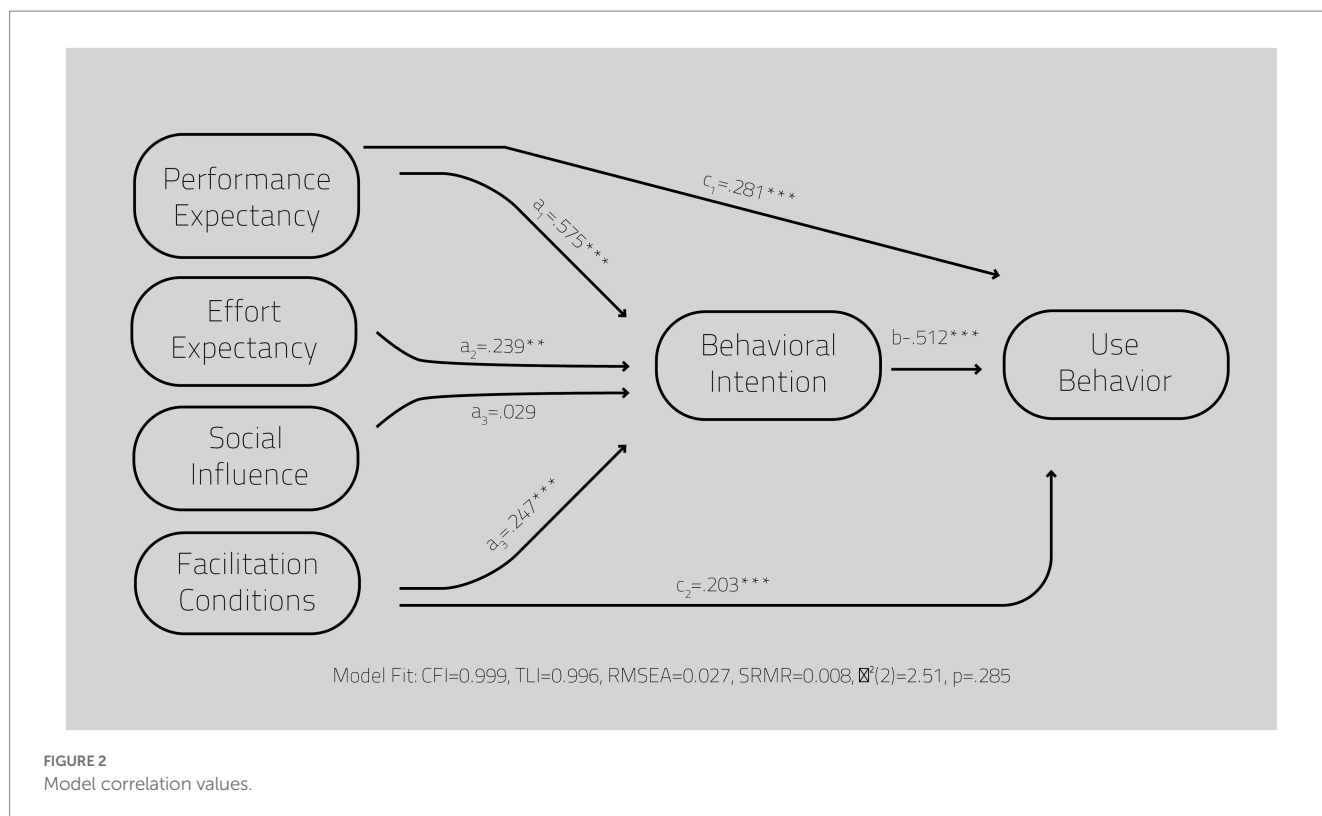
The research hypothesis was verified. Learning assessment measures were predicted by technology use, while technology use was predicted by learning foci. Similarly, technology use mediated the relationship between the three learning foci: teacher and peers, teacher

and students, and teacher and curriculum planning, and the four learning assessment measures. Likewise, the focus “teacher alone” predicted the four learning assessment measures, whereas the foci “teacher and peers” and “teacher and students” predicted the assessment measure “career-long learning and professionalization.” Furthermore, within the components of the use of remote online teaching technology, performance expectancy, effort expectancy, and facilitating conditions predict intent, and intent predicts actual use. Similarly, intent mediates the relationship between performance expectancy, effort expectancy, and facilitating conditions, and actual use. All suggest that pedagogical efficacy is influenced by professional development *via* a positive outlook on the use of remote online teaching technology.

## 4.3. Qualitative outcomes

The objective of the interviews was to determine how teachers perceive various learning methodologies used in professional development during COVID-19. In addition, their attitude toward different factors related to online learning technologies used during this period was examined. The analysis process was qualitative-interpretive, where an analysis unit was a statement with one meaning. In total, the study analyzed 150 statements constituting meaningful units, which reflected teachers’ attitudes toward professional development and the use of remote online teaching technology (Figure 4).

Examples of statements provided by study participants included (translated from Hebrew): “Technology comes to serve pedagogy and not the other way around”; “Technology enables closer communication - allows the teacher to continue communicating with his students in the academic and social-emotional aspects and also allows the learner to continue learning and to be in contact with his teachers and friends”; and “We connected [technology] to the world of the children’s content, and it was very beautiful.”



## 5. Discussion

The study examined the relationship between professional development, remote online teaching technology, and pedagogical efficacy. The outbreak of the COVID-19 pandemic forced the educational system, particularly teachers, to move to online learning in order to maintain educational and academic continuity (Wong and Moorhouse, 2020). Teachers' professional development programs were also impacted by the pandemic and online learning offered an effective solution (Van Nuland et al., 2020). This necessitated a pedagogical reform to make technology accessible to teachers. Theory-based change explains how to develop reforms. This requires understanding the need and most appropriate solution to structure a suitable, practical reform (McLaughlin and Mitra, 2001). In this study, new measurements of learning principles were constructed based on research and analysis of changes needed during the COVID-19 pandemic, using the model of technology use processes.

The significant innovation of this study is the combination of pedagogical outputs, which are expressed in the four pillars of LLL (Alt and Raichel, 2020) as methodologies of practice, according to RAMA's map of dimensions (RAMA, 2018). Together, they affect teachers' technology use processes and create four learning foci. These include: (1) Teacher alone. Here, the teacher develops and becomes more professional in his field of knowledge. (2) Teacher and peers which focuses on peer learning that derives from the "learning to live together" pillar. (3) Teacher and students. Student-centred teaching that includes empathetic learning and differentiated teaching. (4) Teacher and curriculum planning which focuses on data-driven instruction methodologies. The teachers study existing

needs and translate these into pedagogical practice to improve the learning process.

The research hypothesis was verified, creating a general model that shows how learning foci and professional development frameworks affect pedagogical output processes *via* use of online learning technology as was shown in Figure 3. These findings validated that the four measures of learning assessment, according to the RAMA map of assessment measures (RAMA, 2018), were dependent variables. The predictor variables were the four learning foci, and professional development. Use of technology processes mediated the predictor variables. Findings showed a direct relationship between teachers' perception of advanced training as being positive and experience using technology as effective. Professional development formed a significant basis for increasing teacher's ability to face challenges, or to expand pedagogical goals into new areas (Davey and Egan, 2021). Figure 4 summarized these outcomes.

Teachers' training programs were designed for the current situation, with the aim of developing educational practices to help teachers teach more effectively (Ran and Josefberg Ben-Yehoshua, 2020). The qualitative analysis results in this study demonstrated the majority of teachers perceived technology as an educational tool that advanced the students and helped upgrade the learning process. Similarly, many study participants expressed the desire to continue using technological tools even after the full-return to the classroom. This finding is reinforced in the research literature (van der Spoel et al., 2020). Table 5 summarizes the central research findings. Perusal of the table reveals that learning foci and professional development predict technology use and learning assessment, such that different learning foci predict measures of technology use and learning assessment.

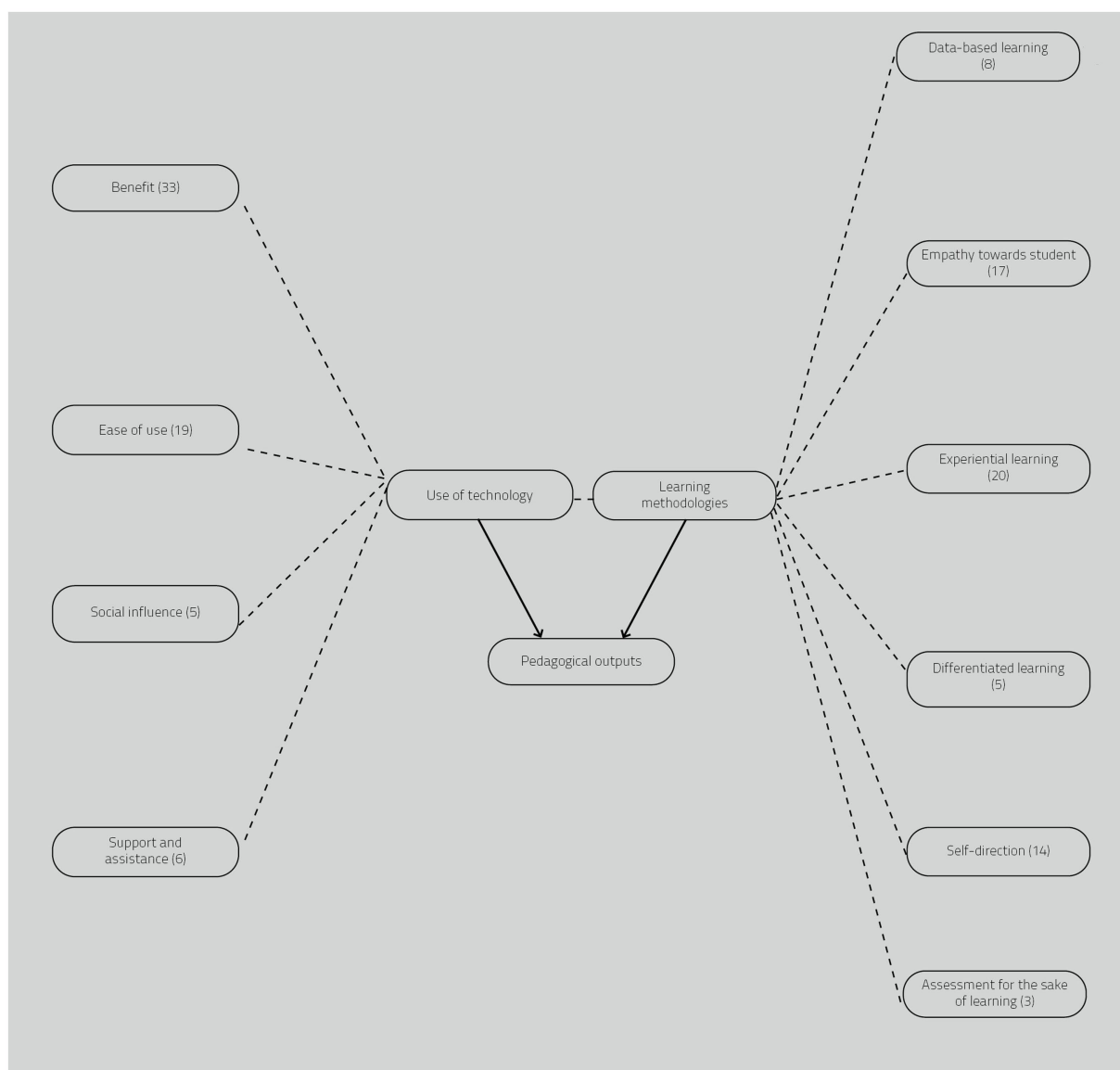


FIGURE 3  
Data model fit.

## 6. Conclusion

Despite the unexpected urgency required to integrate technology into the pedagogical arena in the wake of the COVID-19 outbreak, many teachers found technological tools to be a good answer to the challenges that confronted them in the transition to remote learning. In the present study, the results of the statistical and qualitative analysis show that, indeed, teachers in the Israeli educational system experienced a mostly positive effect from the integration of technological tools into the learning process and reported that they would continue to use these tools after the return to the classroom. Use of technology for remote learning, with the appropriate professional development processes, produced improved pedagogical results.

The successful integration experience and the process of effective use of technology are products of various and diverse information resources, mainly those that allow teachers to learn autonomously as well as with peers. For teachers, information resources are the perceptual basis for using technology and can become the foundation for personal and professional advancement. Additionally, the use of technology is perceived by teachers as effective mainly when they experience high performance expectancy and low effort expectancy. In other words, our study indicates that the less complicated the technology and the greater the pedagogical benefits – for the teacher and, even more importantly, for the students – the more the teachers tended to perceive the integration as successful. Various sources of knowledge have a significant impact on technology use processes among Israeli teachers.

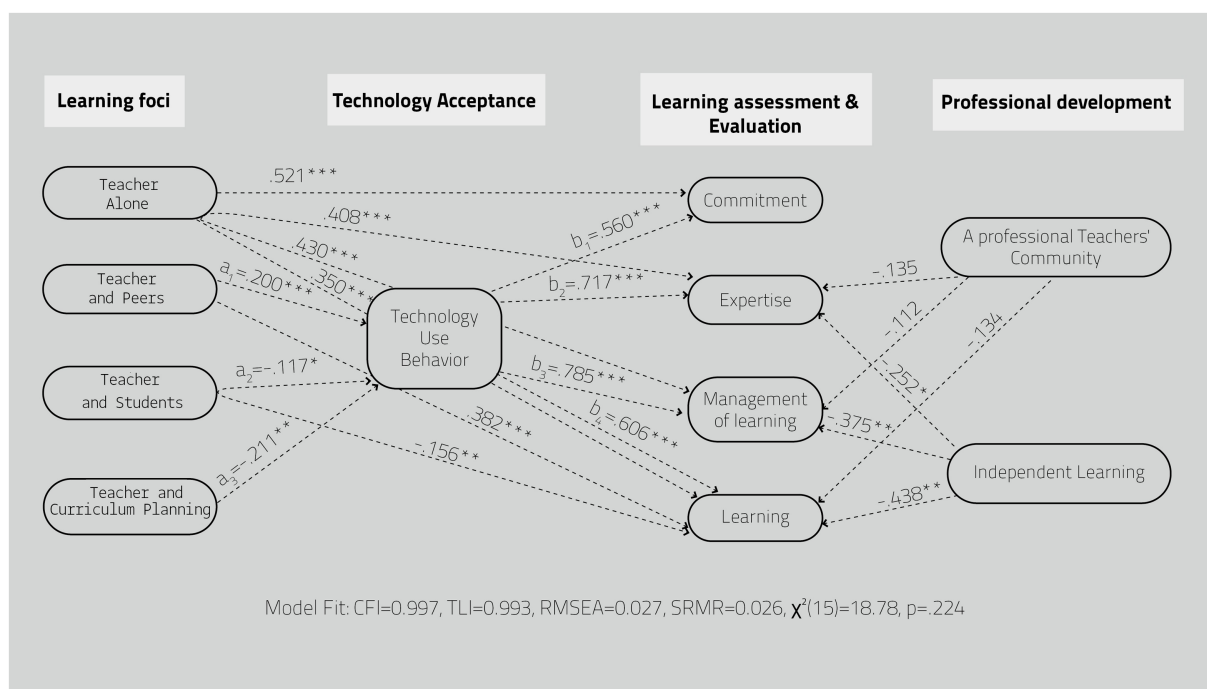


FIGURE 4 Teachers' attitudes toward the process of professional development.

TABLE 5 Summary of predictors for the learning assessment measures in path analysis.

Variable	Predictors
<i>Learning assessment measures</i>	
Commitment to students and school	Learning focus is the teacher alone (+)
	Use of technology use (+)
Expertise in subject content and in teaching it	Learning focus is the teacher alone (+)
	Use of technology (+)
	Online training at "Pisga" > autonomous learning
Management of teaching and education	Learning focus is the teacher alone (+)
	Use of technology (+)
	Online training at "Pisga" > autonomous learning
Learning and professionalization throughout career	Learning focus is the teacher alone (+)
	Learning focus is teacher and peers (+)
	Learning focus is teacher and students (-)
	Use of technology (+)
	Online training at "Pisga" > autonomous learning
Use of technology	Learning focus is the teacher alone (+)
	Learning focus is teacher and peers (+)
	Learning focus is teacher and students (-)
	Learning focus is teacher and curriculum planning (+)

### 6.1. Limitations and research directions

This study had several limitations. Among these were that the study took place within a single nation during the pandemic. This could mean generalizability issues may exist. The study is also subject to all limitations inherent to self-report surveys, although the qualitative portion of the study may help mitigate this to some extent. Another potential limitation relates to the rapid changes taking place in educational technology. The pace of change may impact our findings.

Future research directions may include broadening the sample and testing in additional nations' educational systems. Other interesting studies could include examining differences in educational institutions (e.g., higher education, adult education, and primary school differences). Obtaining students' perspectives on teachers' LLL could also be interesting.

### Data availability statement

The datasets presented in this article are not readily available because the datasets generated during and/or analyzed during the current study are not publicly available due government restrictions. Please contact the corresponding author for more information and requests. Requests to access the datasets should be directed to [irisre@ariel.ac.il](mailto:irisre@ariel.ac.il).

### Ethics statement

The studies involving human participants were reviewed and approved by Ministry of Education. The patients/participants

provided their written informed consent to participate in this study.

## Author contributions

The design of the research was done by NE and IR. NE, IR, and RM realized the review of the literature, analysis of the review of the literature and writing of the manuscript, and the additional research of literature. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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