

# Strengthening the quality of teacher education programs

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# Strengthening the quality of teacher education programs

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# Editorial: Strengthening the quality of teacher education programs

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## KEYWORDS

teacher education, strategies, teacher, field experience, pre-service teacher

## Editorial on the Research Topic

### Strengthening the quality of teacher education programs

## Introduction

Teacher education programs play a crucial role in promoting the quality of future teacher education by equipping teachers with the competencies and skills necessary to foster innovative teaching in diverse classroom settings. They are also considered as the cornerstone of preparing future teachers to meet the complex and diverse needs of 21<sup>st</sup>-century learners. Over the last decade, there has been a growing effort to sustainably strengthen the quality of teacher education programs to meet the evolving demands of contemporary education (Megawati et al., 2021). This growing effort has led to increased attention from educational researchers to identify innovative strategies that enhance the quality of teacher education programs (Mulyadi et al., 2020; Arifani et al., 2022). The articles published in this Research Topic explore the current understanding on the subject of strengthening the quality of teacher education programs, emphasizing key themes and research areas that have been raised as critical precursors for enhancing these programs.

## Review of pedagogical reform

### Conceptual outlook

The articles in this volume document three types of pedagogical innovations for strengthening the quality of teacher education programs. The article by Ling et al. highlights the need to meet a contemporary model of teacher education for middle school classrooms through optimizing the role of teacher distributive leadership to stimulate interaction, engagement, motivation, autonomy, and critical thinking. Moreover, Jang introduces his book review on Singapore's approach to teacher education. Teacher education program policy in Singapore is quite unique compared to other major countries such as the United States and China because Singapore prioritizes unilateral collaborative systems, like other countries, through the equal tripartite partnership between the Ministry of Education (MOE), National Institute of Education (NIE), and schools to equip their students with 21<sup>st</sup>-century skills, critical thinking, and creativity. Next, Dahl et al. introduce an innovative approach to teacher professional development using the ECHO model,

which presents the best practices for sharing (e.g., case presentations, problem-solving, mentorship) using teleconferencing technology. This adapted model intentionally focuses on creating a community of practice (CoP) or professional learning networks with the overarching objective of promoting ongoing relationships and dialogue across geographical and cultural boundaries to improve teacher professional development.

## Research findings

As part of the effort to enhance the quality of teacher education programs, two articles give positive contributions toward the body of knowledge through pedagogical reforms in the context of Chinese and Korean teacher education programs. First, in the Chinese pre-service teacher education program setting, [Cheng and Zhao](#) express the findings of the impact of the workshop for English teaching competition (WETC) as a professional learning community (PLC) on pre-service teachers' professional commitment. The findings reveal that the WETC program had significant and positive effects on pre-service teachers' professional commitment and collaboration, shared vision, and reflective dialogue, which effected their professional commitment by heightening their interest in professional development, commitment to teaching as a career, and personal time investment.

In addition, [Kim et al.](#) report the importance of international teaching practicum (ITP) experience for South Korean pre-service teachers' teaching attitudes, ways of thinking, and perceptions of classroom teaching. The study explains in what ways the participants' TPACK has been promoted and optimized. The findings illustrate that the ITP could trigger pre-service teachers' experience in terms of their teaching achievement and teacher agency, and among the elements of TPACK, the categories of CK, PK, PCK, and TK are very dominant during ITP activities.

The next two articles explore the psychological factors of teacher education during the COVID-19 pandemic, in addition to the pedagogical and technological barriers ([Megawati et al., 2021](#)). These articles examine the challenges faced by teachers during the COVID-19 situation, in which they did not have sufficient mental and physical preparation to teach. The first article, by [Moosa and Ramnarin](#), identifies teachers' beliefs and attitudes and measures the impact of their beliefs and attitudes on their behavioral intentions to integrate ICTs into their science classes during the pandemic situation in South Africa. The findings from this case study indicate that the empowerment evaluation approach positively impacted the teacher's beliefs and attitudes.

Furthermore, [Adams et al.](#) attempt to explore whether field experience becomes one of the key predictors of PST's instructional knowledge and community engagement. In their case study involving eight pre-service teachers and 33 pupils from culturally and socioeconomically marginalized communities, the researchers discover that training in the clinical experience of PST education plays a crucial role in the development of pre-service teaching, specifically for teaching students from culturally and linguistically diverse backgrounds. These two articles suggest further research to provide more TPACK training for pre-service teachers so that

they are ready to face unpredictable situations, such as that of the COVID-19 pandemic.

The last article by [Meutstege et al.](#) uses differentiated instruction (DI), which is a part of TPD. Providing differentiated instruction (DI) in secondary education requires teachers to engage in four phases: preparing a lesson series, preparing a lesson, teaching during the lesson, and evaluating the lesson. The significance of psychological factors in teacher education programs is also promoted in a study by [Spittle et al.](#) The study explores the confidence and motivation of pre-service teachers specializing in primary school physical education in Australia. The findings reveal that pre-service teachers generally have higher confidence in implementation and higher motivation in practice and performance.

## Conclusion

From the conceptual dimension, the articles explore different models of teacher education programs, from the tripartite model of Singapore to the ECHO community of practices model of the United States and the teachers' distributive leadership of Australia. These three conceptual articles agree that synergy among policymakers, teacher education institutions, and practitioners is the key to the success of teacher education programs in their countries. Finally, the empirical evidence demonstrates that a unique community of practices, such as the international teaching practicum (ITP), differentiated instruction (DI), workshop for English teaching competition (WETC), and training in physical education, can significantly enhance teacher attitudes, performance, and TPACK.

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# Confidence and motivation to teach primary physical education: A survey of specialist primary physical education pre-service teachers in Australia

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**Introduction:** This study explored confidence and motivation to teach physical education of pre-service teachers specialising in primary school physical education.

**Methods:** Participants were 277 pre-service teachers with a mean age of 21.37 years ( $SD = 3.09$ ) enrolled in a Bachelor of Education (P-12) who were specialising in primary physical education (P-6). Pre-service teachers completed the Confidence and Motivation to Teach Primary Physical Education Questionnaire (CMTPEQ), which measures confidence (management and planning and implementation) and intrinsic, extrinsic, and amotivated types of motivation (knowledge, performance, practice, professional expectations, student outcomes, and disengagement) toward teaching primary school physical education.

**Results:** Pre-service teachers reported higher confidence in implementation and higher motivation in practice and performance, with very low disengagement. Pre-service teachers in first-year were significantly less confident in both management and planning and implementation than other year levels ( $p < 0.05$ ). Pre-service teachers with less training and experience (completed no units in physical education or who had taught less than one hour of physical education on teaching rounds) were significantly less confident in both management and planning and implementation ( $p < 0.05$ ). Pre-service teachers reported higher intrinsic motivation for practice and extrinsic motivation for performance, with males reporting significantly higher extrinsic motivation in professional expectations than females ( $p < 0.05$ ).

**Discussion:** The study has highlighted the confidence of pre-service primary physical education specialist teachers in implementing physical education, but lower confidence in management and planning. A practical implication from the findings is the importance of training and experience in developing confidence and motivation, even for those specialising in physical education.

## KEYWORDS

physical education, primary school, teacher education, confidence, motivation, elementary school



## Introduction

Primary school physical education have the potential to contribute to the development of movement skills and competencies, as well as social, cognitive, and affective skills (Graber et al., 2008; Pangrazi and Beighle, 2019; Rink, 2020; Rink and Hall, 2008). It is, thus, imperative that primary school teachers provide quality physical education programs for children to engage with during development (Lloyd et al., 2014; Lopes et al., 2017) and that pre-service teachers feel equipped to deliver physical education. Despite the perceived importance of primary physical education, research on teacher education in physical education remains an under researched area (Carse et al., 2018). Several studies have highlighted challenges in design and delivery of physical education (Freak and Miller, 2017; Randall and Fleet, 2021), as well limited training and exposure for pre-service teachers in primary physical education (Lynch, 2017) that may influence teacher confidence (Brennan et al., 2021) and, potentially, motivation in physical education.

In many countries, including in Australia, primary school physical education is most often delivered by generalist primary teachers (O'Sullivan and Oslin, 2012; Freak and Miller, 2017), who typically do not engage in specialist training in physical education as part of their pre-service teacher education (Lynch and Soukup, 2017; Randall and Griggs, 2021). This presents a challenge to teacher education programs to equip generalist teachers to feel prepared, confident, and motivated in physical education (Freak and Miller, 2017). This has led to some debate as to whether generalist primary school teachers or specialist physical education teachers are best placed to deliver physical education (Freak and Miller, 2017; Jones and Green, 2017; Truelove et al., 2021). There are not many not many specialist programs for primary physical education (Lynch, 2013, 2015). Specialists generally complete a major area of study in a discipline area, typically in Australia this is a 6 unit/subject sequence (Spittle et al., 2022). Developing primary physical education specialists (as is common in secondary physical education) may contribute to quality physical education programs (Lynch, 2015, 2017) and could support primary generalists in delivering physical education in primary school settings.

Previous research has consistently demonstrated that generalists have lower levels of confidence to teach primary physical education (Morgan and Bourke, 2005, 2008; Callea et al., 2008; Morgan and Hansen, 2008; Randall and Fleet, 2021), which may be a barrier to the motivation of teachers and the delivery of quality physical education programs. Confidence can be considered to be an individual's belief toward their capabilities (Duda and Treasure, 2010). A closely related concept is perceived self-efficacy, which is an individual's belief about their capability to complete a task (Bandura, 1977), that is, it is specific to a particular skill and situation (Duda and Treasure, 2010; Weinberg and Gould, 2019).

Confidence to teach physical education then could be defined as a perceived belief about the ability to complete a range of specific tasks and handle situations in physical education (Spittle et al., 2022). This confidence is important because it can influence performance, decisions, engagement in tasks as well as self-regulation and motivation (Choi et al., 2021). Teachers' sense of efficacy has also been related to student outcomes and teacher behaviour, including teacher effort and willingness to utilise new delivery approaches (Jimenez-Silva et al., 2012). Bandura's (1977, 1997) conceptual model of self-efficacy brings together concepts of confidence and expectations and outlines the main sources of information and experiences on which individuals base their self-efficacy. For pre-service teachers, sources of information and experiences might include the units studied in physical education as part of teacher education and the experience teaching physical education on teaching rounds.

Motivation refers to an intention to act (Gredler et al., 2004) and is a multi-faceted construct that consists of beliefs, perceptions, values, interests and actions that drive behaviour (Deci and Ryan, 1985). Thus, the motivation of pre-service teachers will influence whether and how they deliver physical education in primary schools. Motivation of students in physical education has been the subject of research (Teraoka et al., 2021) and despite several studies of teacher motivation (Spittle et al., 2009; Hein et al., 2012; Spittle and Spittle, 2014), there is much less research on the motivation in the teaching of physical education.

Self-determination theory (SDT) is a wide-reaching theory of motivation (Deci and Ryan, 1985) that can be applied to physical education teaching. SDT (Deci and Ryan, 1985, 2000) describes different types of motivation based how much the behaviour is self-determined and how it is regulated (Ryan and Deci, 2000b). An individual feels self-determined when they perceive that they are the cause of their behaviour, and the higher this feeling of self-determination, the better the motivational outcomes (Ryan and Deci, 2000a,b). According to SDT the type, rather than the amount, of motivation is more important to behavioural outcomes (Baumeister and Vohs, 2007). The types of motivation are amotivation (the absence of intrinsic and extrinsic motivation), extrinsic (undertaking activities for reasons other than inherent interest in the activity), and intrinsic (the most self-determined form of motivation, involving undertaking an activity out of interest, enjoyment, or inherent satisfaction) motivation. Like confidence, motivation is influenced by experience (Visser-Wijnveen et al., 2014), so examining experiences in physical education may be important in understanding the motivation of pre-service teachers.

Primary school teachers may have differing levels of motivation toward teaching subject areas, including physical education, based on their personal characteristics and experience. This is highly applicable in a primary school setting, as generalist teachers teach across a range of subject areas, so may have different motives in relation to different

curriculum areas. Generalist teachers who lack confidence may also have different motivation for teaching physical education than those who have chosen to specialise in primary physical education and have completed more training in physical education. The confidence and motivation of pre-service teachers who have specialised in primary physical education have not been explored, but their confidence and motivation are potentially key drivers in the delivery of quality physical education programs in primary schools.

Spittle et al. (2022) developed the Confidence and Motivation to Teach Primary Physical Education Questionnaire (CMTPEQ) which measures two components of confidence to teach physical education: management and planning and implementation and six components of motivation to teach physical education representing intrinsic, extrinsic, and amotivation. Management and planning comprises confidence in performing common roles or duties when teaching physical education (e.g., planning a physical education program, establishing learning goals, communicating student achievements, maintaining records, and self-evaluating learning activities). Implementation represents delivering content specific to physical education (e.g., teaching motor skills and complex movements, dance, team games and sports, athletics, and fitness). Motivation is assessed in relation to six subscales: practice, knowledge, student outcomes, performance, professional expectations, and disengagement. Intrinsic motivation comprises two of those subscales: knowledge (motivation for teaching physical education as an activity that is undertaken for pleasure and satisfaction of learning new things) and practice (experiencing stimulating sensations of fun and excitement as motives for teaching physical education). Extrinsic motivation comprises three subscales: student outcomes, performance, and professional expectations. Student outcomes describes teaching physical education because it is identified as worthwhile and beneficial for students and is integrated into teacher behaviour. Performance, is governed by rewards and restrictions implemented by the teacher themselves (e.g., teaching physical education to avoid feelings of guilt or anxiety or to build up their ego and feelings of self-importance). Professional expectations is the least autonomous form of extrinsic motivation, where teacher behaviour is controlled by external sources (e.g., teaching physical education because it is required by the curriculum). Amotivation is represented by disengagement, which describes a lack of motivation toward teaching physical education (e.g., not valuing physical education, not feeling competent to teach it, or not believing it will result in a desired outcome).

Exploring confidence and motivation for teaching primary school physical education seems warranted given the influence of confidence on motivation and the influence of this on quality physical education programs. As primary school physical education is most often delivered by generalist teachers and most research exploring confidence in teaching primary physical

education has centred on generalist teachers and their lack of confidence, research exploring confidence and motivation with those who are training in primary physical education seems warranted. In Australia, there are very few universities that offer specialisations in primary school physical education (as opposed to secondary physical education), but this may be important for preparing teachers to deliver and support others in delivering physical education programs (Lynch, 2013, 2015).

The aim of this study was to explore the confidence and motivation of pre-service primary teachers who had chosen a specialisation in physical education to teach physical education. To do this we compared how characteristics of confidence (management and planning and implementation) and intrinsic, extrinsic, and amotivated types of motivation (knowledge, performance, practice, professional expectations, student outcomes, and disengagement) differed for personal characteristics and experience of pre-service teachers specialising in primary physical education that may influence confidence and motivation. The characteristics compared included gender, year-level, units of physical education completed in the course, and hours of physical education taught on teaching rounds. A further aim was to discover whether confidence factors were associated with different types of motivation to teach primary physical education.

## Materials and methods

### Participants

Pre-service teachers must choose two teaching methods to specialise in. All participants had elected to specialise in primary physical education (P-6), which involves undertaking a six-unit major in physical education so that they can register to teach primary school physical education. The method does not enable them to register to teach secondary school physical education. A total of 277 pre-service teachers with a mean age of 21.37 years ( $SD = 3.09$ ) completed the questionnaires, comprising 131 (47.3%) male and 146 (52.7%) female participants. As indicated in Table 1, there were 93 (33.6%) first-year, 105 (37.9%) second-year, and 79 (28.5%) third-year students. Many of the pre-service teachers had not yet completed any units of physical education as part of their course ( $n = 92$ , 33.2%), 15 students had completed one unit (5.4%), 80 had completed two units (28.9%), 18 had completed three units (6.5%), 36 had completed four units (13%), and 36 had completed more than four units (13%). Most pre-service teachers had taught less than 1 h of physical education on their teaching rounds ( $n = 139$ , 50.2%), 90 had taught between 1 and 5 h (32.5%), 20 had taught between 5 and 10 h (7.2%), 10 between 10 and 15 h (3.6%), and 18 had taught more than 15 h of physical education on their teaching rounds (6.5%).

TABLE 1 Frequency and percentage of sample characteristics.

Year level	1st year	2nd year	3rd year			
	93 (33.6%)	105 (37.9%)	79 (28.5%)			
Units of physical education completed	0	1 unit	2 units	3 units	4 units	>4 units
	92 (33.2%),	15 (5.4%),	80 (28.9%)	18 (6.5%),	36 (13%)	36 (13%)
Hours of physical education taught on teaching rounds	<1 h	1–5 h	5–10 h	10–15 h	> 15 h	
	139 (50.2%),	90 (32.5%),	20 (7.2%),	10 (3.6%),	18 (6.5%).	

## Measures

A questionnaire was used to measure demographic information and confidence and motivation of pre-service education students to teach physical education. The demographics form contained five questions which asked participants to indicate their gender, age, current year level, number of units of physical education completed, and number of hours of physical education taught on teaching rounds. The Confidence and Motivation to Teach Primary Physical Education Questionnaire (CMTPEEQ) (Spittle et al., 2022) consists of two sections: one section addressing confidence (24 items) and one section addressing motivation (28 items) toward teaching primary school physical education. The CMTPEEQ uses a 6-point Likert Scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*), with the item stem ‘I am confident in my ability to’ for confidence and ‘Why you would teach physical education’ for motivation. Confidence comprises two subscales; management and planning (15 items) and implementation (9 items). Motivation is assessed in six subscales: practice, knowledge, student outcomes, performance, professional expectations, and disengagement. Intrinsic motivation comprises two subscales in the CMTPEEQ: knowledge and practice. Extrinsic motivation comprises three CMTPEEQ subscales: student outcomes, performance, and professional expectations. Amotivation is represented in the CMTPEEQ by disengagement.

Spittle et al. (2022) reported that the CMTPEEQ has acceptable reliability with Cronbach’s alpha values greater than .70 for confidence subscales (management and planning = 0.96 and implementation = 0.89) and all motivation subscales (ranging from 0.73 for professional expectations to 0.91 for practice). In the current study they were 0.75 and 0.93, respectively (Table 2).

## Procedure

Students studying a Bachelor of Education (P-12) who had chosen primary physical education as a teaching method were

invited to participate in the study. Participants were given a plain language statement and informed that their participation was voluntary and returning a completed questionnaire implied consent. The questionnaire took between 10 and 15 min to complete. A University Human Research Ethics Committee approved the study.

## Data analysis

Cronbach’s alpha coefficients were calculated for each of the confidence and motivation subscales to determine internal consistency. Independent samples t-tests were used to determine if there were any significant differences in the confidence and motivation subscales for gender. One-way analyses of variance (ANOVA) were used to determine if there were any significant differences in confidence and motivation subscales for year level, units of physical education completed in the course, and hours of physical education taught on teaching rounds. Where significant differences were found, *post-hoc* tests were employed to further investigate the nature of those differences. Scores (mean and standard deviations) are presented as average score per item in each subscale. Pearson correlations were calculated between the confidence and motivation subscales to discover whether confidence factors were associated with different types of motivation to teach primary physical education.

## Results

### Confidence and motivation

#### Confidence scores

The Bachelor of Education students who chose to specialise in primary physical education reported higher confidence for implementation than for management and planning (Table 2). Cronbach’s alpha coefficients were calculated for each of the factors, displaying adequate internal consistency (Table 2).

TABLE 2 Descriptive statistics and internal consistency coefficients for the confidence subscales.

Subscale	Total scale score		Average score per item		Internal consistency
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Implementation	38.51	6.04	4.28	0.57	0.750
Management and planning	68.02	10.35	4.54	0.27	0.931

## Motivation scores

Participants reported higher motivation in practice and performance; and lower scores on professional expectations, and knowledge, as well as low scores on disengagement (Table 3). Cronbach's alpha coefficients were calculated for each of the factors, displaying adequate internal consistency (Table 3).

## Gender

Males reported significantly higher motivation in relation to professional expectations than females (Table 4), however, no significant differences for any of the other confidence or motivation subscales.

## Year level

There were significant differences for year level on the two confidence factors: implementation and management and planning (Table 5). *Post-hoc* tests revealed that first-year students had lower confidence related to management and planning than second- and third-year students and second-year students had lower confidence than third-year students. First-year students also had lower confidence in implementation than second- and third-year students. There were no significant differences for any of the motivation factors.

## Units of physical education

There were significant differences on the two confidence factors between participants based on the number of units of physical education completed in the course, but no significant differences for any of the motivation factors (Table 6). For implementation, pre-service teachers who had completed no units were significantly lower in confidence than pre-service teachers who had completed 2, 4, and 4+ units. Pre-service teachers who had completed 1 unit were also significantly less confident than those who had completed 4 units. For management and planning, pre-service teachers who had completed no units of physical education were significantly less confident than pre-service teachers who had completed 2, 4, or 4+ units.

## Hours of physical education taught

For hours of physical education taught on teaching rounds, there were significant differences on the two confidence factors, but no significant differences for any of the motivation factors (Table 7). Pre-service teachers who had taught less than one hour of physical education on teaching rounds were significantly less confident on implementation than pre-service teachers who had taught 1–5 or 15+ h. Similarly, for management and planning, pre-service teachers who had taught less than one hour were significantly less confident than those who had taught 1–5, 10–15, or 15+ h. No other comparisons were significantly different.

## Relationships between confidence and motivation

Pearson's correlations to explore the relationships between the confidence and motivation subscales indicated that both confidence in implementation and planning and management were significantly related to motivation related to knowledge, practice, and performance (Table 8). The significant relationships were generally small, ranging between 0.26 and 0.41.

## Discussion

This study explored the confidence and motivation of pre-service primary teachers specialising in physical education to teach physical education. To do this we compared how characteristics of confidence (management and planning and implementation) and types of motivation (knowledge, practice, performance, professional expectations, student outcomes, and disengagement) differed for personal characteristics and experience. We found that the pre-service teachers specialising in primary physical education reported higher confidence for implementation than for management and planning and higher motivation in practice and performance; and lower motivation for professional expectations and knowledge, with very low disengagement. Males reported significantly higher extrinsic motivation in relation to professional expectations than females. Pre-service teachers in first-year were significantly less confident

TABLE 3 Descriptive statistics and internal consistency coefficients for the motivation subscales.

Subscale	Total scale score		Average score per item		Internal consistency
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Intrinsic Motivation					
Knowledge	14.03	2.56	4.68	0.23	0.624
Performance	29.01	4.80	4.84	0.22	0.827
Extrinsic Motivation					
Practice	25.68	3.43	5.09	0.20	0.793
Professional expectations	11.46	3.74	3.82	0.55	0.692
Student outcomes	21.61	2.57	5.40	0.25	0.793
Amotivation					
Disengagement	6.78	3.85	1.70	0.21	0.799

TABLE 4 Descriptive statistics and *t*-test results for confidence and motivation subscales by gender.

Subscales		Gender				<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
		Male ( <i>n</i> = 131)		Female ( <i>n</i> = 146)					
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Confidence									
	Implementation	4.29	0.73	4.27	0.48	0.30	275	0.77	0.04
	Management and planning	4.59	2.24	4.49	0.30	1.28	275	0.20	0.15
Motivation									
Intrinsic motivation									
	Knowledge	4.63	0.12	4.72	0.33	−0.90	275	0.37	−0.10
	Practice	5.18	0.25	5.09	0.14	1.04	275	0.30	0.13
Extrinsic motivation									
	Performance	4.92	0.13	4.76	0.30	1.61	275	0.11	0.19
	Professional Expectations	4.00	0.57	3.67	0.54	2.15	275	0.05*	0.26
	Student Outcomes	5.39	0.26	5.41	0.25	−0.23	275	0.82	−0.03
Amotivation									
	Disengagement	1.80	0.23	1.60	0.19	1.69	275	0.10	0.20

\**p* < 0.05.

in management and planning and implementation than other year levels, similarly those who had completed no units in physical education and those who had taught less than 1 h of physical education on teaching rounds were less confident in both management and planning and implementation than pre-service teachers who had completed units in physical education or had taught more than one hour of physical education on teaching rounds. For motivation, the pre-service teachers reported higher motivation in practice and performance; and lower motivation based on professional expectations and knowledge, and even lower scores on disengagement.

In terms of confidence, the pre-service teachers reported being generally confident, with mean item scores of 4.28 and 4.54 out of 5 for the two confidence subscales. Primary physical education is commonly delivered by generalist primary teachers (Freak and Miller, 2017) who typically do have significant

pre-service teacher education training in physical education (Lynch and Soukup, 2017; Randall and Griggs, 2021), which can make it difficult to equip generalist teachers to be confident and motivated to teach physical education (Freak and Miller, 2017), with previous research indicating lower confidence in generalist teachers (Morgan and Bourke, 2005, 2008; Callea et al., 2008; Morgan and Hansen, 2008; Randall and Fleet, 2021). The current study indicates there may be some benefits in terms of confidence to teach in having specialists deliver physical education in primary schools, whether this translates to higher quality physical education programs is an area for further research. Irrespective of the debate around whether generalist primary school teachers or specialist physical education teachers are best placed to deliver physical education (Freak and Miller, 2017; Jones and Green, 2017; Truelove et al., 2021), the higher confidence of the specialists in the current study indicates



TABLE 5 Descriptive statistics and ANOVA results confidence and motivation by year level.

Subscales		Current year level						<i>F</i>	<i>df</i>	<i>p</i>	$\eta^2 p_2$
		1st year ( <i>n</i> = 93)		2nd year ( <i>n</i> = 105)		3rd year ( <i>n</i> = 79)					
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Confidence											
	Implementation	4.00	0.80	4.35	0.51	4.51	0.53	15.04	2, 274	0.001**	0.10
	Management and planning	4.23	0.32	4.55	0.28	4.87	0.23	21.15	2, 274	0.001**	0.13
Motivation											
Intrinsic motivation											
	Knowledge	4.69	0.23	4.58	0.24	4.79	0.25	1.46	2, 274	0.23	0.01
	Practice	5.23	0.18	5.02	0.20	5.18	0.23	2.57	2, 274	0.07	0.02
Extrinsic motivation											
	Performance	4.92	0.19	4.69	0.26	4.93	0.22	2.85	2, 274	0.06	0.02
	Professional expectations	3.75	0.82	3.93	0.34	3.76	0.56	0.65	2,274	0.52	0.01
	Student outcomes	5.41	0.20	5.31	0.29	5.52	0.27	2.42	2, 274	0.91	0.02
Amotivation											
	Disengagement	1.62	0.22	1.67	0.23	1.81	0.19	0.90	2, 274	0.40	0.00

\*\**p* < 0.01.

the importance of at least some exposure or training in physical education as part of teacher education to develop that confidence for any pre-service teacher (Brennan et al., 2021).

The pre-service teachers reported higher confidence for implementation than for management and planning. This indicates that the pre-service teachers were confident to deliver physical education, such as teach skills and games and sports, but less confident in their ability to plan and manage physical education, such as plan a program, maintain records, and establish learning goals. Several studies have highlighted challenges in design and delivery of physical education (e.g., Freak and Miller, 2017; Randall and Fleet, 2021), with the current study emphasising that management and planning may be an area to focus on with specialist pre-service teachers. This indicates that for the generalist, implementation and delivering is a concern, whereas the specialists were very confident in delivery but somewhat less confident in management and planning.

For motivation, the pre-service teachers reported higher motivation in practice and performance; and lower scores on professional expectations and knowledge. This indicates that pre-service teachers were more intrinsically motivated by practice, involving experiencing fun and excitement for teaching physical education while also being more extrinsically motivated by performance, being governed by internal rewards and restrictions such as to avoid feelings of guilt or anxiety. The pre-service teachers were less intrinsically motivated by knowledge, that is, to learn new things, and less extrinsically motivated by professional expectations and requirements controlling their teaching behaviour in physical education. Importantly, amotivation through disengagement was very low, indicating that, as would be hoped, these pre-service teachers specialising

in primary physical education were motivated to teach it. This appears to indicate that practice and performance may be important motives for specialists.

Males and females did not differ significantly in most areas of confidence or motivation, but males reported significantly higher extrinsic motivation in relation to professional expectations than females. Professional expectations is behaviour controlled by external sources (i.e., doing it because it is a requirement rather than choosing to do it) and is the least autonomous form of extrinsic motivation. Pre-service teachers did differ on confidence between year levels but not on motivation. For confidence, first-year students were significantly lower on management and planning than second- and third-year students and second-year students were significantly lower than third-year students. In addition, first-year students also had significantly lower confidence in implementation than second- and third-year students. This indicates lower confidence for first-year students, which might be expected, given that they will have less training and experience than those in later years.

Pre-service teachers who were yet to complete any physical education units were less confident in both management and planning and implementation than pre-service teachers who had completed units in physical education. Motivation did not differ based on number of units completed. Similarly for hours of physical education taught as for number of units completed, pre-service teachers who had taught less than one hour of physical education on teaching rounds were significantly less confident on implementation and management and planning than pre-service teachers who had taught more physical education on teaching rounds. Limited training and practical experience for pre-service teachers, particularly generalists, in

TABLE 6 Descriptive statistics and ANOVA results for confidence and motivation by units of physical education completed.

Subscales		Units of physical education completed												<i>F</i>	<i>df</i>	<i>p</i>	$\eta^2 p^2$
		0 ( <i>n</i> = 92)		1 ( <i>n</i> = 15)		2 ( <i>n</i> = 80)		3 ( <i>n</i> = 18)		4 ( <i>n</i> = 36)		4 + ( <i>n</i> = 36)					
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Confidence																	
	Implementation	4.01	0.80	3.95	0.56	4.44	0.54	4.30	0.55	4.55	0.48	4.46	0.62	6.96	5,271	0.001**	0.11
	Management and planning	4.24	0.31	4.37	0.38	4.61	0.27	4.64	0.27	4.83	0.23	4.84	0.27	7.34	5,271	0.001**	0.12
Motivation																	
Intrinsic motivation																	
	Knowledge	4.70	0.26	4.87	0.07	4.53	0.29	4.72	0.15	4.80	0.34	4.69	0.23	0.80	5,271	0.55	0.01
	Practice	5.25	0.19	4.93	0.14	5.03	0.24	5.18	0.29	4.61	1.23	5.14	0.19	1.09	5,271	0.36	0.02
Extrinsic motivation																	
	Performance	4.93	0.21	4.77	0.14	4.65	0.25	4.90	0.28	4.84	0.28	4.98	0.20	1.42	5,271	0.22	0.03
	Professional expectations	4.45	0.47	3.73	0.81	3.92	0.34	4.04	0.53	3.75	0.71	3.81	0.32	0.33	5,271	0.89	0.01
	Student outcomes	5.41	0.24	5.12	0.27	5.36	0.26	5.50	0.25	5.48	0.24	5.45	0.32	0.89	5,271	0.49	0.02
Amotivation																	
	Disengagement	1.64	0.20	1.73	0.33	1.64	0.21	1.67	0.27	1.72	0.23	1.94	0.24	0.58	5,271	0.72	0.01

\*\**p* < 0.01.



TABLE 7 Descriptive statistics and ANOVA results for confidence and motivation by hours of physical education taught on teaching rounds.

Subscales		Hours of physical education taught on teaching rounds										<i>F</i>	<i>df</i>	<i>p</i>	$\eta^2 p^2$
		<1 ( <i>n</i> = 139)		1–5 ( <i>n</i> = 90)		5–10 ( <i>n</i> = 20)		10–15 ( <i>n</i> = 10)		15+ ( <i>n</i> = 18)					
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Confidence															
	Implementation	4.09	0.65	4.42	0.53	4.46	0.44	4.60	0.63	4.65	0.64	6.58	4, 272	0.001**	0.09
	Management and Planning	4.33	0.32	4.66	0.24	4.70	0.29	5.01	0.17	5.04	0.30	8.55	4, 272	0.001**	0.11
Motivation															
Intrinsic motivation															
	Knowledge	4.65	0.27	4.63	0.18	4.78	0.26	4.83	0.58	4.93	0.44	0.64	4, 272	0.63	0.01
	Practice	5.11	0.17	5.12	0.22	5.08	0.35	5.28	0.26	5.37	0.31	0.71	4, 272	0.59	0.01
Extrinsic motivation															
	Performance	4.82	0.19	4.75	0.29	4.88	0.16	5.27	0.27	5.06	0.32	1.33	4, 272	0.26	0.02
	Professional expectations	3.70	0.60	4.00	0.50	3.53	0.28	4.13	0.93	4.11	0.62	1.27	4, 272	0.28	0.02
	Student outcomes	5.34	0.24	5.42	0.29	5.56	0.26	5.58	0.13	5.53	0.29	0.98	4, 272	0.42	0.01
Amotivation															
	Disengagement	1.67	0.21	1.73	0.25	1.54	0.14	2.48	0.39	1.53	0.26	2.00	4, 272	0.10	0.03

\*\**p* < 0.01.

primary physical education (Lynch, 2017) has been discussed as a factor that may influence teacher confidence (Morgan and Hansen, 2007). Specialists generally complete a major area of study in a discipline area, whereas generalists may only complete one or two subjects in the health and physical education area (Lynch, 2013, 2015). The current study shows that this training and experience is important not only for generalists (Ensign et al., 2020) but for specialists, with those with more units of study and/or more teaching experience on teaching rounds more confident.

There were significant relationships between confidence and motivation, with both confidence in implementation and planning and management significantly related to motivation related to knowledge, practice, and performance. Confidence in management and planning and implementation were not related to the least autonomous form of motivation: professional expectations, and disengagement. The findings of the current study further indicate the relationship between confidence in teaching primary physical education and motivation to teach it.

## Limitations

This study provides important information on the confidence and motivation of pre-service teachers specialising in primary physical education, however, some potential limitations of the study should be acknowledged. The questionnaire utilised has been developed based on an existing theoretical framework and has established reliability and validity. The use of a questionnaire, however, with volunteer participants may limit the range of possible responses and as a form of self-report data may be potentially subject to participants providing socially desirable responses (Paulhus, 1991) and common method variance (Podsakoff et al., 2003). The sample of participants is a potential limitation and may limit the generalisability of findings. Participants volunteered to participate in the study, so the responses may be limited to those with an interest in the topic or may exclude particular groups of pre-service teachers who have chosen not to participate. In addition, participants were pre-service teachers from one university. Future research should continue to examine the role of confidence and motivation in teaching primary physical education. Investigating in-service physical education teachers would help develop further understanding of confidence and motivation of specialists in primary physical education.

## Implications

The pre-service teachers were more confident and intrinsically motivated to teach physical education than generalists in previous studies (Morgan and Bourke, 2005, 2008; Callea et al., 2008; Morgan and Hansen, 2008; Randall and Fleet, 2021), indicating the importance of exposure

TABLE 8 Pearson's correlations between confidence and motivation subscales.

Motivation	Confidence	
	Implementation	Management and planning
Knowledge	0.260**	0.280**
Practice	0.322**	0.356**
Performance	0.266**	0.309**
Professional expectations	−0.041	0.008
Student outcomes	0.325**	0.411**
Disengagement	−0.039	−0.061

\*\* $p < 0.01$ .

and access to physical education in teacher education, for confidence of both generalists and specialists. Providing university courses where teachers have the opportunity to specialise in primary physical education should help prepare teachers to be confident and motivated in teaching physical education (Lynch, 2013). Currently in Australia there are a number of universities that offer specialisations in secondary physical education and generalist primary education, but few university courses that offer a specialisation in primary school physical education (Lynch, 2013, 2015).

The pre-service teachers specialising in primary physical education reported higher confidence for implementation than for management and planning, this may indicate that teacher education programs may need to ensure they support pre-service teachers in planning and managing physical education, as well as in delivering a program. The pre-service teachers reported higher intrinsic motivation for fun and excitement in practice, and were extrinsically motivated and governed by their own expectations of performance. Delivering physical education was important to them for the fun and enjoyment they experience, but also because internally they feel it is important. They were less motivated by professional expectations and requirements to deliver physical education or for knowledge and learning new things. Therefore, making sure pre-service teachers experience the fun and enjoyment of teaching in physical education and not making it feel like it is a requirement to teach may be important to maximising engagement in physical education.

## Conclusion

In conclusion, we found that pre-service primary teachers specialising in physical education reported higher confidence for implementation than for management and planning and higher motivation in practice and performance, with very low disengagement. Pre-service teachers in first-year were significantly less confident in both management and planning

and implementation than other year levels. Pre-service teachers who had completed no units in physical education and those who had taught less than one hour of physical education on teaching rounds were less confident in both management and planning and implementation than pre-service teachers who had completed units in physical education or had taught more than one hour of physical education on teaching round, indicating the importance of training and experience to confidence in teaching physical education, even for those specialising in physical education. Pre-service teachers reported higher intrinsic motivation for practice and extrinsic motivation performance, indicating motives for fun and excitement in teaching and internal regulation of motivation for teaching physical education. The study highlighted the importance of training and experience in developing confidence and motivation to teach physical education, even for those who have chosen to specialise in physical education in teacher education programs.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by the Victoria University Human Research Ethics

Committee. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

SS and MS co-designed the study. SS, MS, and KE implemented the study and data collection. SI conducted the data management. SS, MS, SI, and KE contributed to the initial draft. MS conducted data analysis and prepared the final draft. All authors contributed to the manuscript and approved the submitted version.

## 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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# Book review: Singapore's approach to developing teachers—Hindsight, insight, and foresight authored by Woon Chia Liu

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## KEYWORDS

Singapore, 21C skills, teacher, motivation, education

In the 1960s, Singaporeans were poorly educated. Singaporean education was the envy of none. Today, Singaporeans enjoy what some believe to be the best educational system in the world—the envy of all. How did this miracle happen?

The author of *Singapore's approach to developing teachers* (2022), Woon Chia Liu (Dean of Teacher Education at the National Institute of Education [NIE], co-chair of NIE's Teacher Education Model for the 21st Century, and former high school teacher) is perhaps the best placed educator in Singapore to explain how the “Little Red Dot” on the world map developed its flourishing educational system. According to Liu, the foundation to the nation's educational success was its focus on the quality of its teachers. Of course, many nations focus on their teachers, but Singapore did so deliberately, strategically, and with a full commitment to provide its teachers with the resources they needed to thrive. This is a book about how a nation supported its teachers—but also the costs of doing so.

On the bookshelves of many educators are titles telling the story of how a nation elevated its educational system to world-class status, such as *Teach like Finland* (Walker, 2017), *Learning from Shanghai* (Tan, 2013), and even the earlier-published *Learning from Singapore* (Ng, 2017). What makes *Singapore's approach to developing teachers* different is that the story is told by a professor who was in daily contact with everyone involved in the effort to elevate Singaporean education to world-class status, including the Ministers of Education, NIE policy makers, University Deans, chairs of special committees, principals, head teachers, beginning teachers, preservice teachers, students, and parents. As they say in the musical *Hamilton*, she was “in the room where it happened.”

*How did Singapore achieve educational success?* Singapore's rise was a decades-long tale. According to Liu, it started with governmental policy and the priorities of the Ministry of Education (MOE). To realize its priorities, the MOE created the institutions and organizations needed to realize its national goals, such as the NIE and the Academy of Singaporean Teachers (AST). These organizations prioritized good teaching, and its standards were high (Liu, 2022, p. 34). To help teachers' reach these high standards, the MOE made a special effort to provide systematic teacher support, such as professional collaboration and diverse career trajectories (Teacher Growth Model; Liu, 2022, p. 72–73). Promotions were based on merit and professional growth. Beginning teacher development was prioritized. Schools treated beginning teachers very well *via* a mentoring system and a reduced workload. Eventually, the tripartite partnership (MOE, NIE, schools) came together to produce a teacher-centric support system. The “coherence” within the tripartite system is Singapore's “secret sauce” (e.g., “common vision” section in Chapter 3; Tripartite Partnership, Chapter 5; “shared goals and purpose, mutual respect; commitment to work together”).

This policy—teacher education—schools collaboration (i.e., MOE, NIE, schools) is what makes the Singaporean system unique. For example, in the USA, policy makers produce policies and identify best practices with elected representatives. However, discrepancies in perspectives from school practitioners are likely to prevent local implementation of state-level discipline policy (e.g., Arkansas Act 1059; Anderson and McKenzie, 2022). In other countries (e.g., China), national policies are made and communicated unilaterally rather than collaboratively. Teachers have little voice to provide their input and priorities into the shaping of national policies. In Singapore, all three agents have equal status and responsibility. They mutually communicate and make new programs to attain shared goals. And each party executes their own responsibility.

*How does Singapore prepare its teachers to provide 21<sup>st</sup> century education?* The tripartite partnership dedicates itself to providing Singaporean students with a 21st century education. This national goal begins with formulating shared values and a sense of mission that the three-core organizations (MOE, NIE, schools) achieve together (V<sup>3</sup>SK framework, p. 97). Singapore created new teacher training programs to support well-established existing professional platforms, such as school-based collaborative programs, professional learning communities, and inter-school level communities. These programs take instruction beyond traditional knowledge-based learning to emphasize 21st century skills such as critical thinking, curiosity, and creativity. The result of such values, planning, and teacher education is the education of students who can create problems, think critically, work collaborative, and develop novel solutions, rather than simply generate a designated answer to a pre-set question.

*What are the costs?* Although Singapore has a well-developed teacher educational system, we need to take a step back and ask what costs have been incurred. Teachers' high level of stress and burnout are critical issues. Singaporean teachers collectively report a high intention to leave the profession within 5 years (35%; OECD average 25%). Singapore supports its teachers and cares about their professional wellbeing (e.g., reduced administrative workload), but the Singaporean effort overlooks one robust predictor of teacher stress—namely, performance assessment of teachers. Singapore teacher education utilizes a competence-based performance assessment system that revolves around teacher accountability for high student achievement scores, and it put in place a teacher reward system to drive that assessment. The result is an atmosphere of high-stakes testing. The Singaporean effort also overlooks the important role played by teachers' instructional goals. The types of instructional goals that promote students' 21st century outcomes and teachers' autonomy and wellbeing are “intrinsic instructional goals” (e.g., teachers have students strive for personal growth and relationship growth; Jang, 2019), but the types of instructional goals that are commonplace in the Singaporean classroom are “extrinsic instructional goals” (e.g.,

teachers have students strive for high test scores and getting ahead of others). Another concern is the personal and social development of Singaporean students. As the PISA 2018 data attest, Singaporean students show high academic achievement, but there is room for improvement in terms of their personal and social development. For instance, bullying in Singapore is higher than the OECD average (ranked 28 out of 75 countries). This is educationally important. The mere presence of bullying and victimization influences students' mental and physical health (e.g., depression, anxiety, low self-esteem, loneliness and sadness) and academic performance (Marsh et al., 2022). According to Liu, Singaporean educators recognized these concerns, and they are currently upgrading their teacher education programs accordingly.

*Can educational stake holders in other countries learn from and successfully apply the Singaporean system to their nation?* All countries vary in culture and context. It might be difficult for other nations to replicate the Singaporean educational success story. However, all nations can benefit from Singapore's hindsight, insight, and foresight as catalysts to improve their own education system. The book is valuable reading to the full range of international educational stakeholders, including policy makers, teacher educators, school leaders, and researchers.

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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	• Learning to know
		• Learning to do
		• Learning to be
	Continuing professional Development for online teaching (RAMA, 2018)	• Learning to live together
		• Data-driven instruction
		• Empathy-based pedagogy
		• Experiential learning
Technological mediating	UTAUT model	• Differentiated learning
		• SRL – self regulated learning method
		• Assessment of learning method
		• Performance expectancy
Output	Teachers' performance assessment	• Effort expectancy
		• Social influence
		• Facilitating conditions
		• Teachers' commitment to the students and school
		• Expertise in content knowledge and pedagogical content knowledge
		• Teaching and education management
		• Teacher as learner

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 Josefborg 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 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). Vanteghem 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 Josefberg 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),

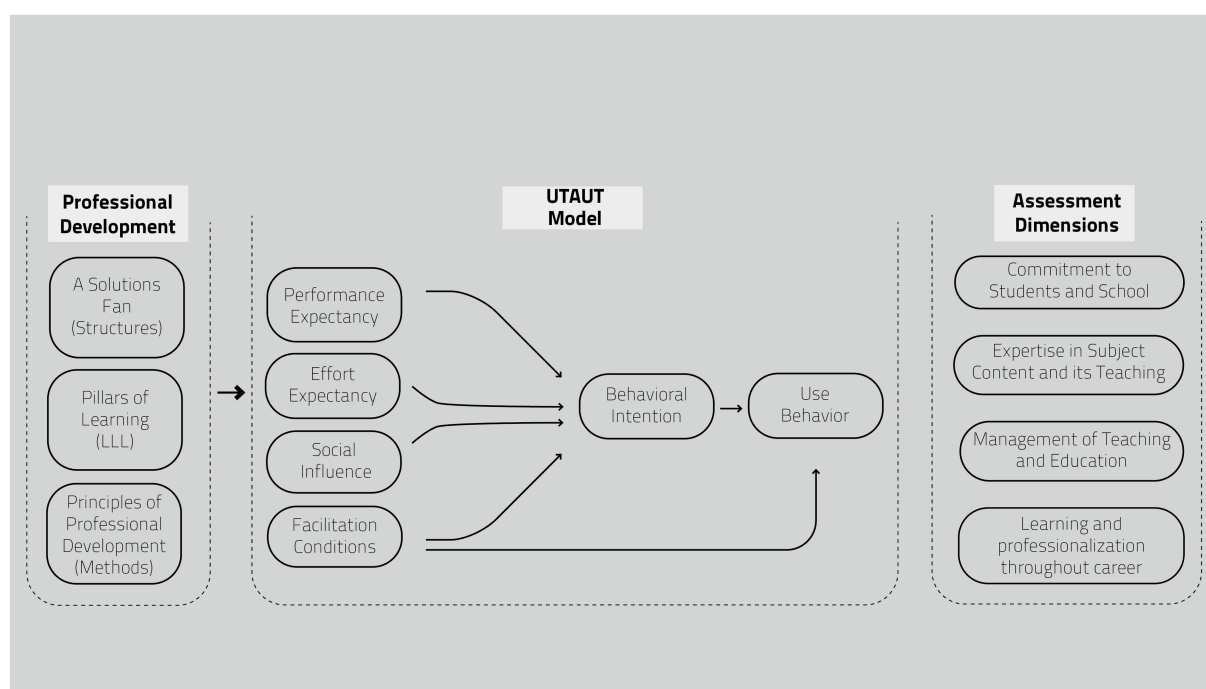


FIGURE 1  
Research model.

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.”

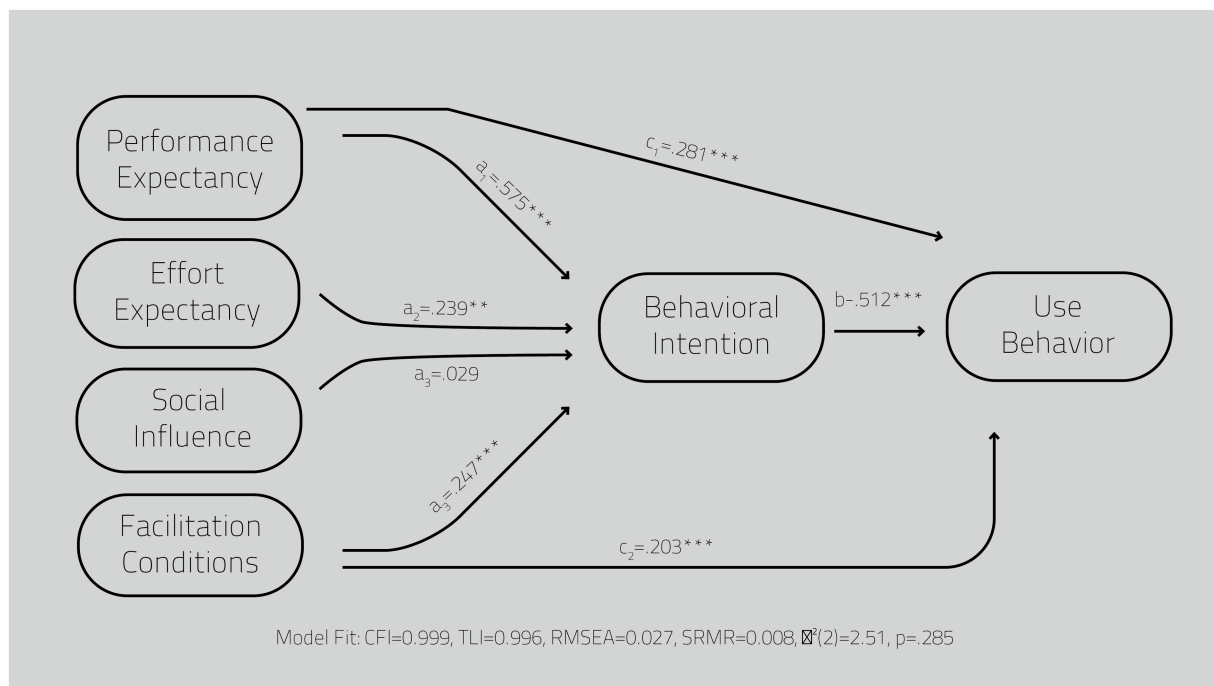


FIGURE 2  
Model correlation values.

## 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.

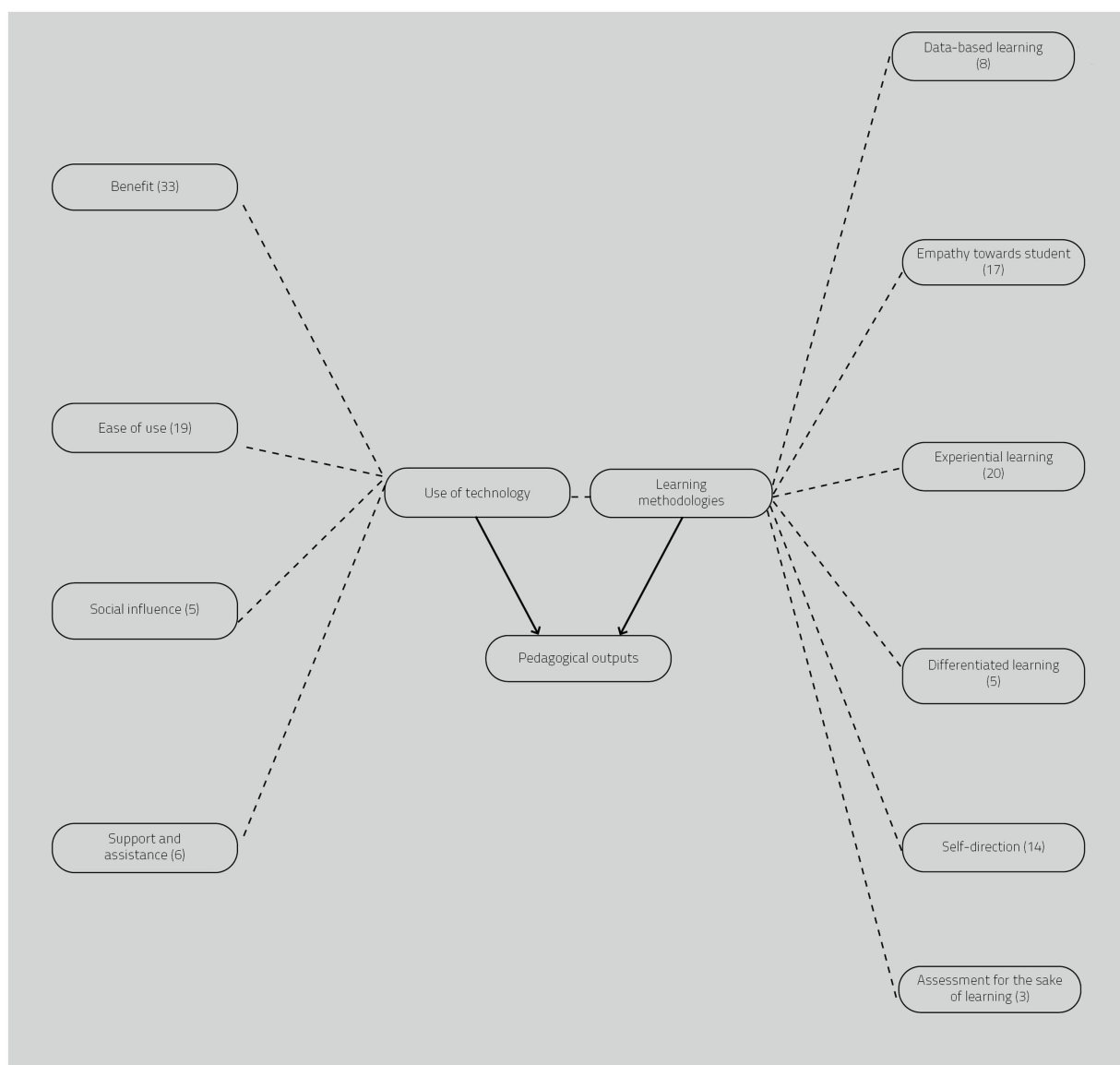


FIGURE 3  
Data model fit.

## 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.

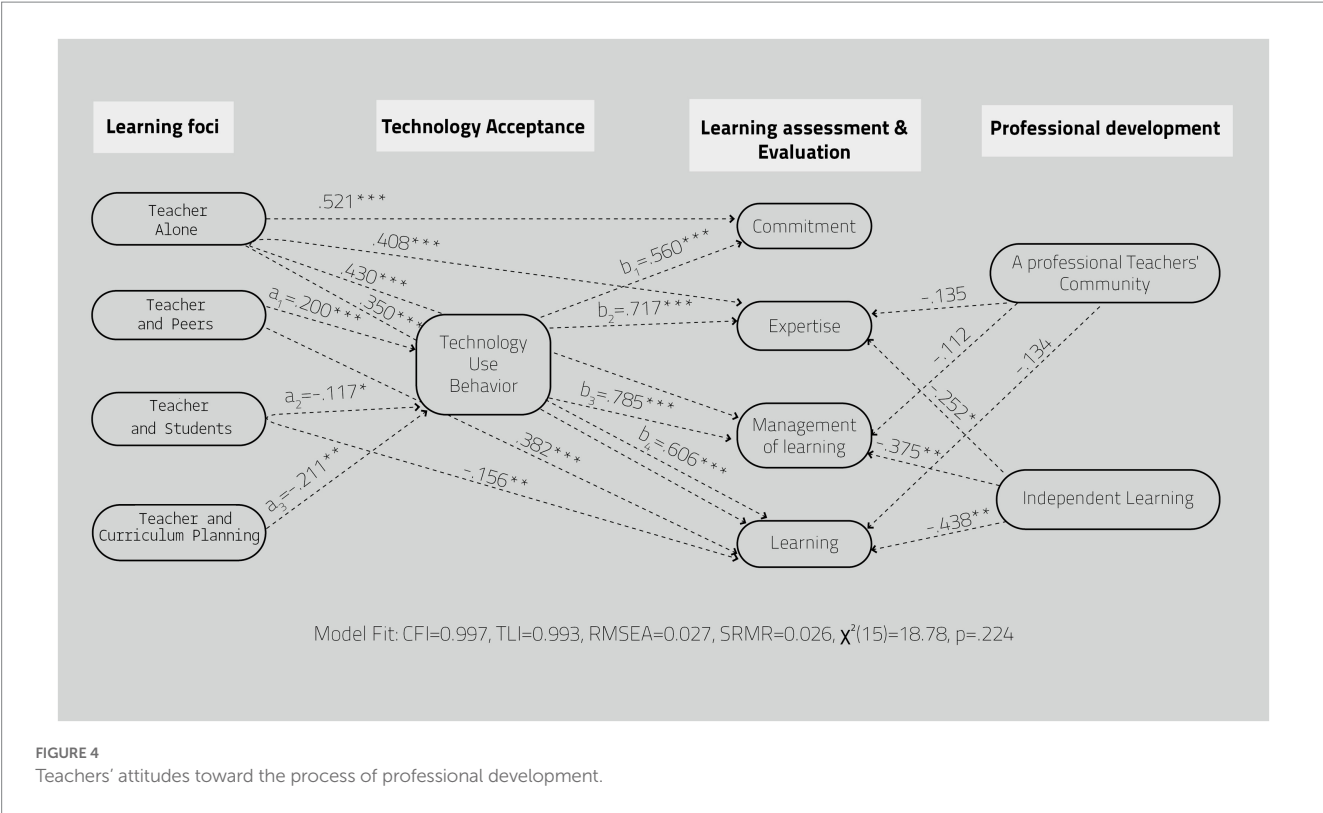


TABLE 5 Summary of predictors for the learning assessment measures in path analysis.

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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# The use of the ECHO model™ for education as an innovative approach to educator professional development

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After entering the workforce, educators may face novel problems of practice that require additional training. Ongoing professional learning and development (PD) is meant to provide the additional training necessary to ensure educators are prepared to meet those challenges. PD offerings should meet the recommendations of Adult Learning Theory, the Model for Teacher Change, and recommended best practices for adult learning and PD. The ECHO Model for Education is an effective, high-quality model of educator PD that satisfies such recommendations. Practical issues are discussed, and recommendations are made for those interested in implementing this innovative model for PD.

## KEYWORDS

The ECHO model™, ECHO for Education, professional learning and development, education, community of practice

## 1. Introduction

Schools and their students can only be as good as their teachers and administrators (Guskey, 2002). Effective teaching that leads to positive student outcomes requires educators to not only understand content-specific knowledge related to their specialty area(s), such as reading or math, but also pedagogical principles that support implementation [Knowles et al., 1998; National Joint Committee on Learning Disabilities (NJCLD), 2000]. Ongoing professional learning and development (PD) is an essential strategy for educators to receive training on both pedagogical and content-specific knowledge and practices [National Joint Committee on Learning Disabilities (NJCLD), 2000]. In addressing the need for active and engaging PD, the ECHO Model™ (Extension for Community Healthcare Outcomes, Arora et al., 2007a,b) is an innovative way to provide high-quality, effective PD to educators while also supporting the implementation of best practices in local communities where expertise is minimal. Specifically, ECHO for Education is an effective form of educator PD that meets the needs of educators in regard to their learning and their ability to impact student outcomes.

### 1.1. Best practices for educator professional development

To achieve the goal of improving educational outcomes for students, educators first need to improve their instructional skills by supplementing their teaching with novel methods or

approaches that are informed by best and promising practices [National Joint Committee on Learning Disabilities (NJCLD), 2000]. The improvement of educator instructional skills is often done through ongoing educator training, which is commonly referred to as PD (Corcoran, 1995). PD is primarily provided for educators at district, regional, or state-level conferences such as formal workshops (Corcoran, 1995). While PD can lead to a stronger sense of self-efficacy in educators, when poorly designed, PD can result in educators failing to generate substantial change in their teaching approaches and practices (Corcoran, 1995). In order for educators to successfully incorporate concepts learned through PD into their educational practice, three core requirements must be satisfied: (1) the PD should focus on content-specific knowledge; (2) the PD must incorporate active, rather than passive, learning principles; and (3) there must be coherence between PD activities to align with educators' experiences and goals (Garet et al., 2001). Similarly, Donovan et al. (1999) outline three elements that are necessary to acquire, and subsequently master, new skills and knowledge. First, new information should correspond to the learner's existing knowledge and should be pertinent to the learner. Second, acquired knowledge should be applied under the guidance of an operational, conceptual, or theoretical framework. Lastly, to sustain learner progress, self-assessments and evaluations should be utilized.

A key issue with traditional PD, delivered through passive activities such as conferences and webinars, is that the PD is not always effective at producing change that positively impacts teacher practice. To promote advantageous change in teaching practices, PD for educators should incorporate principles shown to be beneficial for adult learners, as well as practices that lead to positive outcomes for students [National Joint Committee on Learning Disabilities (NJCLD), 2000]. Guskey's (1986) Model of Teacher Change (MTC) and Knowles's (1968) Adult Learning Theory are two theories that highlight features of PD that are likely to increase effectiveness. MTC asserts that PD is effective when it supports changes in teachers' educational practices, which leads to improved student outcomes and subsequently results in a change in teachers' attitudes and beliefs (Guskey, 1986, 2002). As educators receive feedback through the success or failure of new practices, they can tailor the practices to suit their own needs and observe concrete changes in student outcomes. This subsequently changes their attitudes and beliefs about those practices, making them a long-term feature of their repertoire of skills (see Figure 1).

A similar theory, Adult Learning Theory emphasizes: (1) adult learners' need to know why they should learn about a topic before they actually engage in learning; (2) their concept of self-direction and personal responsibility to engage in learning; (3) their life experiences and how those contribute to the learning experience; (4) their readiness to learn based on their unique daily needs; (5) their task- or life-centered orientation rather than subject-centered orientation to learning; and (6) specific motivators (e.g., salary increases, career mobility) that entice adults to engage in learning (Knowles et al., 1998). Essentially, this theory suggests that adult learners must be able to link the learning topic to their day-to-day activities. Given the tenets of these two theories, it is not the mere attendance of PD that initiates teacher change, but rather the actual experience of practices and knowledge garnered from PD as well as educators' personal investment and proximity to the issues at hand.

Darling-Hammond et al. (2017) reviewed several different PD models and determined that there are seven shared features of successful PD models. Specifically, successful models are focused on content, utilize adult learning theory through active learning, promote collaboration, support participants with coaching, model effective practices, allow for reflection and feedback, and are sustained over a number of ongoing sessions. A meta-analysis examining methods of adult learning revealed analogous findings (Dunst et al., 2010). Methods that displayed the greatest influence on learner knowledge, self-efficacy, attitudes, and skills actively included learners in the acquisition, use, evaluation, and reflection of new practice and knowledge (Dunst et al., 2010). Additionally, adult learning methods appeared to be effective when at least five adult learning characteristics (introduction by instructor, thorough explanation of new practice or knowledge, application, evaluation, and learner self-assessment) were implemented in training with at least 30 learners over multiple sessions for a total of at least 10 h of training (Dunst et al., 2010).

As an alternative to traditional in-person PD, forms of online or web-based PD activities have gained popularity because of their ability to reach rural districts and educators (O'Dwyer et al., 2007) as well as events like COVID-19 necessitating a move to virtual forms of PD (Hartshorne et al., 2020). COVID-19 specifically highlighted the need for PD that builds a community among participants that allows for the sharing of resources (Safi et al., 2020). Teachers during COVID-19 sought PD that was learner-centered, social, and self-directed (Trust and Whalen, 2020), demonstrating that virtual training of teachers is useful in improving their development (Stringer Keefe, 2020). With steadily decreasing state and federal education budgets, online PD also appeals to those in rural areas as they are able to increase accessibility to PD opportunities while keeping costs low (Stone-MacDonald and Douglass, 2015). However, while online PD may be a viable and feasible option for rural or time-constrained educators, there are additional complications with the use of traditional forms of PD that include a lack of interaction and the use of "sit and get" sessions. A lack of face-to-face interaction can create feelings of isolation in participants which can lead to lower levels of engagement and satisfaction (Cook and Steinert, 2013; McConnell et al., 2013). Social participation in a community allows learners to increase their overall level of professional competence as well as display this competency in day-to-day situations with the opportunity for feedback from other community members (Buyse et al., 2003; Anfara and Angelle, 2008), but without interactions with other members in online PD, these communities cannot be appropriately established. Thus, online PD should build a community for its members to interact and learn together, provide resources that are easily available for educators on their own time, connect experts to educators to train them on the needed skills, and focus on the needs of the participants. Many of the recommended best practices for educator PD are addressed by the adaptation of the ECHO Model in ECHO for Education.

## 1.2. Project ECHO®

Given the shift to online forms of PD, it is critical to develop innovative forms of PD that will have a positive impact on teaching practice and student outcomes. One novel PD model, Project ECHO, holds tremendous promise. Project ECHO was originally created to address the health disparities and lack of access to healthcare and



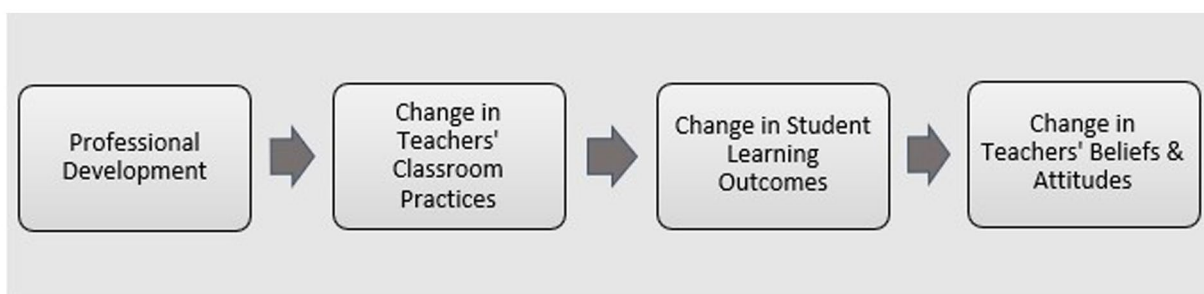


FIGURE 1  
Guskey's (1986, 2002) model of teacher change.

TABLE 1 ECHO implementations.

Area	Source(s)
Asthma	Arora et al. (2010)
Behavioral health care	Hager et al. (2018)
Chronic pain	Scott et al. (2012); Anderson et al. (2017); Carlin et al. (2018)
Diabetes care	Arora et al. (2007a, 2010), Colleran et al. (2012)
Eating disorder treatment	Tantillo et al. (2020)
Education	Root-Elledge et al. (2018); Hardesty et al. (2020)
Geriatrics	Gordon et al. (2016); Bennett et al. (2018)
Medical education	Arora et al. (2010); Fowler et al. (2018)
Mental health care/psychiatry	Arora et al. (2007a, 2010); Scott et al. (2012); Mehrotra et al. (2018)
Obesity	Arora et al. (2010)
Opioid prescription management	Carlin et al. (2018)
Osteoporosis care	Lewiecki et al. (2016)
Pregnancy care	Arora et al. (2010)
Pulmonary disease	Arora et al. (2010)
Rheumatology	Arora et al. (2007a)
Rural regions	Arora et al. (2007b, 2010, 2011), Scott et al. (2012), Mitruka et al. (2014), Tahan et al. (2015), Carlin et al. (2018), Mehrotra et al. (2018)
Substance abuse/use disorders	Arora et al. (2007a, 2010), Scott et al. (2012); Komaromy et al. (2016); Mehrotra et al. (2018)
Veteran health care	Pfeifer (2012), Kauth et al. (2015)
Viral illnesses/infections	Arora et al. (2007b, 2010, 2011); Scott et al. (2012); Mitruka et al. (2014); Tahan et al. (2015)

specialists related to hepatitis C across New Mexico, particularly in rural and underserved areas (Arora et al., 2007a,b). The overarching goal of Project ECHO is to create a multi-directional knowledge exchange by providing content expertise and professional support to

rural and high-risk locations that lack access to what is provided at university or large urban settings (Arora et al., 2007b). Project ECHO aims to create mentor-mentee relationships utilizing teleconferencing technology to allow for best practices to be shared and implemented in applied settings. Project ECHO has been generalized into the ECHO Model, which has been successfully utilized in a number of different contexts, including education (see Table 1). Given the increased accessibility and real-time delivery (e.g., case presentations, problem-solving, mentorship) afforded by the ECHO Model, this model represents an alternative to traditional PD for educators that conforms to adult learning theory and is especially beneficial for those in rural settings.

The ECHO Model is a formalized PD delivery model in which implementation is based on four core components: using technology to leverage scarce resources, training on core professional development topics, case presentations and ongoing mentorship, and outcome measurement. Implementing sites must be trained in the use of ECHO and agree to implement ECHO to fidelity. Like ECHO for medical settings, ECHO for Education adheres to all core components of the ECHO Model. ECHO for Education simply applies the model to the context of education and educators with adaptations to make this model relevant to the educational context. Implementation of ECHO is based on organizing a community of individuals in attending a series of meetings or sessions over a pre-determined period, however most networks are ongoing, taking place over multiple years and addressing evolving best-practices. Generally, this includes either bi-monthly or monthly sessions that are held virtually and include subject matter experts and individuals interested in connecting and learning about the topic. A set of sessions is often referred to as a network. While ECHO for Education fully adheres to the ECHO Model, there are a few small variations in comparison to the original, medical ECHO Model.

One of the most important adaptations of the ECHO Model for Education is the intentional focus of ECHO for Education on creating a community of practice (CoP; also referred to as professional communities, learning communities, and professional learning networks). CoPs are social structures that revolve around continuously updating and maintaining knowledge while also emphasizing member-to-member interaction as an essential feature that provides opportunities for professional development, outreach, and networking across geographical or organizational boundaries (Wenger et al., 2002; Brooks, 2010). The overarching goal of a CoP is to promote ongoing dialog and evolving relationships between colleagues that help to improve the knowledge and abilities of everyone involved (Golden,

2016). Further, learners capitalize on their learned knowledge through social participation once they are assimilated into a community of like individuals with similar goals (Palincsar et al., 1998; Barab and Duffy, 2000). Social participation in a community allows for learners to increase their overall level of professional competence as well as display this competency in day-to-day situations with the opportunity for feedback from other community members (Buyse et al., 2003; Anfara and Angelle, 2008).

ECHO for Education intentionally identifies each network as a CoP to reflect the importance of building a community of learners across disciplines and areas of experience, of building local expertise, and of emphasizing an alignment with the common practices and terminology of educators. While the traditional ECHO Model focuses on building mentorship relationships in order to transmit expert knowledge between the hub and spoke sites, ECHO for Education emphasizes the importance of network members working together to address the issues faced by rural educators. In following the principles of a CoP, ECHO for Education encourages network members—who display trust and respect for other members as well as commitment to the community itself—to exchange their thoughts, knowledge, and personal expertise with other members in order to enact change in practice (Wenger et al., 2002; Anfara and Angelle, 2008).

Ideal CoPs employ an equal balance of individual learning practices (i.e., learning through doing) and observing more experienced members of the community (i.e., learning from others; Wenger et al., 2002; Brooks, 2010). However, when there is a lack of access to colleagues in other schools or districts, increased rural isolation can decrease the likelihood of educators communicating their knowledge, successes, and failures with others (Johnston, 1994). While online PD can help professionals in all fields who are faced with rurality or underserved areas, the lack of face-to-face interaction in these programs fails to adequately address professional isolation (Arora et al., 2010). ECHO for Education utilizes traditional distance services such as e-mail, online presentations, telephone, fax, and video- or teleconferencing to provide members with links to colleagues. Participants in ECHO for Education report frequent communication with network members outside of network sessions to build relationships and continue to assist with issues discussed during network sessions (Root-Elledge et al., 2018). ECHO for Education is designed to create an ideal CoP by balancing the sharing of expertise with ongoing interactions from all network members.

Of equal importance in the adaptation of the ECHO Model for Education is the alteration of the medically-focused language that is used in the original ECHO Model. This includes altering terms such as “tele-clinics,” “grand rounds,” and “case presentations.” Educators rarely think of their students as a case, or presentations regarding their students’ behavior and outcomes as grand rounds. Therefore, within ECHO for Education, slight alterations of these terms are made. Reference to educators’ places of work are labeled and discussed as the school/district within which the educator works. Cases discussed during network sessions are often referred to as problems of practice or student narratives. By subtly changing the terminology used within ECHO for Education educators are able to see the relevance of the model to their work, grasp the model quickly, and are not pushed away by unfamiliar medical jargon.

Another adaptation includes delivering the core learning content related to current problems and student needs identified by network participants. These topics are directly related to best and promising

practice and include student outcomes in specific academic areas, strategies for addressing challenging behaviors, social skills, secondary transitions, early childhood, focusing on educator skills and strategies, or any number of other areas that are of relevance to current issues in education. ECHO for Education networks are also longer in duration, sometimes spanning years while covering the new and emerging topics in these areas. These extended networks bring back many of the same members who are looking to connect with their community. In addition to having a different focus on education topics, the evaluation of ECHO for Education looks slightly different when adapted from the original ECHO Model. Network evaluation must be centered on the specific outcomes that a network has selected, and therefore are unique to each. For example, a medically-focused ECHO network may want to measure the outcome of deaths associated with hepatitis C while an ECHO for Education network may want to evaluate the amount of time a student with Autism Spectrum Disorder (ASD) spends in a classroom.

### 1.3. Implementation and efficacy of ECHO in education

The first step in implementing ECHO is defining the focus of the ECHO network. Importantly, the focus of the network should address a community identified need. After understanding the need for the network, it is critical to establish an interdisciplinary expert hub team. Hub team members should be able to commit to designing and delivering the learning content for the duration of the network (e.g., 6–8 sessions) and should have sufficient content expertise to effectively deliver the materials to session attendees. For extended networks that are common among ECHO for Education, hub team members may remain on the hub team between network years or implementations, but new members may need to be identified prior to each new network implementation. Once the hub team is established, the network must recruit participant “spoke sites.” These participants are typically individuals who are currently facing challenges addressed by the network, are interested in the network topic, or want to earn professional development credits. After a hub team has been established and spoke site participants have been identified, the hub team should ensure they are sufficiently prepared to organize and lead ECHO sessions.

Typical ECHO for Education sessions include brief introductions (~ 10 min), a short (~ 30 min) didactic session, a narrative presentation about a student with an associated discussion (30–45 min), and finally a wrap up that includes the sharing of additional resources (5–10 min). Sessions are organized by the hub team and run by session facilitators. In applying the ECHO Model to education, the importance of having strong session facilitators and ensuring that attendees are comfortable with all aspects of technology used for the sessions cannot be overstated. Overall, challenges can occur due to participants assuming ECHO for Education is a more traditional “sit and get” form of PD, so steps should be taken to explain the difference and build an active community of participants. Additional details on implementing ECHO for Education can be obtained from ECHO training sessions at ECHO Superhub sites.<sup>1</sup>

<sup>1</sup> <http://www.uwyo.edu/wind/echo-replication/index.html>



Prior work has demonstrated the successful application of the model for educators in the specific context of assistive technology (Root-Elledge et al., 2018), autism, secondary transitions, and behavioral supports (Hardesty et al., 2020), and family empowerment around educational goals (Moody et al., 2020). Root-Elledge et al. (2018) demonstrated that ECHO for Education was able to reach a wide range of individuals in rural areas and that both knowledge and reported skills of participants increased due to participation in ECHO for Education. This work laid the initial foundation for the efficacy of ECHO in Education. Hardesty et al. (2020) expanded on the work of Root-Elledge in demonstrating that ECHO for Education was also effective across additional contexts such as autism, secondary transitions, and behavior supports. Educator participants in these networks reported increased knowledge and skills and indicated high levels of satisfaction with this form of professional development. Moody et al. (2020) also demonstrated how ECHO was beneficial in supporting families with children with Autism. It was shown that the community created in ECHO helped parents and families take more ownership and support the educational goals for their children.

Data from the ECHO in Education Superhub at the University of Wyoming supports the efficacy of the ECHO Model for Education as a high-quality form of Educator PD. During the 2020–2021 ( $n = 1,118$ ) and 2021–2022 ( $n = 399$ ) academic years, evaluation data was collected from  $N = 1,517$  respondents across five separate ECHO in Education networks (Act Early ECHO, UW ECHO in Assistive Technology, UW ECHO in Autism and Positive Behavior Supports, UW ECHO in Early Childhood, UW ECHO in Student Health). Respondents in these networks were asked to complete evaluation surveys after each session they attended. Professional development credits were offered for participation (if applicable to their profession) and attendance was not mandatory. Data were compiled across networks and respondents. Across both academic years, respondents reported very positive responses to items such as “Today’s session has contributed to my understanding of (network topic)” (1–5 scale, 1 = Strongly Disagree, 5 = Strongly Agree) –  $M = 4.35$ ;  $SD = 0.77$ , “Today’s training topic was useful to me.” (1–5 scale, 1 = Strongly Disagree, 5 = Strongly Agree) –  $M = 4.53$ ;  $SD = 0.64$ , and “Attending today’s session has helped me feel connected to other professionals or families.” (1–5 scale, 1 = Strongly Disagree, 5 = Strongly Agree) –  $M = 4.36$ ;  $SD = 0.66$ . Confidence was also high among participants in implementing what they learned from the sessions (1–5 scale, 1 = Not at all confident, 5 = Extremely confident) –  $M = 3.79$ ;  $SD = 0.88$ .

Respondents also completed a retrospective assessment of their knowledge change. Across all networks, a paired samples t-test indicated a significant increase in knowledge,  $t(1485) = -40.89$ ,  $p < 0.001$ , due to participation in the individual ECHO in Education sessions. A paired samples t-test was selected as responses were aggregated across all participations for the purposes of a single pre-post comparison as not every participant completed every evaluation survey. Responses were measured from 1—Not at all knowledgeable to 5—Extremely knowledgeable: “Knowledge BEFORE this ECHO session?”— $M = 2.98$ ;  $SD = 0.89$ , “Knowledge AFTER this ECHO session?”— $M = 3.76$ ;  $SD = 0.72$ . It should be noted that data was collected only from participants who elected to complete the evaluation surveys. These surveys were mandatory for receipt of professional development credits but did not capture all participants in the ECHO for Education sessions. Future research may learn more about the success of ECHO for Education by interviewing those

individuals who chose to discontinue participation in the ECHO networks. Overall, these findings indicate that the ECHO Model in Education is successful in providing skills, strategies, and a sense of community to educators in an effective way.

The adaptation of the ECHO Model to education is further supported by the alignment of ECHO for Education with the principles of MTC, Adult Learning Theory, and best practices for successful PD and adult learning. MTC suggests that PD causes teacher change due to the experience of practices and knowledge gained (Guskey, 1986) while Adult Learning Theory emphasizes the importance of the motivation to learn and outlines the way in which the content is delivered (Knowles et al., 1998). Overall, the use of case-based learning in ECHO for Education allows educators to bring real-world experiences into their learning through the mutual sharing of their interactions with students. The discussion of student narratives also allows educators to take skills, knowledge, and other participants’ recommendations out of the PD environment and apply them in their classrooms or educational settings. Educators are also motivated to participate as the learning is applied and focused on topics that they have identified as areas of highest need. ECHO for Education also builds capacity for participants by connecting them to a virtual professional network that creates an ongoing learning community they can communicate with as they progress in their careers.

ECHO for Education additionally addresses all the key aspects of successful PD models (Darling-Hammond et al., 2017) and effective adult learning methods outlined in Dunst et al.’ (2010) meta-analysis. ECHO for Education delivers core learning content about best-practices that have been identified and prioritized by educators. The content is delivered by experts and participants are asked to reflect on their learning and assess their progress via evaluation. The mechanisms of mixing best-practice, self-directed voluntary attendance, and real-time application and learning via discussion and student narrative presentations encourage discussion of day-to-day situations faced within their educational setting and encourage collaboration. The discussion of these experiences remain task-oriented as topics covered in the PD are specific to what is faced in the educational setting and offers educators specific motivators such as continuing education credits to allow for career and salary mobility. The engagement of the participants is also sustained across several sessions and a community of practice is built over several weeks or months for the educators. ECHO for Education as a form of PD follows the recommended best practices outlined in the literature and has been shown to be successful in past implementations.

## 2. Discussion

Ongoing PD is extremely important if educators wish to provide the best education they can for their students. Attending physical PD sessions may be very difficult for some educators, particularly those in rural locations, and many of the common approaches to PD (e.g., conferences, online webinars) do not follow best practices prescribed by Adult Learning Theory (Knowles et al., 1998; Garet et al., 2001; Tour, 2017), the MTC (Guskey, 1986), adult learning (Dunst et al., 2010), and successful PD models (Darling-Hammond et al., 2017). The adaptation of the ECHO Model for education addresses these issues associated with traditional forms of PD. Additionally, ECHO for Education offers aspects of PD which are not available through

traditional outlets and has been shown to be successful in past applications.

The ECHO Model (Arora et al., 2007a,b) was originally designed as a service and training network to transfer knowledge and expertise to rural healthcare providers. Since its inception, this model has been adapted to fit the needs of educators in a similar fashion (Root-Elledge et al., 2018; Hardesty et al., 2020), as small alterations to the model allow it to fit into an educational PD context. These changes include an emphasis on building a CoP, focusing on education-relevant topics, a departure from medically-focused language to more educationally-based language, and an evaluation strategy focused on the educational outcomes of interest. ECHO for Education networks successfully meet educators where they are and deliver high-quality PD that meets the needs they have identified.

In addition to highlighting the value of ECHO for Education for educator PD, this paper seeks to assist those interested in starting their own ECHO for Education networks. Maintaining fidelity to the original ECHO Model while responding to the real-time needs of the target educator community guides the process. A network must meet a need, bring expertise to all participants, encourage the engagement of members, and offer applied skills and techniques that can be applied in authentic educational settings. The core focus of the ECHO network is important to consider during the planning, recruitment, implementation, and evaluation processes. ECHO for Education networks also rely heavily on the quality of hub team members and session facilitators who oversee the day-to-day and long-term success of the network. The ability of the network to offer varying forms of continuing education credits is also important in building network participation among educators. The use of the components outlined here, along with immersive training in the ECHO for Education protocol, will ensure the successful creation of an ECHO for Education network. It should be noted that while the ECHO Model and ECHO for Education have been utilized in settings across the globe, ECHO for Education may not fit within all legal and regulatory frameworks and those interested in implementation should review local standards prior to implementation.

In conclusion, ECHO for Education is an innovative and effective form of educator PD. In comparison to traditional forms of PD, ECHO for Education saves time for educators by allowing participation from anywhere with an internet connection, responds to educator needs by allowing interaction and encouraging

community, and offers specific and applied recommendations to educators via student narrative presentations and network feedback sessions. ECHO for Education has the potential to reach more educators and bring high-quality PD into a wide array of educational settings. PD is a vital component of improving educator self-efficacy and student outcomes, and ECHO for Education can provide educators with a collaborative learning community that is an accessible option for bettering future practice and improving student outcomes.

## Author contributions

ED, HS, OS, CH, SR-E, SZ, and EM contributed to conception and design of the manuscript. ED, HS, and OS organized the data and performed the statistical analysis. 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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# The impact of professional learning communities on pre-service teachers' professional commitment

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While in-service teachers' professional commitment has gained significant attention in recent years, researches on pre-service teachers' professional commitment is still insufficient, particularly with regard to the effect that professional learning communities play on pre-service teachers' professional commitment. In this context, this study employed mixed methods to investigate the impact of workshops for teaching competitions as a professional learning community on pre-service teachers' professional commitment in China. A questionnaire survey was administered to pre-service teachers who had workshop experiences ( $n=43$ ) and their classmates who did not have workshop experiences ( $n=98$ ) to examine the effect of workshops for teaching competitions as a professional learning community on pre-service teachers' professional commitment. Follow-up qualitative interviews with 5 pre-service teachers with workshop experiences were conducted to explain the reasons behind such effects. The results showed that workshop experiences had significant and positive effects on pre-service teachers' professional commitment and the characteristics of shared vision, collaboration, and reflective dialogue affected their professional commitment from three perspectives: commitment to teaching as a career, personal time investment, and interest in professional development.

## KEYWORDS

professional learning community, workshops for teaching competitions, pre-service teacher, impact, professional commitment

## 1. Introduction

The concept of professional learning communities (PLCs) has been one of the most widely discussed research topics in the last 30 years (Zhang et al., 2023). Numerous studies have suggested that well-implemented PLCs can significantly contribute to student learning outcomes (Louis and Marks, 1998; Lomos et al., 2011; Akiba and Liang, 2016), teacher professional development (McLaughlin and Talbert, 2001; Hipp and Huffman, 2010), and school reform (Stoll et al., 2006; Harris and Jones, 2010; Doğan and Adams, 2018). As a result, systems and schools are investing considerable efforts in developing themselves as professional learning communities. Undoubtedly, PLCs are becoming more and more widespread in the world and therefore are in the ascendant in educational practice and policy at this time (Hargreaves, 2007).

In China, PLCs have been around in the form of Teaching Research Groups (TRGs, jiaoyanzu) from school level to provincial level for decades since the founding of the People's Republic of China when TRGs were established officially and formally to improve teaching



quality (Ministry of Education, 1952a,b). Chinese students' top performance in the international assessment programs such as TIMSS and PISA has attracted international attention (Zheng et al., 2019). The multilevel and multifaceted PLCs have been considered as a major contributor to students' excellent performance (Cheng, 2011). Teachers participate in the activities, such as collective lesson planning, teaching competitions, peer class observation, and delivering open lessons, etc. organized by PLCs of different forms, especially by school-level TRGs which are composed of teachers teaching the same subject in the same school. Even in some resource-strained and remote rural areas, teachers participate in these professional learning activities (Zheng et al., 2016). Therefore, a growing number of studies have explored the effects of PLCs on teachers' professional development, such as teacher efficacy (Zonoubi et al., 2016; Zhang et al., 2023), job satisfaction (Zhang and Yuan, 2020; Zhang et al., 2023), and teacher commitment to students (Lee et al., 2011; Zheng et al., 2021).

In addition to the PLCs for in-service teachers, there are PLCs for pre-service teachers in the form of workshops for teaching competitions in many teacher-education-oriented colleges or universities. They provide opportunities for pre-service teachers' professional development, help pre-service teachers get more qualified for their future teaching, and also contribute much to the success of education in China. However, little research has examined the effects of workshops for teaching competitions on pre-service teachers' professional development.

There are usually workshops for teaching competitions of different subjects such as Chinese, English, Mathematics, and Science etc. in the teacher-education-oriented colleges or universities. In view of the research gaps mentioned above, the current study attempts to conduct a case study on workshops for English teaching competitions (WETCs) to explore the effect of workshops for teaching competitions on pre-service teachers' professional commitment in China. It aims to explore whether their participation in the workshops enhance their personal time investment in activities related to teaching, their interest in professional development and their commitment to teaching as a career. Specifically, two research questions will be addressed in the study.

- (1) Do WETCs as a professional learning community improve pre-service teachers' professional commitment?
- (2) How do WETCs practices affect pre-service teachers' professional commitment?

## 2. Literature review

### 2.1. Teachers' professional commitment

Commitment is individuals' psychological bond or identification with an object that represents a special meaning or importance (Mowday et al., 1982; Buchanan, 1997). A committed employee is more likely to desire to be affiliated with the object, believe in the values and goals of the object, and exert effort beyond minimal expectations for the object (Firestone and Pennell, 1993).

In teacher education, teacher commitment is defined as teachers' psychological attachment to professional institutions, to the teaching

profession, and to colleagues, students and their parents (Park, 2005; Lee et al., 2011). This means teacher commitment is multifaceted and it is associated with various commitment objects such as students, the teaching profession, and school organizations. In other words, there are three types of teacher commitment, i.e., teacher commitment to the teaching profession (professional commitment), to the school (organizational commitment) and to students (student commitment).

Professional commitment is a psychological attachment or bond to the teaching profession (Firestone and Pennell, 1993). It implies the degree to which teachers value and feel connected to the teaching profession (Lamote and Engels, 2010) and the degree to which teachers are engaged in carrying out various specific tasks in the workplace (Brown and Leigh, 1996). Thus, teachers who are committed to their teaching profession are willing to exert considerable efforts for teaching and considered to be more satisfied with the work.

Previous studies show that professional commitment is the primary motivator of persistence and effort for pre-service learning to teach, thus having a great impact on their professional development. The stronger their professional commitment is, the more energized pre-service teachers feel to learn to teach (Durksen and Klassen, 2012). Parkes (1989) studied the impact of British pre-service teachers' professional commitment on their performance in teacher education. It was found that professional commitment was positively related to performance. According to the study conducted by Fokkens-Bruinsma and Canrinus (2015) in the Netherlands, highly committed pre-service teachers are more likely to complete teacher education programs than their uncommitted counterparts.

What is more, previous studies indicate that professional commitment is one of key factors deciding whether pre-service teachers enter the teaching profession and influencing their intention in the teaching profession after graduation (Lam et al., 1995; Rots et al., 2007; Wang et al., 2021). The stronger the commitment is, the more likely pre-service teachers would plan to stay in the teaching profession (Lam et al., 1995). Rots et al. (2007, 2010) reported, highly committed pre-service teachers have clearer intentions to keep a teaching career goal but lower attrition from teaching. Their psychological attachment to the teaching profession rules out other professions as their primary career goals (Wang et al., 2021).

### 2.2. WETC as a PLC

In China, there are provincial and national teaching competitions for pre-service teachers. Even before they enter the provincial teaching competitions, they participate in the competitions held by the college or university. In both provincial and national teaching competitions, pre-service teachers are asked to design a lesson plan and conduct a micro-teaching according to the teaching material given to them. In order to help pre-service teachers have a good performance in the competitions, workshops for teaching competitions have been established in many four-year bachelor programs of education in the universities. The workshops are usually presided over and run by one or more supervisors whose major concern is improving pre-service teachers' teaching of a subject in the primary or secondary school. They study the subject teaching or have some teaching experience in elementary or secondary schools.

Although there is no universal definition of a professional learning community, there is a consensus that one exists when a group of teachers share and critically interrogate their practice in an ongoing, reflective, collaborative, learning-oriented, growth promoting way (Toole and Louis, 2002). An underlying assumption is that the teachers involved see the group as a serious collective enterprise (King and Newmann, 2001). It is also generally agreed that effective professional learning communities have the capacity to promote and sustain the learning of professionals with the collective purpose of enhancing student learning (Louis et al., 1995).

In WETCs, pre-service EFL teachers under the supervision of supervisor(s) come together as a team to help each other in a reflective and collaborative way. WETCs are different from one-time workshops. WETC participants can build long-term connections with the supervisor and other pre-service teachers from other classes. Under the supervisor's supervision, pre-service teachers collectively interrogate and improve their EFL teaching performance by means of mutual learning and collaborative reflection with the purpose of promoting their professionalism (shared vision on learning). Specifically, under the guidance of the supervisor, they collectively design lesson plans, deliver micro-teaching, observe master teachers' classroom teaching, and conduct peer observation of micro-teaching (deprivatized practice). In addition, they discuss the major or difficult issues in their lesson plans and micro-teaching (collaborative learning), and give comment on each other's lesson plans and micro-teaching (reflective dialogue). The supervisor also makes comments and suggestions on their works. They learn not only from peers but experts as well in learning communities. According to the activities and organization above-mentioned, it is found that WETCs have the core characteristics of PLCs, such as shared vision on learning, collaborative learning, deprivatized practice and reflective dialogue (Stoll et al., 2006; Vescio et al., 2008; Vangrieken et al., 2017). In this way it is considered as a typical PLC for pre-service teachers.

Previous studies indicate that PLCs for in-service teachers hold promise for improving teacher development (Zhang and Yuan, 2020). Participants of PLCs report a higher level of professional development, including enhanced collective responsibility for student learning (Louis et al., 1995), improved teaching effectiveness (Vescio et al., 2008), an increased organizational commitment (Hausman and Goldring, 2001), and a reduced sense of isolation (Dalgarno and Colgan, 2007). However, there is no empirical evidence as to whether and how PLCs for pre-service teachers can improve their professional development. Since professional commitment is considered as the primary motivator of persistence and effort for pre-service learning to teach and has a great impact on their professional development (Wang et al., 2021), the current study attempts to conduct a case study of WETCs in China and explore whether and how PLCs for pre-service teachers can improve their professional commitment.

### 3. Methods

Mix methods were adopted in the study. The first question was addressed through a quantitative study, in which a questionnaire survey was conducted to examine the effect of WETCs on pre-service EFL teachers' professional commitment. The second question was

answered by an explanatory qualitative research, in which semi-structured interviews were conducted after the questionnaire survey to explain how the effects identified from the questionnaire survey occurred as perceived by the pre-service teachers.

### 3.1. Research respondents

In China, initial teacher education is university-based. In all the undergraduate teacher education programs, both subject courses and teacher education courses are offered. For example, in the four-year Bachelor programs of EFL teacher education, besides the compulsory subject courses such as English reading, English writing, English speaking, English listening, linguistics and English literature, teacher education courses such as EFL pedagogy, EFL lesson planning, EFL micro-teaching, and teaching practicum are also usually compulsory. The difference among the curricula in different universities lies in the number of credits of some courses or the semester in which the courses are provided.

In the study, altogether 141 respondents (aged from 21 to 23 years old) were included. All of them were from the WETCs in Zhejiang Province. The particular WETCs in Zhejiang Province were selected for two reasons. First, the teacher-education-oriented universities in Zhejiang Province have longer history and more experience of workshops for pre-service teachers' teaching competitions as the provincial teaching competitions for pre-service teachers in China started in Zhejiang Province, and even the national teaching competitions for pre-service teachers are a copy of Zhejiang provincial competitions and held by Zhejiang Normal University. Second, the authors were familiar with the supervisors of the WETCs. With the help of the supervisors, respondents were free to speak in the interview.

There are two semesters in an academic year in China. The WETCs are offered to students when they are in the sixth and seventh semesters. The provincial and national teaching competitions are usually held at the end of each year. In the study, all of the respondents were in the last year of their undergraduate study in the teacher education program. Among them, 43 respondents who attended the WETC were in the experimental group and agreed to complete the questionnaire survey on a voluntary base. The rest 98 respondents who did not have the WETC experience were included in the control group and agreed to complete the questionnaire survey on a voluntary base. Since most students in EFL teacher Education programs are female, among the 43 respondents in the experiment group, 37 were female and only 6 were male. Among the 98 respondents in the control group, 81 were female and only 17 were male.

### 3.2. Research procedure

The WETCs usually went from students' sixth semester through the end of their seventh semester. After the WETCs ended, with the help of WETC supervisors, the authors asked the WETC participants to be the respondents in the experimental group and participate in the questionnaire survey on a voluntary basis. Their classmates who did not participated in the workshop were invited to be respondents in the control group. Finally, 43 respondents in the experimental group and 98 respondents in the control group completed the



questionnaire survey. The questionnaire was anonymous and all the respondents were informed that the data would only be used for research purpose.

After the questionnaire survey, semi-structured interviews were conducted with 5 participants in the experimental group. The 5 participants were selected to be interviewed because they gained much professional growth from the WETC experience, such as winning teaching prizes, being offered jobs in reputational schools.

### 3.3. Research instruments

Pre-service teachers' professional commitment was measured using the questionnaire developed by [Lauermann et al. \(2017\)](#). The questionnaire included three subscales: commitment to teaching as a career, interest in professional development, and personal time investment. The questionnaire was translated by the first author and back translated by the second author.

Commitment to teaching as a career was assessed with two items from the FIT-Choice framework ([Watt and Richardson, 2007](#)) that capture satisfaction with one's career choice and planned persistence in teaching ( $\alpha=0.896$ : How satisfied are you with your choice of becoming an EFL teacher? How sure are you that you want to work as an EFL teacher in the future?). The respondents rated each item on a seven-point Likert scale ranging from 1 (Not at all) to 7 (Very much).

Interest in professional development was assessed with four questions ( $\alpha=0.806$ ): How important would it be/ is it to you to participate in professional development activities that... (1) focus on pedagogical knowledge of English teaching? (2) focus on classroom management skills? (3) focus on alternative teaching practices? (4) focus on subject specific knowledge of English? The participants responded on a seven-point Likert scale ranging from 1 (Not at all) to 7 (Very much).

Personal time investment measured the amount of personal time the participants were willing to invest in professional activities and tasks. It was assessed with five questions ( $\alpha=0.922$ ): How much of your personal time are you willing to invest ... (1) to work with students? (2) to communicate with parents? (3) to help students? (4) to prepare good lessons? (5) to improve your teaching? The participants responded on a seven-point Likert scale ranging from 1 (None) to 7 (Most of it).

This validated 11-item scale showed acceptable reliability (Cronbach's alpha coefficients of global professional commitment to sub-dimensions ranged from 0.806 to 0.970) and good structural validity (see [Lauermann et al., 2017](#)).

The second research question was addressed by means of a follow-up qualitative research, in which semi-structured interviews were conducted after the respondents finished the questionnaire survey. All interviews were conducted in Chinese and each lasted approximately 40–60 min. During the interviews, the participants were asked to share their individual experiences with WETC practices and describe how these experiences affected their commitment toward EFL teaching. All of the interviews were audio-recorded and transcribed by the first author and checked by the second author. The Chinese data were first analyzed and then translated into English by both authors.

### 3.4. Data analysis plan

The quantitative data were analyzed using the statistical package SPSS version 27. First descriptive statistics such as mean scores of each question and each subscale were calculated. Then, to answer the first research question, the difference was tested between the experimental group and the control group in terms of the three subscales of professional commitment. Assumptions were checked prior to conducting relevant tests in order to ensure appropriate tests (i.e., parametric or non-parametric) were used.

The result of normality test with Kolmogorov–Smirnov significance value ( $<0.001$ ) indicated a violation of the assumption of normality. However, such a result is quite common because of small sample size or unbalanced samples, and the actual shape of the distribution of scores indicated a reasonable normal distribution. This outcome was supported by an inspection of the normal probability plots (Normal Q–Q plot) that suggested a normal distribution (See [Figure 1](#)). The Levene test result indicated a significance value ( $<0.001$ ) suggesting a violation of the assumption of homogeneity of variance, leading to the use of the non-parametric Mann–Whitney *U* tests to test whether the two groups differ significantly in professional commitment.

All of the interviews were audio-recorded and transcribed by the first author. The Chinese data were first analyzed and then translated into English. The data were analyzed in the following ways: “(1) making sense of the narratives, (2) coding for themes, (3) reconstructing the narratives for a storyline, and (4) telling and retelling, living and reliving the stories” ([Liu and Xu, 2011](#): 591). Narrative excerpts are included in the section of Findings and Discussions, where participants are given pseudonyms to maintain anonymity. For the qualitative part, the authors transcribed and read repeatedly the data. Transcripts were also sent back to the participants for correction and approval. They were told that they could edit the transcripts for accuracy and clarity.

## 4. Findings

### 4.1. Do WETC experiences improve pre-service teachers' professional commitment?

Many studies (e.g., [Vescio et al., 2008](#); [Doğan and Adams, 2018](#)) have revealed that PLCs are a beneficial structural condition for promoting teacher development. This study showed that PLCs benefited pre-service teachers more than that. WETC experiences motivated them to be more committed to their future teaching profession. Mann–Whitney *U* tests showed the null hypotheses were rejected and pre-service EFL teachers who had WETC experiences were significantly more committed than their counterparts who had no such experiences. [Table 1](#) is a summary of descriptive statistics and the results of Mann–Whitney *U* tests.

As depicted in [Table 1](#), the mean score of the experimental group's commitment to teaching, interest in professional development and personal time investment were, respectively, 6.76, 6.94 and 6.88. These indicated that pre-service EFL teachers who had WETC experiences were extremely interested in professional development, extremely willing to invest their personal time on teaching activities, and

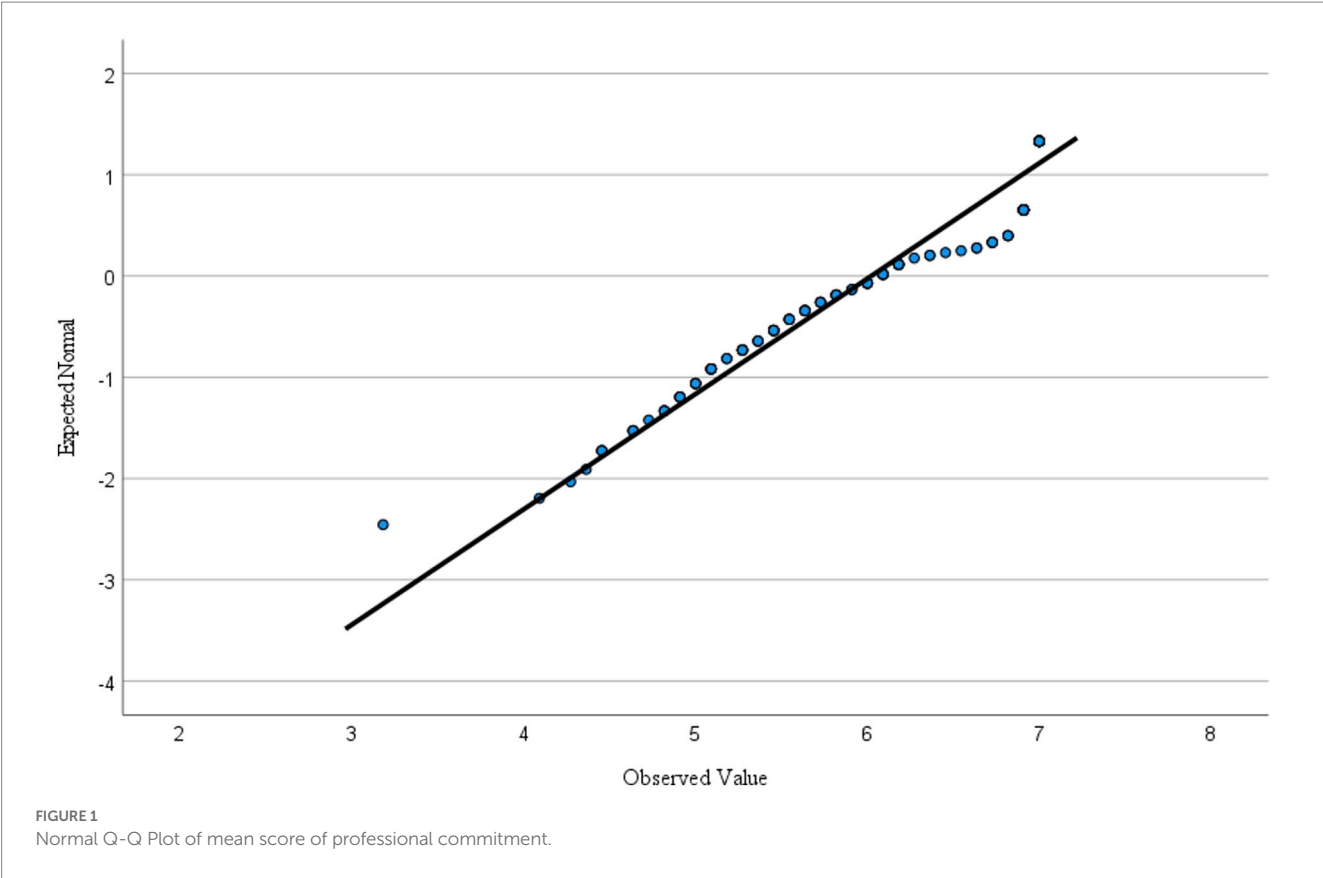


TABLE 1 Comparison of experimental group and control group on professional commitment.

Subscale	Experimental group (n=43)		Control group (n=98)		U	Z	Sig.
	M	SD	M	SD			
CTA	6.76	0.35	5.03	1.31	442.00	-7.59	0.000
IPD	6.94	0.12	5.66	0.90	357.00	-8.01	0.000
PTI	6.88	0.15	5.87	0.64	467.50	-7.49	0.000

CTA, commitment to teaching; IPD, interest in professional development; PTI, personal time investment.

extremely likely to take EFL teaching as career. The mean score of the control group's commitment to teaching, interest in professional development and personal time investment were, respectively, 5.03, 5.66 and 5.87. The experimental group's mean scores were significantly higher than those of the control group. This means that comparatively speaking, pre-service EFL teachers with WETC experiences were more committed than those without WETC experiences. Inspections of the mean differences in the three subscales indicated that the biggest difference between these two groups of pre-service EFL teachers on professional commitment was the difference in commitment to teaching as a career ( $MD = 1.73$ ). The mean score of control group's commitment to teaching was only 5.03, but that of the experimental group was as high as 6.76.

Further inspections of the mean scores of each question also showed that the difference of the three subscales between these two

groups of pre-service EFL teachers varied from question to question. Table 2 shows the difference between the experimental group and the control group in terms of each question in the three subscales.

As shown in Table 2, the mean score of each question in the experimental group ranges from 6.70 to 7.00, which means they were extremely committed in all perspectives. The mean score of each question in the control group ranges from 4.97 to 6.14. The highest score (6.14) is from Question 5 of PTI, the lowest (4.97) from Question 2 of CTA. Furthermore, Mann-Whitney *U* tests showed that there was significant difference among the mean scores of some questions of IPD and PTI in the control group. For example, in the subscale of PTI, the mean scores of Question 4 (6.13) and Question 5 (6.14) were higher than those of Question 1, Question 2, and Question 3. This means that pre-service EFL teachers without WECT experiences were more willing to prepare good lessons and to improve their teaching than to work with students, to communicate with parents and to help students.

### 4.2. How do WETC experiences affect pre-service teachers' professional commitment?

In order to discover how WETC experiences affect pre-service teachers' professional commitment, an interview study was conducted with 5 respondents who had WETC experiences. By analyzing the interview transcript, we found that three characteristics of PLCs were significant predictors of EFL pre-service teachers' professional commitment.

TABLE 2 Comparison of experimental group and control group on each question.

Subscale	Questions	Experimental group ( <i>n</i> =43)		Control group ( <i>n</i> =98)		<i>U</i>	<i>Z</i>	<i>Sig.</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
CTA	Question 1	6.70	0.46	5.10	1.33	576.00	−7.08	0.000
	Question 2	6.84	0.37	4.97	1.35	405.50	−7.88	0.000
IPD	Question 1	7.00	0.00	5.75	1.04	580.50	−7.38	0.000
	Question 2	6.80	0.41	5.46	0.95	520.50	−7.44	0.000
	Question 3	6.98	0.15	5.54	1.00	432.50	−7.95	0.000
	Question 4	7.00	0.00	5.91	1.00	645.00	−7.15	0.000
PTI	Question 1	6.95	0.21	5.71	0.77	381.50	−8.20	0.000
	Question 2	6.70	0.51	5.65	0.83	686.50	−6.72	0.000
	Question 3	6.95	0.21	5.72	0.76	381.50	−8.21	0.000
	Question 4	6.91	0.29	6.13	0.59	651.00	−7.33	0.000
	Question 5	6.90	0.29	6.14	0.54	653.00	−7.35	0.000

The first significant predictor is shared vision. WETC participants worked with a group of people who had the same vision and goals. All of them participated in WETCs in order to improve their professional competence. The shared vision helped create throughout the workshop a progressive learning culture which affected their professional commitment positively by encouraging and stimulating the participants to attend the workshop activities and make more efforts in their professional development. As the interviewee Ge reported,

As the saying goes “If you want to go fast, go alone; if you want to go far, go together,” our teaching professional development is the case. Before I participated in the WETC, I learned the way of practicing my lesson planning from the course of Lesson Planning, but I could not persist on practicing lesson plans alone. In the WETC, I was always stimulated and encouraged by other members’ persistence and diligence. Sometimes, I was even pushed. Gradually I got used to the practice and got to enjoy these activities beneficial to my professional development. Now I really miss the days when we worked together.

The preceding quote indicated that the company of peers who had shared vision played an important role in pre-service teachers’ leaning and their professional commitment was affected positively by the progressive learning culture. The culture facilitated pre-service teachers’ continuous learning. This opinion was shared by all the interviewees. Besides, their professional commitment was also affected by the WETC participants of the previous years. Each year there were WETC participants who won the national or provincial English teaching prizes or received job offers from some prestigious schools. They were often invited to introduce their WETC experience to the new participants of WETCs. They set good examples for the new participants. For example, pre-service teachers interviewed reported that they always considered some of the participants of the previous year as their role models.

Before I participated in the workshop, I was always told that the job market for pre-service EFL teachers was very competitive because the vacancies for EFL teachers were much less than those for Chinese or Math teachers in Zhejiang Province. I was afraid that I would not be employed by any school, but my WETC experiences told me those who had good professional competency could still find teaching positions. Many of those who participated in the WETC in the

previous years are working in very famous elementary or middle schools now, so I’m confident I will receive job offers from middle schools. Before I participated in the workshop, I hoped that I could teach at an elementary school, but now I think I’ll be qualified to teach middle school students (Ge).

I always take Mo as my role model. He was in the WETC last year and now he is teaching at a very reputational middle school in Hangzhou. He said the WETC experience which improved his professional competence greatly helped him get recruited to such a prestigious school. He often expressed his great gratitude to the WETC. I will participate in the WETC activities like him to improve my professional competence. I’m very confident that I will be a qualified English teacher and successfully receive job offers when I graduate (Fang).

The two quotes showed that new WETC participants were encouraged and motivated by the previous participants. After WETC learning they were more confident about their teaching profession in the future than before. They could see good job opportunities brought about by WETC experiences. In this study, the WETC participants believed that they would successfully receive job offers when they graduated. As a reward, their confidence influenced how satisfactory they were with their choice of becoming/being an EFL teacher and how sure they were to want to work as an EFL teacher in the future. In this way, their confidence made them more committed.

The second significant predictor is collaboration. WETCs set clear goals for improving participants’ professional competence by engaging them into many activities. As WETC participants took part in collaborative activities, such as lesson study, collective lesson planning, and micro-teaching, they collaborated with each other and improved their professional competence. As the saying goes “Great things may be done by mass effort,” they improved their teacher competency by collaboration. Gradually they learned to set more appropriate teaching objectives, design better and more diverse classroom activities, implement more proper evaluation activities. Such improvement helped them develop a sense of achievement and satisfaction which as a result affected their commitment to teaching as a career and encouraged them to spend more efforts in these activities. They believed they could be a good English teacher if only they kept

attending such activities and they knew the feasible ways of improving their professional competence.

Many collaborative activities were offered in WETCs, such as peer observation, collective lesson planning, observing expert teachers' teaching. The more activities I participated in, the more progress I made. I can set specific teaching objectives and design better lesson plans now. I'm willing to spend more time learning to be a good English teacher (Lin).

The preceding quote from the interview indicated that the progress she made affected her willingness to invest in professional activities and tasks. She experienced the proper ways of improving her professional competence, so she became confident in her future English teaching career. On the other hand, the progress stimulated her motivation to be a better English teacher applicant. She not only interested in the activities that are beneficial to improving her professional development, but also willing to invest time to these activities. She believed she could be a good English teacher if only they kept attending such activities even after she finished the WETC learning.

Pre-service teachers have various motivations to enter teaching profession. Some are motivated to impact students (altruism), some are motivated by an innate calling to the profession (intrinsic motivation), and some are motivated from observing and interacting with others (socialization influences) (Kwok et al., 2022). The study found that pre-service EFL teachers were motivated differently to enter the four-year Bachelor Program of English Education. Among the five interviewees, 3 of them reported that they had intrinsic motivation to teach English. They chose the program mostly because they loved English teaching. One reported she was motivated mostly by the social status of teaching profession and one reported she wanted to be a translator. As the interviewee Li reported,

I planned to study in the Bachelor Program of English Education with the purpose of improving my English so that I could do business translation or literature translation when I graduate, but WETC activities such as collective lesson planning, peer observation of micro-teaching changed my plan. I found these activities so interesting and they made me a qualified EFL teacher. I like these professional development activities (Li).

In Li's case, she planned to be a translator after graduation, but WETC changed her mind because WETC activities built her interest in EFL teaching. According to the quantitative analysis, among the three subscales, the biggest difference between these two groups of pre-service teachers' professional commitment lies in their commitment to teaching as a career. Those with WETC experiences were far more confident that they would be able to be EFL teachers when they graduated. According to the qualitative analysis, their confidence had great impact on their commitment to teaching as a career and could explain the reason for the biggest difference. In China, teachers at all levels of the educational system possess considerable social status and are highly respected (Zhang et al., 2018). According to the 2013 Global Teacher Status Index, teachers in China rank the first among the 21 surveyed countries such as the UK, the USA, France (Dolton and Marcenaro-Gutierrez, 2013). This Index also shows that two-thirds of the 21 countries surveyed see the status of their teachers as being most similar to social work (i.e., lowly ranked compared to other professions), but in China teachers are ranked as being on the same level as the medical practitioners. The study discovered that those with WETC

experiences were more likely to be motivated by the intrinsic motivation even if they were motivated by teachers' social status when they entered the teacher education program. They gained confidence from their community learning and experienced the feasible way of promoting their professional competence. Their confidence in turn motivated them to be more interested in professional development and encouraged them to invest more time on their professional competence.

The third significant predictor is reflective dialogue which bridges theories and practice. Reflective dialogue is a conversation wherein two or more colleagues reflect with each other on serious educational issues or problems related to instructional practice and specific students' learning (Louis and Marks, 1998; Stoll et al., 2006; Brown et al., 2017). Under the supervisor's guidance, the participants reflected on the teaching objectives they set, the instructional activities they designed, the questions they asked, and the assignments they designed. They discussed how they could make the teaching objectives more clearly stated and more specific, how they could make the instructional activities helpful to achieve teaching objectives and assignments more beneficial to improving students' English proficiency and critical thinking, and how they could make the questions more easily understood by students. In this way, participants realized the importance of theories and teaching principles underlying the lesson plans and micro-teaching, found it interesting to make lesson plans and micro-teaching better and gained a better understanding of English teaching from different perspectives. They learned to connect theory and practice more effectively. As the interviewee Zhang reported,

My favorite activity is reflective dialogue after lesson planning and micro-teaching. The supervisor guided us to reflect on everything related to lesson plans and micro-teaching. Each time we were asked to reflect on the problems in teaching objectives we set, in instructional activities and assignments, even in the way questions were presented. The most important was that we could find solutions to the problems and understood the pedagogical theories and teaching principles underlying the solutions with the supervisor's help. I was very happy with the process and was always looking forward to the activity (Zhang).

The quote showed that participant was very interested in reflective dialogues and always looked forward to the activities because these activities helped him gain a better understanding of English teaching. Reflective dialogues built them more committed in that he was more interested in and willing to participate in the professional activities. The study showed that reflective dialogue was a significant predictor of professional commitment. The result is similar to those of previous studies conducted to in-service teachers (Hausman and Goldring, 2001; Fransson and Frelin, 2016; Doğan and Adams, 2018), but surprisingly a little inconsistent with that of researches conducted by Zheng et al. (2021) who found in-service teachers in PLCs in China were likely to talk "the right nonsense" to maintain a harmonious atmosphere and interpersonal relationships, and this stopped them having critical and deep conversations. In this study, the pre-service teachers were less likely to talk "the right nonsense" in order to save each other's face. They were guided by the supervisor to present their opinions from different perspectives to avoid superficial conversations. They were more likely to have critical and deep conversations and many constructional suggestions were raised each time in reflective dialogues.



## 5. Discussions

The quantitative findings showed that pre-service EFL teachers who had WETC experiences were more interested in professional development and more willing to invest personal time on teaching activities than their counterparts who had no WETC experiences. The biggest difference was those with WETC experiences were more likely to take EFL teaching as their career. Therefore, WETCs had significant and positive effects on pre-service EFL teachers' professional commitment. Such findings are consistent with the results of previous research (e.g., Hausman and Goldring, 2001; Zheng et al., 2021) that PLCs help sustain and enhance teachers' professional commitment.

The qualitative findings indicate that shared vision, collaborative efforts and reflective dialogue are the three characteristics of PLCs that influenced pre-service EFL teachers' professional commitment significantly as Figure 2 shows. Shared vision helped create among the whole workshop a progressive learning culture. Collaboration helped develop among the participants a sense of achievement and satisfaction. Both the progressive learning culture and the sense of achievement and satisfaction helped improve their confidence to be an EFL teacher. In addition, the sense of achievement and satisfaction enhance their willingness to invest personal time on teaching and made them more interested in professional development activities. Reflective dialogues helped participants have a better understanding of EFL teaching and the connection between theory and practice, which make participants more interested in professional development activities and willing to spend more time on professional activities.

Both the quantitative and qualitative findings indicated that WETC experiences are beneficial to pre-service EFL teachers in many ways. The experiences improved their professional competence, helped them experience the feasible way for their future professional development, and enhanced their professional commitment. The most important is that pre-service teachers gained confidence from the experiences. They are far more confident than their classmates with no WETC experiences that they could be able to be EFL teachers

when they graduated. Therefore, it was concluded that WETCs as professional learning communities are the way toward sustainable teacher professional development.

## 6. Conclusion and implications

The study explored the impact of WETCs as professional learning communities on pre-service EFL teachers' professional commitment in China and how WETC experiences affect their professional commitment by means of a quantitative survey and follow-up qualitative interviews. Workshops as professional learning communities benefit pre-service teachers from different perspectives. The characteristics of PLCs: shared vision, collaborative efforts and reflective dialogue work together to develop pre-service teachers' teaching competence and enhance and sustain their professional commitment. It may be concluded that WETCs as professional learning communities provide pre-service teachers with the way toward sustainable development for their future profession.

The study implied much for promoting pre-service teachers' professional commitment. First, extra efforts are needed to cultivate committed teachers. Usually teacher education courses for pre-service EFL teachers such as Pedagogy, English language teaching methodology, studies of English curriculum and teaching materials, second language acquisition as well as teaching practicum are offered in undergraduate EFL teacher education programs of Chinese universities, but respondents became more confident after the WETC learning than before. They are more satisfied with their choice of becoming an EFL teacher and more sure that they want to work as an EFL teacher in the future. They are more confident that they would be qualified to be an EFL teacher when they graduated. According to the interview, WETCs played a very important role in enhancing the participants' professional competence. Without the WETC, the participants could not persist on the professional development activities even though they learned the feasible way of improving their professional competence from the teacher education

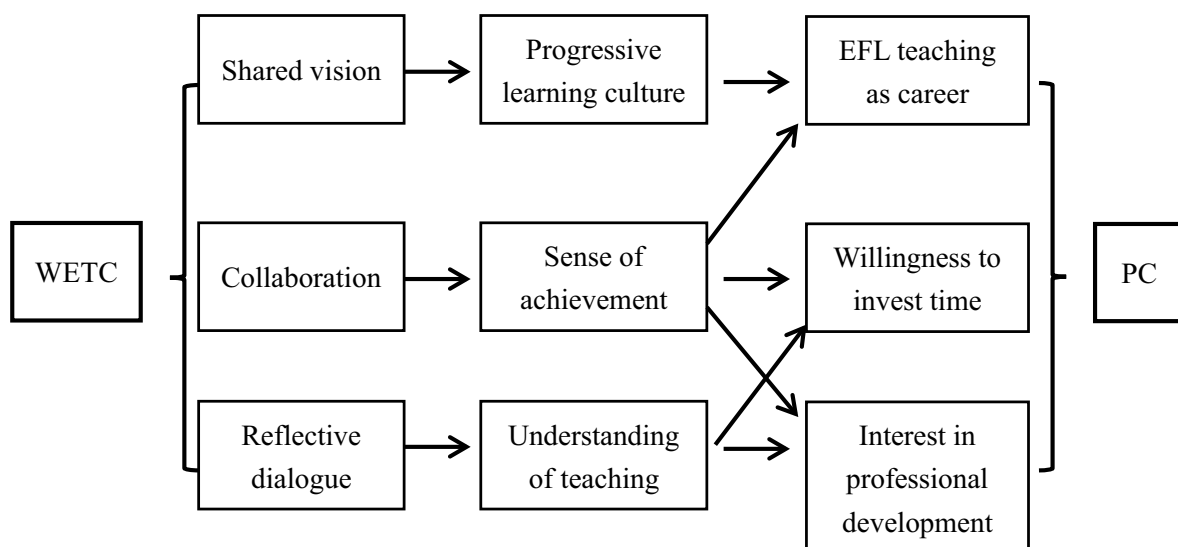


FIGURE 2  
Mechanism of how WETCS influences pre-service teacher' professional commitment.

courses before they participated in the workshop. However, they successfully promoted their professional competence in the WETC. From the difference between these two groups of pre-service teachers' commitment to teaching as a career, it can be referred that these teacher education courses alone are not enough to cultivate committed EFL teachers. Extra efforts or practices are needed for teacher candidates to be more qualified and more committed. Professional learning communities are good places in which they work collectively to improve their professional competence and enhance their professional commitment.

Second, pre-service teachers' professional learning communities need supervisors. In the interview, the respondents mentioned the importance of supervisors. Thanks to the supervisors reflective dialogues were well organized. Supervisors have extensive experience in teaching and know much more about theories and educational policies. They know what theories pre-service teachers need to understand, what teaching methods they will apply in the future teaching profession, and what reflective skills they will employ in the reflection activities. On the one hand, it is very beneficial for pre-service teachers to learn directly from these supervisors' professional competence, as this will greatly enhance pre-service teachers' professional competence. On the other hand, supervisors can make plans for the community to work, to recommend right books for pre-service teachers to read, to organize reflective dialogues, and to give insightful comments and suggestions on their lesson plans and micro-teaching.

This study includes limitations and directions for future research. First, this study is a cross-sectional study which compared two groups of pre-service EFL teachers' professional commitment when they were in the last year of their undergraduate study. A longitudinal study may find more details of the impact of WETCs on their professional commitment and how their professional commitment get promoted when they are in the WETCs. Second, the quantitative data were based on respondents' self-report. Future research should use multiple methods such as respondents' journals, supervisors' interview or observation, and their classmates' interview or observation to investigate how WETCs impact pre-service EFL teachers' professional commitment. Third, the study misses a social validity measure. If the social validity was assessed, the study would be more persuasive and more helpful to the teacher education programs in other countries.

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## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by the Ethics Committee of the College of Teacher Education, Zhejiang Normal University. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

CC: conceptualization, methodology, and writing – original draft preparation. CC and JZ: questionnaire, investigation, data analysis, writing – review and editing and supervision. All authors critically revised the manuscript and gave their final approval of the manuscript submitted for publication.

## 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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# The application of distributed leadership in middle school classroom

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This mini-review explores the conceptual framework of distributed leadership and its application in middle school classrooms. Traditional teacher leadership in middle school classrooms has been found to be deficient in meeting the diverse needs of students. Therefore, this article investigates the potential advantages of distributed leadership in addressing the shortcomings of teacher leadership. The article examines the impact of distributed leadership on student achievement, particularly in promoting students' academic performance and ability. Through a critical analysis of existing literature, the review highlights the need to establish effective communication channels, teamwork, and trust in distributed leadership. Furthermore, the article acknowledges the limited empirical research on the effectiveness of distributed leadership in middle school classrooms. Despite this, the article concludes that the adoption of distributed leadership in middle school classrooms can improve student learning outcomes, classroom teaching effectiveness, and school operation efficiency. Overall, this conceptual exploration suggests that distributed leadership has the potential to offer a more effective and inclusive approach to leadership in middle school classrooms.

## KEYWORDS

distributed leadership, teaching strategies, student-centered approach, teacher-centered instruction, learning achievement effects

## Introduction

Contemporary education models require more than the traditional classroom teaching approach to meet the complex needs of modern students and society (Anderson and Sun, 2017; Yan and Yang, 2021). As a result, classroom teaching reforms have become imperative. Recent studies have indicated that the practice of distributed leadership has a positive correlation with school development (Harris and Spillane, 2008; Harris, 2013). Although distributed leadership in middle school classrooms is a relatively new concept, it has gained considerable attention due to the continuous evolution of modern educational concepts that emphasize comprehensive student development over the mere impartation of knowledge (Leithwood et al., 2007; Diamond and Spillane, 2016; Gurr, 2022, 2023; Striepe et al., 2023).

Scholars argue that the traditional model of small group instruction is inadequate to meet the diverse learning needs of modern students (Harris, 2004; Day and Sammons, 2013; Sunaryo, 2020). Therefore, it is necessary for school leaders and teachers to seek an effective leadership strategy to improve this phenomenon. The significance of distributed leadership in middle school classrooms has been emphasized by Harris (2004), as it plays a crucial role in promoting school performance. In this context, this article aims to assist school

administrators and teachers in enhancing their teaching models through the identified advantages of distributed leadership.

This article will commence by introducing the concept of distributed leadership through the theory of distributed leadership. It will then analyze the shortcomings of traditional teacher leadership in middle school classrooms and compare them with the advantages of distributed leadership. Finally, the article will propose methods for utilizing distributed leadership to improve students' academic performance and abilities, ultimately leading to better classroom teaching outcomes and increased school operational efficiency.

## The definition of distributed leadership

Despite the lack of consensus on a widely accepted definition of distributed leadership, it is often characterized by terms such as shared, collaborative, dispersed, and delegated leadership (Spillane, 2005). From a distributed perspective, leadership practices are seen as the result of synergistic interactions between leaders, followers, and their circumstances (Spillane, 2005). This implies that all school personnel collaborate to jointly and cooperatively produce knowledge. Additionally, distributed leadership can be viewed as a decision-making process carried out by personnel at various levels, rather than solely by a single person (Harris, 2009).

Distributed leadership requires everyone in the team to assume certain leadership responsibilities, which can cultivate people's leadership ability and lay a foundation for their future development (Harris, 2008). Harris (2008) believes that by delegating decision-making power to team members, leaders of distributed leadership can empower every employee to participate in leadership, thus improving work efficiency. This view of Harris is supported by MacBeath (2005), who believes that when people have the ability to exercise leadership, they will be more active in the task and can perform better. There is evidence that the wider distribution of leadership has had beneficial effects on schools (Harris, 2011). It can be seen that school leaders can improve the efficiency of school operations through distributed leadership decentralization.

Woods et al. (2004) noted that distributed leadership is primarily characterized by schools' ability to involve different school staff and interested parties in decision-making processes. According to Woods et al. (2004), distributed leadership is a student-centered teaching technique that emphasizes collaboration between instructors and students in classroom instruction, where students play an integral role. Therefore, we believe that distributed leadership can assist students in developing leadership skills, improving their comprehension and mastery of educational topics, and enhancing the effectiveness of classroom instruction.

As a novel leadership style, distributed leadership has gained traction in education, particularly within middle school contexts (Tian et al., 2016). Research indicates that implementing distributed leadership in middle school classrooms is widespread and positively impacts teaching (Harris, 2004; Tian et al., 2016). Traditional classroom teaching, which emphasizes didactic instruction and positions the teacher as the sole authority, often leaves students with limited opportunities for participation and independent thinking (Harris, 2004; Woods et al., 2004;

Tian et al., 2016). In contrast, distributed leadership aims to encourage teachers to create a supportive teaching environment that encourages students to critically analyze things (Harris, 2004; Woods et al., 2004; Tian et al., 2016). With its focus on flat organizational structures and active student participation, distributed leadership can cultivate a sense of involvement and promote independent thinking (Gregory et al., 2009).

Furthermore, distributed leadership is an institutional arrangement that enables the full expression of group members' roles and promotes cooperation and mutual support in achieving team objectives (Harris, 2008). Ghani et al. (2021) found that teamwork fosters communication and mutual assistance among team members, leading to the efficient attainment of collective goals. According to these perspectives, we believe that distributed leadership has the potential to address challenges and accomplish desired goals by facilitating collaboration and communication among team members.

## Deficiencies in teacher leadership in middle school classrooms

In middle school classrooms, teacher leadership often emphasizes that students should follow the teacher's instructions and respect the authority of classroom content (Zeichner, 2003; Harris and Muijs, 2004; Wubbels, 2011). Baghoussi (2021) describes the teacher leadership environment as one where teachers explain information from books and students listen to lectures. Teachers typically set rules and tasks, and knowledge is primarily transmitted through lectures (Garrett, 2008).

Several studies have illustrated the potential negative effects of teacher leadership approaches on student learning (Muijs and Harris, 2003; Harris, 2005; Karadağ et al., 2015; Wenner and Campbell, 2017). For example, according to Evertson and Weinstein (2006), the teacher leadership learning environment might weaken students' motivation to learn. In a learning environment led by teachers, students have few opportunities to communicate and interact with others, particularly students who like to communicate with others, leading to low motivation to learn and hindering their learning (Baghoussi, 2021). In this case, teachers should create an active classroom atmosphere, encourage positive student dialogue, create opportunities for each student to speak, and enhance students' enthusiasm.

Teacher leadership approaches could hinder the development of students' creative and critical thinking (Hyvonen, 2011). The teacher leadership approach has been universally criticized for placing students in a passive position, receiving only knowledge, thus limiting their opportunities for creative and critical thinking (Muis, 2004; Webb, 2009). One possible explanation for this phenomenon is that teacher leadership teaching methods lead to a sense of dependence on the teacher, further leading students to believe that the teacher will help them solve all problems without any efforts through themselves. Burkhalter and Shegebayev (2012) clarified that textbooks and teachers' guidance always provide formalistic critical problems, but lack additional critical thinking inspiration and resources. Similarly, a quasi-experiment reported that students in teacher leadership classrooms performed well on simple tasks but poorly on more demanding tasks, suggesting that

traditional teaching styles may limit students' ability to think in complex ways (Milenković and Dimitrijević, 2019).

Teacher leadership approaches may hinder collaboration and communication among students. Research suggests that a teacher leadership learning environment can create a sense of unfamiliarity between students and the teacher (Yip and Raelin, 2012). This sense of unfamiliarity may inhibit students' classroom engagement levels. In a teacher leadership classroom, the teacher leads the class alone, and there is little group discussion and communication among students (Stanulis et al., 2016). In this situation, students' collaborative skills may not be adequately developed.

In summary, teacher leadership in middle school classrooms has negative effects on student learning in different ways. For example, it hinders student engagement and motivation, the development of creative and critical thinking, and teamwork skills. Distributed leadership, on the other hand, can better compensate for these deficiencies in teacher leadership in middle school classrooms. After explaining the negative effects of teacher leadership, the next section will discuss the advantages of distributed leadership in middle school classrooms.

## The advantages of distributed leadership in middle school classrooms

Distributed leadership, characterized by shared, collaborative, dispersed, and delegated leadership practices, has gained popularity in education, particularly in middle school contexts (Tian et al., 2016). This section outlines the advantages of distributed leadership in middle school classrooms. Firstly, distributed leadership can stimulate students' enthusiasm and initiative. Students play a central role in distributed leadership, which grants them autonomy to learn and take the initiative in their learning. Harackiewicz and Hulleman (2010) highlighted the importance of interest in improving students' motivation and engagement. Jacobson's (2011) research showed that students under distributed leadership exhibit higher enthusiasm and initiative in learning, focus better, and complete tasks effectively, leading to higher academic performance. Students also have autonomy to choose their own learning content, which results in increased interest in their learning and improved academic performance.

Distributed leadership supports independent learning and self-regulation, which improves academic performance (Anthonysamy et al., 2020). Students who can self-regulate their learning in class can maintain excellent academic performance and make continuous progress (MacLellan, 2014). Personal progress enhances students' self-confidence, and allowing students to experience success in their own progress plays a crucial role in improving their enthusiasm.

Distributed leadership promotes creative and critical thinking. Students can freely exert their creative and critical thinking and improve their problem-solving ability (Gronn, 2008). Bennett et al. (2003) found that distributed leadership improves critical thinking, judgment, and intelligence. Distributed classrooms foster discussion styles, enabling teachers to encourage students to challenge different points of view, leading to increased questioning and acceptance of different perspectives. Students constantly think

and try new methods and strategies to solve problems, which stimulates their creative and critical thinking.

Distributed leadership enhances students' leadership abilities. Distributed leadership mode requires each student to assume certain leadership responsibilities, which cultivates students' leadership and management abilities and lays a foundation for their future development (Dempster and Lizzio, 2007). The new discipline of "student voice" has the potential to make an important contribution to public engagement (Mitra, 2005).

In conclusion, the distributed leadership model can provide more opportunities and platforms for middle school students to improve their abilities and qualities in a team. The traditional teacher leadership classroom environment can hinder students' motivation, critical thinking, and teamwork skills. The new classroom under distributed leadership will promote students' initiative, critical thinking, teamwork, and leadership skills. The next section will discuss how distributed leadership can be used to improve students' academic achievement and ability to improve the effectiveness of classroom teaching and school operations.

## Ways to improve the efficiency of school operations using distributed leadership

Distributed leadership requires teamwork, which cultivates students' collaborative ability and enables them to cooperate with others to solve problems. Thoonen et al. (2011) found that when students were engaged in school planning, they were more eager to collaborate. Similarly, Blase (2000) advocates for improving students' cooperative abilities through partnership, peer teaching, inquiry, collegial working groups, and reflection discourse as methods of influencing education. Therefore, distributed leadership builds teamwork by constantly encouraging interaction and mutual support among team members.

Distributed leadership requires better communication and coordination between leaders and members (Harris, 2008). This means that leaders need to establish effective communication channels to ensure that members understand each other. In distributed leadership, effective communication is essential for understanding, respecting, and learning from differences, and developing critical thinking skills (Harris, 2008). For example, disagreements and conflicts may arise in a group, but communication can resolve them. When teachers and students establish close ties and communicate effectively, students become more confident. Research has found that communication skills are strongly correlated with students' academic achievement, with students who are better communicators performing better academically. Conversely, students with poorer communication skills tend to do worse academically and are more likely to drop out of school (Tian et al., 2016). Therefore, good communication skills are important to facilitate student learning.

Distributed leadership requires an environment of trust and support that encourages members to develop their talents (Leithwood et al., 2007). Leaders should give their members enough trust and provide necessary support and help (Fairholm, 1994). This can be achieved by establishing a positive school environment and teacher-student relationships (MacSuga-Gage et al., 2012).



Schools can support student development by establishing a safe, friendly, respectful, and inclusive school environment. DeMatthews et al. (2020) recommend that schools promote the ethos and conditions of a supportive, caring, and inclusive community. By creating a friendly, inclusive, and equal school atmosphere, schools can boost students' confidence, optimism, respect, and sense of value, and promote communication and interaction among students.

In summary, distributed leadership can improve students' academic performance and ability, as well as school efficiency and quality. Distributed leadership also strengthens school team cohesion and facilitates the collaborative operation of the education system.

## Conclusion

This mini-review has explored the benefits of implementing distributed leadership in middle school classrooms. In today's educational environment, traditional teacher leadership approaches may not fully meet the diverse needs of students. The distributed leadership approach, with its emphasis on collaboration and mutual support, can address the deficiencies in teacher leadership and has many advantages. Teachers under distributed leadership need to have not only strong educational and teaching skills but also the ability to participate in school management and decision-making. In middle school classrooms, teachers can adopt different distributed leadership methods, such as organizing group cooperation and encouraging independent study, to meet the diverse developmental needs of students, improve their academic performance and abilities, and enhance the effectiveness of classroom teaching and school operation.

Furthermore, distributed leadership is an important leadership model for organizations to meet internal and external uncertainties and to stimulate the potential of leaders with a unique growth logic. The development path based on distributed leadership theory is a gradual and dynamic process, from concept to

practice. The school should continuously optimize all aspects of the organizational structure, institutional system, and learning community construction to build a platform for the development of leaders' individual potential. In this way, the school's management effectiveness can be continuously improved, and sustainable development can be achieved for teachers, students, and the school.

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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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# The impact of an empowerment evaluation professional development program on physical sciences teachers' attitudes, beliefs and behavioral intentions to integrate ICT into their science lessons

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The purpose of this research study was to investigate and determine the impact of teacher's attitudes and beliefs on their behavioral intentions to integrate ICT into their science lessons and to establish the impact of a professional development program underpinned by the principles of empowerment evaluation (EE) on their attitudes and beliefs. The participants were selected from five high schools in Johannesburg, South Africa. A validated questionnaire was used to identify teachers' attitudes and beliefs and to measure the impact of their attitudes and beliefs on their behavioral intentions to integrate ICTs into their science lessons. The findings from this research study indicated that the empowerment evaluation approach positively impacted the teacher's attitudes and beliefs as well as improved their behavioral intentions to integrate ICT into their science lessons. Furthermore, this study revealed that the more confident and competent a teacher felt to integrate ICT into his/her lessons, the more likely he/she would be to integrate ICT into their lessons. Therefore, teachers' behavioral intentions are important in predicting whether they will integrate ICT into their lessons.

## KEYWORDS

empowerment evaluation, professional development, teachers' beliefs, attitudes, ICT integration, science education, theory of planned behavior, technology acceptance model

## 1. Introduction

In South Africa, the White Paper on e-Education ([Department of Education, 2004](#)) advocates the pedagogical integration of ICT to promote the development of higher-order thinking skills. The Department of Basic Education through the Provincial Departments of Education has implemented programs to integrate ICT into the classroom of South African schools ([Department of Education, 2004](#)). The Gauteng Department of Education (GDE) has rolled out an ICT integration program to most of its township schools and conducted professional development sessions to train teachers on the use of technology in the classroom. Smartboards and other technological tools have been procured and delivered to school. However, research conducted on ICT integration in South African schools has indicated that

although teachers have received adequate ICT integration training and resources, they still fail to integrate ICT into their lessons (Ndlovu and Lawrence, 2012; Mooketsi and Chigona, 2014; Mhlanga and Moloi, 2020; Mosehlana and Sebola, 2020; Aruleba and Jere, 2022; Shava, 2022; Crompton et al., 2023; Oki et al., 2023).

There are numerous studies conducted in South Africa that point to the benefits of ICT integration into the curriculum (e.g., Nkula and Krauss, 2014; Dlamini and Mbatha, 2018; Dube et al., 2018; Ostrowick, 2018; Mlambo et al., 2020; Aruleba and Jere, 2022; Crompton et al., 2023; Oki et al., 2023). However, the integration of ICT has been stifled due to various factors. Czerniewicz and Hodgkinson-Williams (2005) and Blignaut and Howie (2009) argue that the government in conjunction with the DBE has developed good policies with regard to the integration of ICT into the South African curriculum. They argue that the stumbling block seems to be the implementation. Thus far, the integration of ICT into the curriculum and effective management strategies for the successful implementation of ICT in all schools are yet to occur in the majority of South African schools (Czerniewicz and Hodgkinson-Williams, 2005; Blignaut and Howie, 2009; Oki et al., 2023). The implementation of ICT into the curriculum is dependent on three things. Firstly, there need to be policies that guide the integration of ICT into the curriculum. The second determinant is the preparedness of the teacher – the question needs to be asked: Do teachers have the required knowledge and skills to accomplish the task of integrating ICTs into their science lessons? Lastly, research indicates that teacher beliefs and attitudes influence their intentions to integrate ICT into the curriculum (Chikasha et al., 2014).

Research conducted in South Africa on the integration of ICT into the mathematics and science classrooms shows that teachers' attitudes and beliefs influenced their use of ICT (Nkula and Krauss, 2014; Singh and Chan, 2014; du Plessis, 2016; George and Ogunniyi, 2016; Padayachee, 2017; Ostrowick, 2018; Graham et al., 2020; Aruleba and Jere, 2022; Saal and Graham, 2023). Teachers with technophobic tendencies tend to not use ICTs in their lessons, even when they have access to ICT resources and have received adequate training on ICT integration (George and Ogunniyi, 2016). George and Ogunniyi (2016) present the argument that even though the general assumption is that ICT resources will provide a platform for ICT integration, thus allowing both learners and teachers with a wide variety of opportunities to interact with ICT, there is still only a small percentage of teachers who have successfully integrated ICT into their lessons (George and Ogunniyi, 2016). Therefore, for effective ICT integration, there needs to be a willingness on the part of the teacher to use the available ICT resources. The effective utilization of the resources has the potential to lead to the successful integration of ICT into lessons but is largely dependent on the willingness of the teacher to make the shift from the traditional "talk and chalk" method of teaching to a more innovative approach that involves integrating ICT into the curriculum (Otto, 2021).

Teachers often "fear change" when confronted with having to acquire a new skill. There is often resistance from them due to the fact that they are "expected to lead developments when they are given insufficient long-term opportunities to make sense of the new technologies for themselves" (Mumtaz, 2000, p. 321). Pham and Phan (2023) identified this as especially evident during the COVID-19 pandemic, when teachers were forced to go from face-to-face teaching that they were familiar with to online teaching that the majority of them were not familiar with. They argue this

transition triggered new emotional experiences for the teachers. These emotional experiences included fear and anxiety as they were required to learn new ways of teaching in a relatively short period of time (Petrie, 2020). To address this "fear of change," Mumtaz (2000) and Fütterer et al. (2023) suggests that teachers be given time to attend professional development training opportunities that would expose them to the latest technologies available for teaching as well as to capacitate them to use the technology to positively impact their learners' understanding of the complexed concepts in science.

This prompted this researcher to investigate and determine the impact of the physical sciences teacher's attitudes and beliefs on their behavioral intentions to integrate ICT into their lessons.

## 2. Theoretical frameworks

Three theoretical frameworks anchored this research study. The first framework is the empowerment evaluation framework that was used to implement the professional development component of this study. The second and third frameworks are the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB). These two frameworks framed the inquiry into teachers' attitudes and beliefs that determine their behavioral intentions to integrate ICT into their lessons.

### 2.1. Empowerment evaluation

Empowerment evaluation (EE) is the use of evaluation concepts, techniques and findings to foster improvement and self-determination (Fetterman, 2001). Its main focus is on the empowering process and the outcomes. It is designed to help people help themselves and improve their programs using a form of self-evaluation and reflection. The participants conduct their own evaluation, and an outside evaluator serves as a coach. This study used EE and in particular Fetterman (1996) four steps as illustrated in Figure 1 below as well as the 10 principles of EE to implement the ICT integration professional development program. These 10 principles are: improvement, inclusion, accountability, organizational learning, evidence-based strategies, social justice, community ownership, community knowledge, democratic participation, and capacity building (Fetterman and Wandersman, 2007). This professional development (PD) program served as an intervention, implemented in order to capacitate the teachers to integrate ICT into their lessons as well as to positively impact their attitudes and beliefs about ICT integration. It was hoped that the more competent and confident they felt, the more positive their attitudes and beliefs would be to integrate ICT into their lessons.

### 2.2. The technology acceptance model and the theory of planned behavior

The TAM was used in determining the impact of constructs on the behavioral intentions of teachers toward the acceptance of technological advancement. For this purpose, the contribution of attitudes of the users and their beliefs is regarded as considerable with

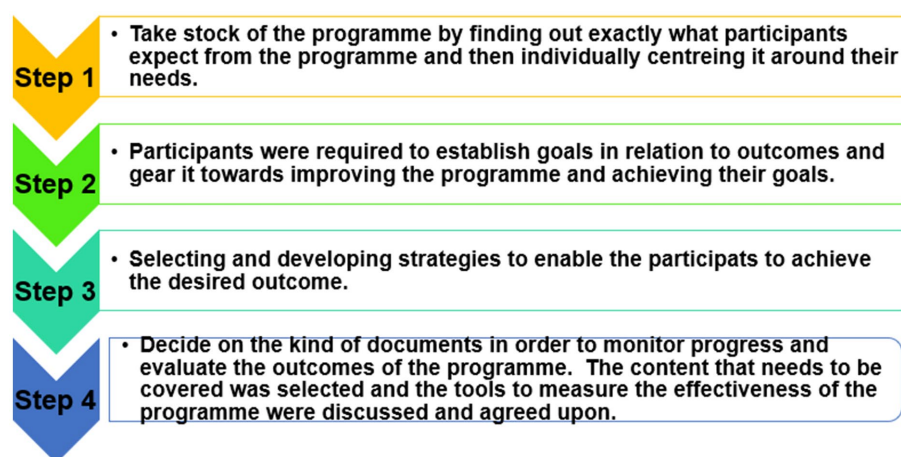


FIGURE 1  
The four steps of EE.

respect to the notion of determining the instructional effectiveness, particularly in the domain of ICT integration.

The TPB is a theory which predicts deliberate behavior because behavior can be deliberate and planned. TPB suggests that the intentions of individuals are the proximal determinant of their behavior, with intentions as a concept to capture the motivation of an individual to perform a given behavior (Ajzen, 1991). The TPB asserts that behavioral intentions are jointly determined by attitudes toward the behavior, subjective norms and perceived behavioral controls. The stronger the intention of the individual to engage in a behavior, the more likely the individual would perform that behavior.

This research study employed the TAM and TPB models in order to assess the attitudinal behavior of Physical Sciences teachers toward the integration of ICT into their science lessons. In this regard, the core constructs of the models were used as the identified variables, including attitudes, self-efficacy, subjective norms, perceived usefulness, perceived ease of use, behavioral intentions and subjective norms. According to the results of the studies conducted there exist a significant association between the constructs under consideration (Venkatesh and Bala, 2008; Adetimirin, 2015; Tang et al., 2020; Oyunge, 2021; Badmus, 2022).

## 3. Methodology

### 3.1. Sampling

This study employed a case study design and was conducted with five in-service physical sciences teachers from schools in the Johannesburg region. The teachers who participated in the study had all taught physical sciences for at least five years and had taught at schools which were resourced with smartboards and other digital resources by the Gauteng Department of Education (GDE). The participants were purposefully chosen based on their eagerness to develop themselves in the use of ICT in their science lessons. At the same time, the sampling was convenient because all teachers were accessible to the researcher in terms of travel time and distance. This study was conducted during the COVID-19 pandemic when

South Africa was under lockdown, the researcher was therefore forced to reduce the sample size in order to comply with lockdown regulations. Yin (2014) argues that not all investigations are conducted for the purposes of generalization. In the context of this research, the intention was not to generalize for the larger population but to explore the concept of EE as a method of PD.

As this study employed a case study design, it is important to have a profile of each participant to be able to understand the contextual factors that each of the participants was faced with. The participants were Teacher A, teacher B, Teacher C, Teacher D, and Teacher E.

### 3.2. Profile of the teachers

#### 3.2.1. Profile of teacher A

Teacher A was the youngest of the five teachers. Her highest qualification was a BEd. (Hons) degree. A BEd. degree is an initial undergraduate degree in education which is followed by a BEd. (Hons) degree, which is a postgraduate degree in education that universities in South Africa offer to teachers. At the time of the study, she was the Grades 10–12 Physical Sciences teacher as well as the head of a department at her school. Her school was a quintile 1 school situated in Soweto. Quintile 1 schools are the schools situated in the most economically disadvantaged areas and are no-fee-paying schools (Dass and Rinquest, 2017). These schools are heavily subsidized by the Department of Basic Education (DBE) and parents are therefore not required to pay any school fees and all books, stationery and resources are provided by the DBE (Hall and Giese, 2008). Teacher A had 10 years of experience teaching Physical Sciences. She has attended training on the use of the smartboard and has used technology in her teaching for less than five years. She had access to one GDE supplied laptop that has a data card with 10 gigabytes of data, and her own personal smartphone in addition to a smartboard in her class. The school only had Wi-Fi connectivity in the office block for the principal, deputy principals and office staff. The teachers and learners had no access to the school's Wi-Fi. The Grade 12 learners also did not have access to tablets. Prior to the ICT integration PD program, she considered herself a novice in the use of technology and basically used

the smartboard mostly as a board to write on and occasionally project PowerPoint presentations.

### 3.2.2. Profile of teacher B

Teacher B trained as a teacher at the age of 35 after her children started school. Her highest qualification was a BEd. (Hon) degree. At the time of the study, she was a Physical Sciences and Natural Sciences teacher at a quintile 5 school and had 10 years of teaching experience. Quintile 5 schools are schools that are fairly well resourced and are situated in more affluent areas and receive less funding from the DBE (as opposed to quintile 1 schools) as they are fee-paying schools (Dass and Rinquest, 2017). Teacher B had access to one GDE supplied laptop and her own personal smartphone. Even though her school was ranked as a quintile 5 school, the school did not supply Wi-Fi to the learners or the teacher. The Wi-Fi was only for the senior management and office staff use. She too attended the GDE smartboard training and has also used technology in teaching for less than five years. She too had a smartboard in her classroom and used her personal smartphone as hotspot to provide her with an internet connection.

### 3.2.3. Profile of teacher C

Teacher C held a 4-year teacher's diploma as well as an ACE in Physical Sciences. The ACE is an advanced certificate in education. Charles was a deputy principal at a quintile 1 school in Soweto. He had been teaching for 29 years and at the time of this study was teaching Physical Sciences and Natural Sciences. He had attended the smartboard training and has used technology in teaching for less than 5 years. He also had access to one GDE supplied laptop and his own smartphone. His school was situated in a very disadvantaged area and there was only Wi-Fi in the office block for senior management of the school and the admin staff. The school experienced electricity power outages regularly due to cable theft and load reduction instituted by Eskom, our electrical power supplier. Teacher C acknowledged that it was very difficult to teach with technology when electricity supply is a serious issue. He has smartboard in his classroom and also used his smartphone as a WIFI hotspot to provide him with an internet connection.

### 3.2.4. Profile of teacher D

Teacher D was a Physical Sciences teacher as well as a deputy principal at a quintile 4 school. Quintile 4, like quintile 5 schools, are situated in more affluent areas and are fee-paying schools. They receive a reduced subsidy from the DBE as parents are required to pay school fees (Dass and Rinquest, 2017). He had access to a department supplied laptop and his own smartphone. He too only had access to Wi-Fi in the office block as he was part of the senior management of the school. He also had a BEd. (Hon) and had 30 years of teaching experience. At the time of the study, he was teaching Natural Sciences and Physical Sciences. He had attended the smartboard training and has used technology for less than five years for teaching purposes. There was no Wi-Fi available for the learners or the teachers and the Grade 12 learners had access to department supplied tablets. He too had a smartboard in his classroom and used his personal data in order to use technology during his lessons.

### 3.2.5. Profile of teacher E

Teacher E had 32 years of teaching experience. She held a BEd. (Hon) degree and was a Physical Sciences and Natural Science teacher,

who was also the head of the science department. Her school was ranked as a quintile 4 school. She did not have access to a GDE supplied laptop and her personal laptop was damaged. She did have access to her own personal smartphone. She also attended the smartboard training and in addition, she attended a Microsoft Office training workshop but did not complete all the modules. Even though it is ranked as quintile 4, her school was under-resourced and there was no Wi-Fi available for the teachers or the learners. Grade 12 learners were also not issued tablets. She had access to a smartboard in her class and used her smartphone as a WIFI hotspot in order to access the internet.

## 3.3. Questionnaire

This research study used a combination of two validated questionnaires. The first by Taylor and Todd (1995) and the second by Valtonen et al. (2015). The questionnaire was divided into six constructs that were based on the TAM and TPB frameworks. These constructs were: attitude, self-efficacy, subject norms, behavioral intentions, perceived usefulness and perceived ease of use. The questionnaire contained Likert-type statements (with a scale 1 = strongly agree and 5 = strongly disagree). Table 1 below indicates the items, the constructs and the references from where they were sourced.

## 3.4. Phases of the study

The study was divided into four phases. Phase 1 involved piloting the questionnaire, phase 2 involved administering the questionnaire to the five participants as a pre-test. Phase 3 involved implementing the ICT integration PD program that was used as an intervention. Lastly, phase 4 involved readministering the questionnaire as a post-test. The purpose of the pre-and post-test was to establish if the intervention was successful in positively impacting teacher's attitudes and beliefs about ICT integration.

TABLE 1 Questionnaire constructs and items.

Items	Construct	Reference
1, 2, 3, 4, 5, 6, 7, 8	Attitudes (language was adapted)	Valtonen et al. (2015)
9, 10, 11, 12	Self-efficacy (language was adapted)	Valtonen et al. (2015)
13, 14, 15	Self-efficacy (language was adapted)	Taylor and Todd (1995)
16, 17, 18	Subjective norms	Valtonen et al. (2015)
19, 20, 21	Subjective norms	Taylor and Todd (1995)
25, 26, 27, 28	Behavioral intentions	Valtonen et al. (2015)
22, 23, 24, 29	Behavioral intentions	Davis (1989)
30, 31, 32, 33, 34, 35, 36, 37	Perceived usefulness (language adapted)	Davis (1989)
38, 39, 40, 41, 42, 43, 44, 45	Perceived ease of use (language adapted)	Davis (1989)



## 4. Results

The findings from the questionnaires were analyzed and the data presented below. The findings are classified according to the six constructs used in the questionnaire, namely attitude, self-efficacy, subject norms, behavioral intentions, perceived usefulness and perceived ease of use. For each of these constructs, we also report on shifts that took place as a result of the professional development intervention based on empowerment evaluation.

### 4.1. Attitudes

In this research study, attitudes toward ICT integration are defined as the degree to which a teacher believes that integrating ICT into the science classroom would have positive effects on their practices and would encourage them to increase the use of ICT in their lessons (Ajzen, 1991; Teo and Tan, 2012; Kemp et al., 2019; Granić, 2023). This construct comprised eight items that asked teachers to rate their responses to them as strongly agree, agree, neutral, strongly disagree or disagree.

The responses were coded and uploaded into an Excel spreadsheet where the average for the eight items for each teacher was calculated. The results were then graphically represented in Figure 2 below. The graph shows Teachers A and C had a change in their level of agreement. Teacher A moved from neutral to agreeing with the items. Teacher C shifted from agreeing with the items to strongly agreeing. For these two teachers, the intervention brought about a positive change in their attitudes toward ICT integration into their science lessons. Teachers B, D, and E showed no change in their attitudes after the intervention. Teacher B still agreed with all the items, while Teachers D and E still strongly agreed with the items. Even though the intervention had no effect on their agreement level, Teachers D and E already strongly agreed, so a shift was not necessary.

### 4.2. Self-efficacy

For the purposes of this research study, self-efficacy is defined as the degree to which a teacher would willingly explore and confidently

introduce new technology into their science classroom in order to enhance learner understanding and performance (Ajzen, 1991; Teo et al., 2019; Granić, 2023; Rafique et al., 2023). The results are graphically represented in Figure 3 below. The graph shows Teachers A and C had a change in their level of agreement. Teacher A moved from neutral to agreeing with the items. Teacher C shifted from agreeing with the items to strongly agreeing. For these two teachers, the intervention brought about a positive change in their self-efficacy. They were more confident about integrating ICTs into their science lessons. Teachers B, D, and E showed no change in their self-efficacy after the intervention. Teacher B still agreed with all the items, while Teachers D and E still strongly agreed with the items.

### 4.3. Subject norms

In this research study, subjective norms are those influences exerted by colleagues, heads of department and other school stakeholders including the GDE and DBE officials on a teacher (Ajzen, 1991; Sun et al., 2020; Rejali et al., 2023). This construct was composed of six items that asked teachers to rate their responses.

The results are graphically represented in Figure 4 below. The graph shows Teacher A was the only one with a change in agreement level. She had a shift from neutral to agree. For Teacher A, the intervention brought about a change in her subjective norms. She was, therefore, more likely to be affected by external pressure from her superiors to integrate ICTs into her science lessons. Teachers B, C, D, and E showed no shift in their agreement levels. Their responses were to agree with the items. Therefore, the PD program had no effect on their subjective norms.

### 4.4. Behavioral intentions

Behavioral intentions are defined as the degree to which a teacher believes that integrating ICT into the science classroom would be beneficial to the teaching and learning process and would encourage teachers to increase their usage of ICTs (Ajzen, 1991;

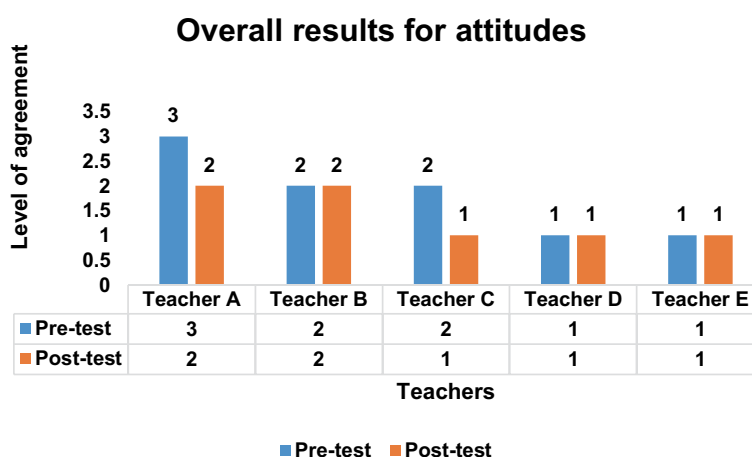
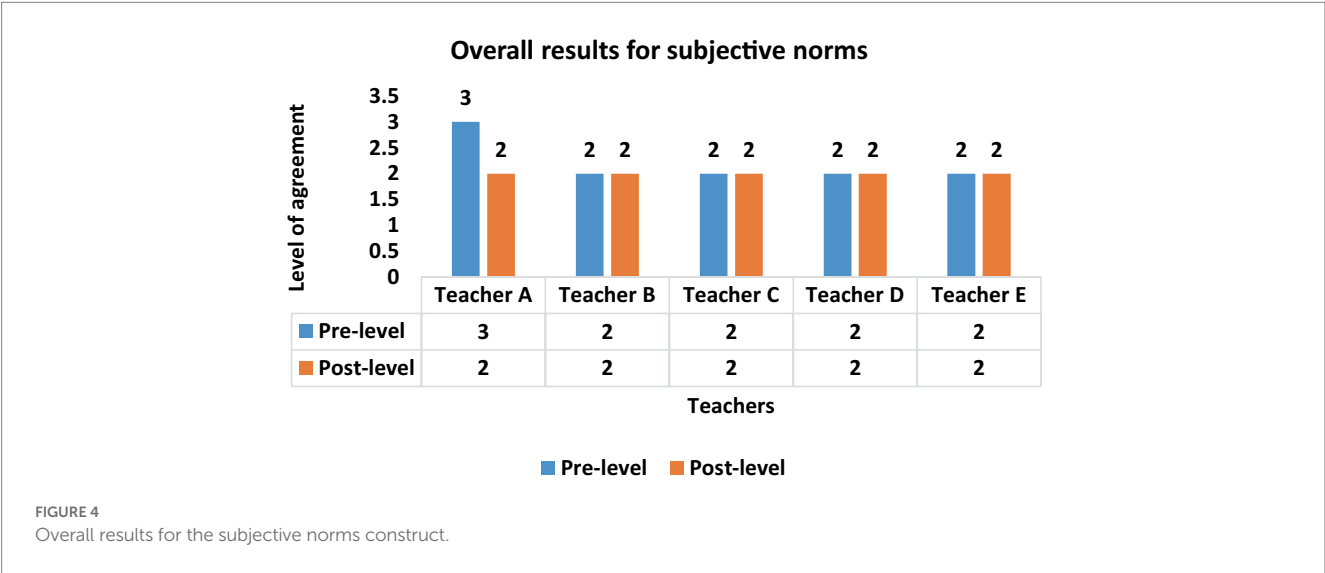
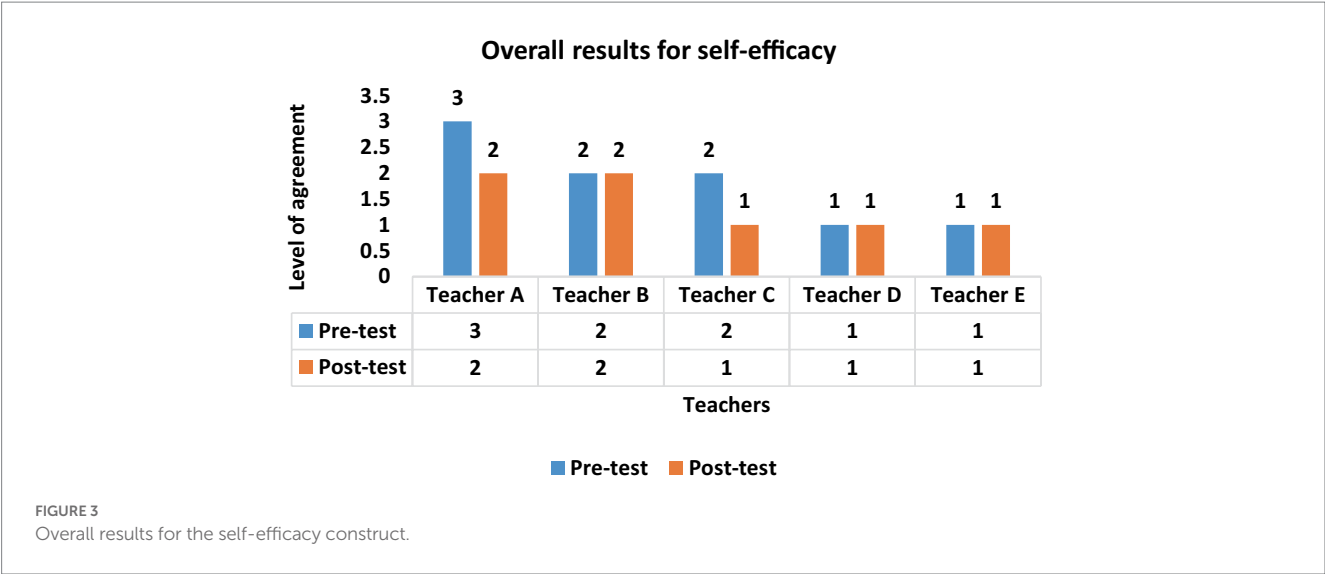


FIGURE 2  
Overall results for the attitudes construct.





Fishbein & Ajzen, 2011; Wang et al., 2019; Rejali et al., 2023). This construct was composed of eight items that required teachers to rate their responses.

Figure 5 below graphically illustrates the results obtained. The graph shows Teachers C and D had a change in their level of agreement. Teacher C moved from agree to strongly agree for the items, while Teacher D moved from strongly agree to agree. For Teacher C, the intervention had a positive change in his behavioral intentions. The intervention for Teacher D had a negative effect as he shifted from strongly agree to just agree. Teachers A, B, and E showed no change in their agreement levels. Teacher A agreed to all the items, while Teachers B and E responded with strongly agree. From their responses, they were most likely willing to integrate ICTs into their lessons.

4.5. Perceived usefulness

In this research study perceived usefulness is defined as the degree to which a teacher believes that integrating ICT into the science

classroom would enhance their job performance and enhance learner understanding of abstract concepts (Ajzen, 1991; Kemp et al., 2019; Teo et al., 2019; Rafique et al., 2023; Rejali et al., 2023; Zhang et al., 2023). This construct was composed of eight items.

The results are graphically represented in Figure 6 below. The graph shows Teachers D and E had a change in their level of agreement and shifted in their responses from agree to strongly agree. The intervention was able to get them to be more positive about integrating ICTs into their science lessons. Teachers A, B, and C showed no shift in their agreement levels. They responded by agreeing to all the items. The intervention had no impact on their perceived usefulness construct and the intervention was not able to shift them from agree to strongly agree.

4.6. Perceived ease of use

Gardner and Amoroso (2004) identify perceived ease of use as a core construct in the TAM and define it as the “degree to which an

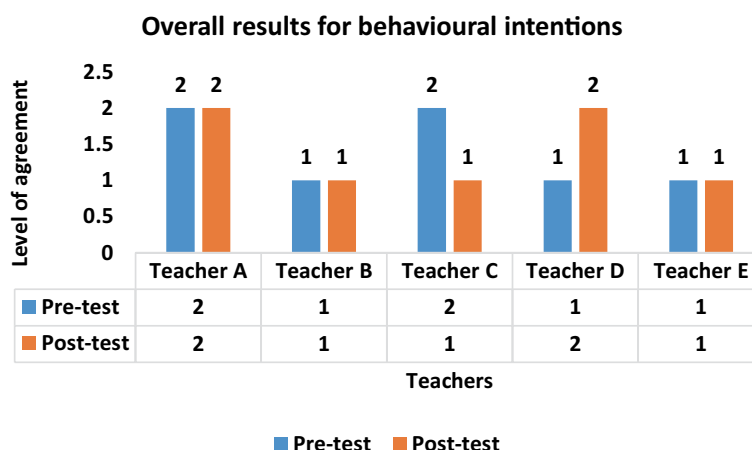


FIGURE 5  
Overall results for the behavioral intentions construct.

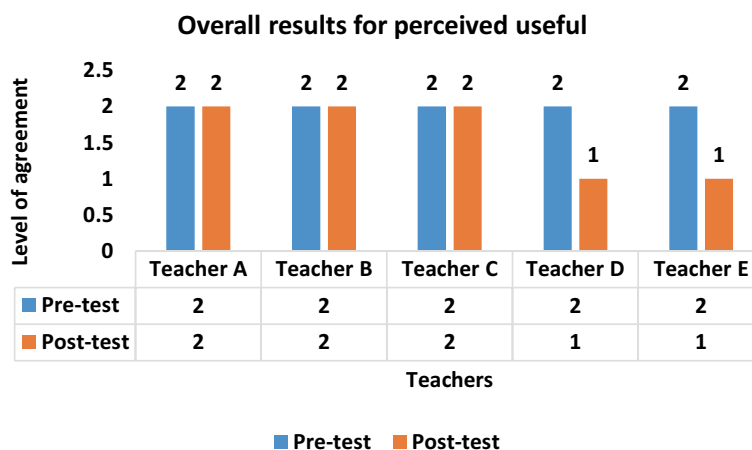


FIGURE 6  
Overall results for the perceived usefulness construct.

individual believes that using a particular system would be free of physical and mental effort” (p. 5). [Chau \(1996\)](#) and [Granić \(2023\)](#) argue that the perceived ease of use is important as it was found to influence not only teachers’ attitudes toward ICT, but also their behavior intention to use ICT and to also actually use ICT. In this research study, perceived ease of use is defined as the degree to which a teacher believes that integrating ICT into the science classroom would be a useful undertaking. This construct was composed of eight items.

The results are graphically represented in [Figure 7](#) below. The graph shows Teachers D and E had a change in their level of agreement and they shifted from responding to agree to strongly agree. The intervention therefore had a positive impact as they now found it easy to integrate ICTs into their science lessons. Teachers A, B, and C showed no change in their agreement levels. They agreed with the items and the intervention had no impact on their agreement levels.

The results presented established that the PD program that encompassed the principles of empowerment evaluation was able to

positively impact teacher’s attitudes and beliefs as well as their behavioral intentions to integrate ICT into their lessons.

## 5. Discussion

Research has established that having a more favorable attitude toward ICT integration leads to a stronger intention to integrate ICT into lessons ([Davis, 1989](#); [Gardner and Amoroso, 2004](#); [Teo and Tan, 2012](#); [Kemp et al., 2019](#); [Granić, 2023](#)). Therefore, for Teachers A and C the PD program that was underpinned by the principles of empowerment evaluation proved effective in positively altering teachers’ attitudes toward ICT integration. Teachers B, D, and E demonstrated no shift in their attitudes. Teachers D and E already strongly agreed to all the items, so no shift in their attitude was necessary. Teacher B remained on level 2, so the PD program was not able to bring about a positive shift in her attitude.

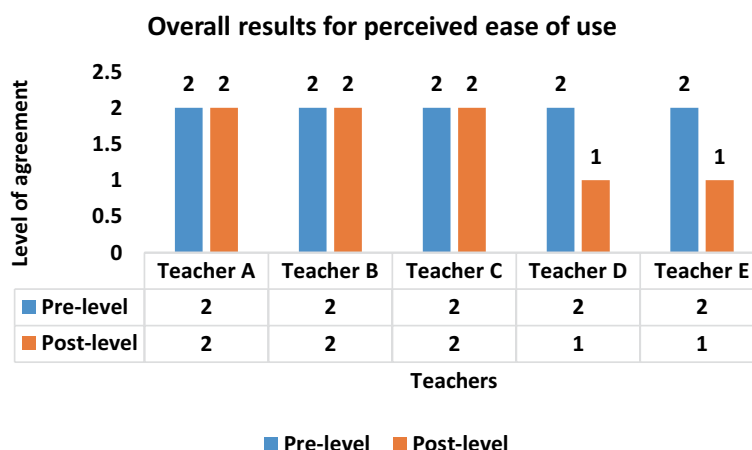


FIGURE 7  
Overall results for the ease of use construct.

Research shows that the higher a teacher's self-efficacy the more confident and willing they are to attempt new challenging opportunities (Davis, 1989; Gardner and Amoroso, 2004; Teo et al., 2019; Granić, 2023; Rafique et al., 2023). In this case, they would be more willing and confident to integrate ICT into their teaching of science. Therefore, for Teachers A and C the professional development program that was underpinned by the principles of empowerment evaluation proved effective in increasing the teachers' self-efficacy and improving their behavioral intentions to integrate ICT into their science lessons.

In relation to subjective norms, the findings suggest that only Teacher A was positively impacted by the PD program, and this led to a positive change in how she views the influence of her superiors on behavioral intentions to integrate ICT into her science lessons (Ajzen, 1991; Sun et al., 2020; Rejali et al., 2023). Therefore, for Teacher A, the professional development program that was underpinned by the principles of empowerment evaluation proved effective in increasing her subjective norms, therefore improving her behavioral intentions to integrate ICT into her science lessons.

With regards to behavioral intentions, it can be concluded that only Teacher C was positively impacted by the professional development program, and this led to a positive change in how he views the benefits of integrating ICT into his lessons (Davis, 1989; Taylor and Todd, 1995; Gardner and Amoroso, 2004; Wang et al., 2019; Rejali et al., 2023). Therefore, for Teacher C the professional development program that was underpinned by the principles of empowerment evaluation proved effective in changing how he views the benefits of ICT integration into his science class. Research indicates that he would most probably be more willing to integrate ICT into his lessons (Davis, 1989; Taylor and Todd, 1995; Venkatesh and Davis, 2000; Gardner and Amoroso, 2004; Wang et al., 2019; Rejali et al., 2023).

Research has established that the more a teacher perceives ICT to be useful, the more they will believe that it has the ability to enhance both their job performance and their learners' understanding (Davis, 1989; Gardner and Amoroso, 2004; Kemp et al., 2019; Teo et al., 2019; Granić, 2023; Rafique et al., 2023; Rejali et al., 2023; Zhang et al., 2023). Therefore, for Teachers D and E the professional development

program that was underpinned by the principles of empowerment evaluation proved effective in increasing the perception of the useful benefits of ICT integration into their science lessons.

In terms of perceived ease of use, it can be concluded that for Teachers D and E the professional development program that was underpinned by the principles of empowerment evaluation proved effective in increasing their beliefs that integrating ICT into their science lessons is a useful undertaking.

## 6. Limitations

This study was subjected to some limitations. Firstly, this study was conducted in the heart of the COVID-19 pandemic which placed many restrictions both on the researcher and the participants. There were also strict policies on access to the school premises and for a while, all meetings and even small gatherings were prohibited.

Secondly, this study was originally going to commence with 100 participants, but due to the pandemic, the researcher was forced to reduce the sample size and the study commenced with seven teachers. During the course of the study, one participant was forced to withdraw due to ill health caused by COVID-19 and a second participant passed on due to COVID-19 complications. The research study then continued with only five participants.

Thirdly, EE is a labor-intensive approach, and it requires a large investment in time (Fetterman, 1999). The researcher found that working individually with five participants was taxing on both her time, resources and budget. It was also taxing on the participants as they had to sacrifice a large amount of time in order to participate in the PD program.

Fourthly, the pandemic caused the researcher to experience setbacks. These setbacks included having to put the study on hold during the hard lockdown period when schools were closed. Also, some of the participants tested positive and were off work for at least 10 days, delaying the progress of this study. Lastly if this study was conducted prior to COVID-19 pandemic a larger sample size could have been used and inferential statistics could have been used to

ascertain significant differences for attitudes and beliefs pre- and post- intervention.

## 7. Suggestions for future studies

Future research could build on this study and investigate the impact EE could make on a larger sample of teachers within a community of practice at schools and within a cluster of schools. From the results of this study, it was found that working on a one-on-one basis with teachers worked really well as the teachers were able to work at their own pace and practice a skill with the help of the researcher until they mastered that skill. This would not have been possible if the PD program took place with a group of teachers. Also, the teachers were part of the decision-making process; they decided what knowledge and skills they wanted to acquire and at what pace they wanted to proceed. In addition, they set goals that they worked toward achieving. This study's PD program strictly adhered to the 10 principles of EE as well as the EE four-step implementation program.

The results of this study could encourage teachers to initiate communities of practice within their schools and within clusters of schools in their areas in order to create EE pairs. Within these communities, senior experienced teachers who have a proven track record of successfully integrating ICT into their lessons can be approached to act as evaluators. The purpose of the evaluator is to guide the teacher to identify their PD needs and then to assist them to set goals in order to address the needs identified. The evaluator would then, together with the teacher, set up PD opportunities to guide the teacher to achieving their goals. The evaluator as well as the teachers would require the school management's support in order to successfully implement this program. In this way we would get more teachers being capacitated to effectively integrate ICT into their lessons. It is hoped that once they are confident and competent in integrating ICT, it would change their attitudes and beliefs about ICT integration, thus resulting in them being more willing to integrate it into their lessons.

## 8. Conclusion

From the findings presented, it can be concluded that the researcher was able to establish that the professional development program that adopted an empowerment evaluation approach was successful in positively impacting the attitudes and beliefs of the teachers, which in turn positively impacted their behavioral intentions to integrate ICT into their lessons. Furthermore, this study revealed that the more confident and competent a teacher felt to integrate ICT into his/her

lessons, the more likely he/she would be to integrate ICT into their lessons. Therefore, the teachers' behavioral intentions are important in predicting whether they will integrate ICT into their lessons. A review of the literature on teachers' behavioral intentions and these six constructs, the findings from this study's teacher attitudes and beliefs questionnaire and the interview data, suggest that they are influenced by the following constructs: teachers' attitudes, self-efficacy, subjective norms, behavioral intentions, perceived usefulness and perceived ease of use (Ajzen, 1991; Lee et al., 2010; Teo and Tan, 2012; Zhou et al., 2016; Kemp et al., 2019; Teo et al., 2019; Wang et al., 2019; Sun et al., 2020; Granić, 2023; Rafique et al., 2023; Rejali et al., 2023; Zhang et al., 2023). The research conducted further suggests that these constructs are responsible for determining a teacher's behavioral intentions to integrate ICT into their science lessons. If teachers are not positive about ICT integration, they are less likely to willingly integrate ICT into their lessons.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## 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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# Field experiences for pre-service teachers post-COVID-19: structures required to support mental health

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This study investigates a supplemental field experience taking place on a university campus in the summer of 2021. The program includes linguistically, culturally, and socioeconomically marginalized children performing below grade level in reading. Pre-service teachers (PSTs) work with the children for 4 weeks, focusing on science-based literacy instruction. The initial findings of this case study were that lesson planning, teacher dispositions, and willingness to accept feedback are critical for PSTs. Additionally, a major concern in the findings is the increased evidence of mental health concerns for the children and PSTs. The findings indicate a need for focused training on social-emotional learning with special care relating to stressors caused by COVID-19. There must also be additional training for PSTs on explicit and detailed lesson plans, adjusting their dispositions, and science-based literacy instruction taught in literacy blocks.

## KEYWORDS

pre-service teaching, COVID-19, mental health, elementary schools, field experiences

## 1. Introduction

In teacher education, the types of field experiences offered across the United States vary widely (Sorensen, 2014). Experiences range from “sit and get” models of learning for preservice teachers to Professional Development Schools where partnerships and communities of practice are formed (Braden et al., 2019; Mulvihill and Martin, 2020; Jakopovic and Gomez-Johnson, 2021). Most studies indicate that a combination of approaches works best for training preservice teachers (Darling-Hammond, 2015; Sleeter, 2018). Therefore, a classroom-based field experience combined with several supplemental field experiences would be a powerful combination for training preservice teachers (Sleeter, 2018). A supplemental field experience is typically not conducted in a school or classroom, but instead takes place in a community-based setting (Sleeter, 2018; Jakopovic and Gomez-Johnson, 2021).

Field experiences are key in developing PST’s knowledge about students and teaching in general. The utilization of a supplemental field experience on a college campus, allowing children to attend a campus-based summer program, was ideal (Afterschool Alliance and Edge Research, 2021). A supplemental field experience allows a PST to work with children outside of the typical parameters of clinical teaching experiences (Sorensen, 2014; Sleeter, 2018). Supplemental field experiences have been cited frequently in the literature as powerful community engagement (Sleeter, 2018). In teacher education, field experiences are often noted as the most critical and impactful component of the program of study (Sorensen, 2014; Darling-Hammond, 2015).

Further, supplemental field experiences are critically important for preservice teachers from minoritized backgrounds (Ladson-Billings, 2021a). Studies indicate that PSTs of color are racially marginalized throughout their programs (Kohli and Pizarro, 2016; Kohli, 2019) and eventually leave teaching at a higher rate than White teachers (Ingersoll and May, 2011; Casey et al., 2015).

The summer of 2021 was a unique time for field experiences in education. Following COVID-19, many undergraduate students had limited experience in the field. Additionally, families were eager to allow children to participate in summer programs given the loosened COVID-19 guidelines (Afterschool Alliance and Edge Research, 2021). Families also began to see areas where their children were experiencing learning gaps. During these summer programs, some children were engaged in person for the first time in many months, and many preservice teachers were entering a classroom setting in person for the first time. In this study, preservice teachers (PSTs) were experiencing teaching live for the first time. This study took place on a college campus during the summer of 2021 and investigated the evidence-based teaching strategies utilized by the PSTs and their lesson planning.

## 2. Review of literature

### 2.1. Field experiences

Field experiences in teacher education play a pivotal role in the development of pre-service teachers, particularly as it relates to teaching students from culturally and linguistically diverse backgrounds (Zeichner, 2010; Maddamsetti, 2020). Field experiences typically begin with more supervised models. As students progress through their programs, they typically require the student to take on more responsibility. Well-planned field experiences are key in teacher preparation programs (Lacina and Block, 2011). This study utilized two specific field experience models—sequential teaching and station teaching (Simons et al., 2020). In sequential teaching, activities to be completed by students are divided among the teachers, and each teacher is responsible for a different phase of the lesson (Simons et al., 2020). In station teaching, the activities are again divided, however, each peer is responsible for teaching a specific activity to a smaller group of students at a station or center (Simons et al., 2020). Typically, in station teaching, groups rotate between stations or centers. There are positive results noted in the literature for each of these models. Some of these benefits include increased engagement, a smaller student-teacher ratio, the potential for differentiated instruction, and ease of classroom management (Bacharach et al., 2010; Simons et al., 2020).

### 2.2. Lesson planning

The instructional decisions that teachers make are considered one of the most important roles of teaching (Jones et al., 2011). Therefore, learning to plan lessons is of less consequence than adapting lessons to the needs of students. This is a challenging concept to teach college education majors. During COVID-19, this was particularly challenging due to the compromised mental health of college students. “The overall wellness of college students can significantly depend on how that college student uses coping strategies to alleviate stress” (Turner, 2021, p. 3).

In this study, the college students and the children were all from culturally and socioeconomically marginalized communities. Those students “experience greater levels of stress than their more affluent White counterparts” (Turner, 2021, p. 3). Therefore, the college students in this study were living with their culturalized stress, stress from COVID, and stress from learning to teach while also taking on the stress of the elementary children that they were working. One way to minimize stress in field experiences is a team-teaching approach, particularly in planning and implementing lessons (Bacharach et al., 2010; Simons et al., 2020).

While research continues to indicate there is no one answer to teach literacy (Literacy Research Association, 2021; Semington and Kerns, 2021), “research raises further questions about the specific needs of... struggling readers representing marginalized groups” (Smith, 2019, p. 2). What training do preservice teachers need, then, to prepare evidence-based literacy-focused lesson plans? Warren (2014) suggests that preparing preservice teachers to design those plans—with all children in mind—depends upon more than training. Warren insists that “culturally diverse students deserve teachers who understand and appreciate their home lives and personal experiences” (p. 399). Further, Warren suggests that to be culturally relevant, teacher educators must develop empathy in preservice teachers. This is critical to assist “teachers... to successfully close ‘perception gaps’” (Warren, 2014, p. 399). Therefore, the suggestion is that preservice teachers must be culturally relevant before planning lessons and with students in mind at all stages of planning. This is aligned with many other experts in culturally relevant pedagogy (Paris, 2012; Sleeter, 2018; Ladson-Billings, 2021a,b).

### 2.3. Teacher dispositions and their usage in education

Teacher disposition instruments are tools that can be used to document observable teacher behaviors (Katz and Raths, 1985; Burant et al., 2007; Nielsen, 2015). One of the first studies to document teacher dispositions referred to teacher dispositions as “summaries of act frequencies” or “trends in behavior” (Katz and Raths, 1985, p. 301). Dispositions refer to what is observable. The use of dispositions became more prevalent during the 1990s when the Interstate New Teacher Assessment Support Consortium (INTASC) added the term to the teacher preparation standards (Villegas, 2007). That growing movement highlighted the need for tools that would measure these trends in behavior. The use of disposition instruments has “create[d] ample opportunities early in the program for candidates to examine critically their taken-for-granted beliefs about classroom actions” (Villegas, 2007, p. 374). Disposition instruments are now a crucial way to understand teacher beliefs and how those beliefs impact actions in classrooms. More recent research has focused on the use of dispositions to learn about the attitudes of teachers toward teaching all students equitably (Kerr and Andreotti, 2019).

## 3. Methods

The researchers selected the supplemental field experience occurring in the summer months on a university campus as the site of the study; it is a bounded system, and all actions of the participants

and researchers occur within that system (Stake, 1995). The focus of this research is to investigate how preservice teachers utilized data to make instructional decisions. Additionally, based upon initial observations and discrepancies in lesson plans, issues of teacher dispositions, particularly the willingness to take feedback and adjust instruction, became of particular importance.

### 3.1. Background and context of the study

This study investigates a supplemental field experience. This is an innovative approach where children in the community receiving free or reduced-priced lunch and performing below grade level in reading attend a summer program for 4 weeks on a university campus. Most of the children are from linguistically marginalized communities and all of the children are socioeconomically marginalized. During the program, PSTs work as a team with faculty and each other to design and implement a literacy-based summer camp. The data for the summer of 2021 included lesson plans utilized by each team of teachers. Utilizing lesson plans and observations to determine the evidence-based practices of the PSTs has been done in many studies (Cochran-Smith and Villegas, 2016; Stigler and Miller, 2018; Konig et al., 2020). By analyzing the lesson plans and researcher observations, it was clear that the supplemental field experience was a site for development in multiple areas. The preservice teachers ranged in ability from beginning (novice) at planning and community engagement to expert. Therefore, a comparative method of analysis was utilized to highlight the strengths and weaknesses evident in the data.

For the past seven summers, starting in 2015 the authors have conducted a summer literacy program on a university campus designed to serve students who qualify for free or reduced lunch and who are reading below grade level. These students are partnered with pre-service teachers (tutors) who are also from marginalized communities; in 2021 all tutors were students of color. The purpose of the program is to mitigate what has been termed as the summer slide or summer learning loss (Allington and McGill-Franzen, 2018). In 2021, the summer slide was compounded by “COVID slide” (Kuhfield and Tarasawa, 2020). For this summer program, students are invited to come to campus for 4 weeks in the summer. Preservice teachers served as lead teachers and tutors who work in small groups with the students. Preservice teachers are paid through America Reads funding, a federal work-study program that was established to have college students work with students in the areas of literacy (Edmondson, 2000). This indicates that all tutors were also from socioeconomically marginalized backgrounds.

During the summer of 2021, the researchers partnered with a local school district for this summer program. Partnering with a school district provided several benefits. The benefits included bus transportation for the students, which eliminated the transportation barrier for families. Another benefit was the breakfast and lunch that were provided by the district. One of the biggest benefits was that the school district selected the students who attended the summer program based on data collected by the teachers. This allowed the students who needed the summer program the most to attend. The district provided the instructional reading level at the end of the year for each child who attended the summer program, which allowed preservice teachers to utilize literacy data to form groups and plan lessons.

### 3.2. Research questions

1. Were preservice teachers able to utilize evidence-based practices, as evident in both their lesson plans and execution of those lesson plans (noted by researcher observations)?
2. What does the data tell us about the importance of teacher disposition scores when hiring pre-service teachers?

This study investigates work taking place during the four-week summer program in a collaborative work environment. The case study method of qualitative inquiry also allowed for the open coding preferred by the researchers for these data (Stake, 1995).

### 3.3. Conceptual framework

Building upon the work of Paris (2012) and Ladson-Billings (2021a,b), we began looking at how the preparation of lesson plans with children in mind was accomplished. The additional component was to compare the lesson plans (as written) to the observations of the execution of the lessons. Finally, the observations included notes on teacher dispositions. We used the theory of funds of knowledge (Moll et al., 1992) to think about what each tutor brought to the program and how that translated into teaching styles. Preservice teachers must learn the difference between teaching content and teaching children. Understanding the content one teaches is critical, however, it means nothing without understanding the people to whom one is teaching. This study aims to understand the reason one teacher with nearly identical training was successful while another was not. Initial data include teacher dispositions, including a willingness to take advice and mentoring. Understanding the impact of teacher dispositions could impact programs utilizing teacher disposition instruments as tools to foster a culture of critical (yet supportive) feedback.

### 3.4. Participants

Eight tutors (college students) and 33 children were the participants in the present study. The pre- and post-scores of the children were used as data points in the study, while the majority of the data were qualitative and included lesson plans and observations of the tutors. All of the tutors were students of color, and all of the tutors are eligible for Federal Work Study indicating that they are socioeconomically marginalized. The children were all in 2nd or 3rd grade, and all attended Title I schools, indicating that more than 50% of the children in the school receive free lunch. All work was conducted following IRB approval. All of the participants signed informed consent (assent for the children). Table 1 includes information about the college students (tutors). Appendix 1 includes pre and post-test data for elementary-aged children.

### 3.5. Data sources and collection

The raw data included weekly lesson plans from the tutors and feedback on those plans, observations of the tutors, and pre- and post-scores on literacy assessments from the children. Feedback was given on the lesson plans, and thus notes on the lesson plans were included

TABLE 1 Table of college student participants in the study.

Participant	Degree	Identified race/ Identified gender
Denise	Elementary education	Latinx/Female
Donally	Elementary education	Latinx/Female
Emile	Science	African American/Female
Jimani	Social work	African American/Female
Juan Carlo	Middle grades education	Latinx/Male
Malia	Elementary education	African American/Female
Mirabelle	Elementary education	African American/Female
Misha	Elementary education	Latinx/Female

as well. The observations were conducted in each classroom weekly and also include notes taken by the researchers upon presenting those observations to the tutors. The Qualitative Reading Inventory 6th edition was utilized, a Pearson product that is designed for reading specialists and school personnel (Leslie and Caldwell, 2017). The assessment utilizes grade-appropriate word lists and measures the rate of reading, reading accuracy, and comprehension (Leslie and Caldwell, 2017). The scores are not numerical but leveled, indicating letter/sound recognition as PP1 (pre-primer 1) through the high school level.

### 3.6. Data analysis

Using Atlas.ti, the researchers began by uploading all documents (lesson plans, observations, and literacy assessments). We analyzed the data utilizing open coding following Stake (1995) coding advice. After carefully reading through all documents, we began a list of all codes. After finalizing the code list, the researchers worked together to create a co-occurrence table and create networks. We refined the code list and found places where additional codes needed to be included, particularly in the area of COVID repercussions and dispositions. Finally, the free-flowing text analysis method was utilized by the researchers as a team (Ryan and Bernard, 2003). We discussed codes and recurring patterns in the data and worked in Atlas.ti to create connections within networks together. The codes were all added to the networks where they belong, again following conversation among the researchers. To visualize the data, the researchers printed a code co-occurrence table and each network with connected codes to move forward in discussing the findings (Ryan and Bernard, 2003).

### 3.7. Trustworthiness

Trustworthiness was established by utilizing multiple data sources (lesson plans, observations, and assessment scores). The data analysis also included a form of member checking; the researchers discussed each finding before finalizing any codes or networks and presented all findings to the participants before finalizing themes. When compared to the scores of the children, it was quite clear that the findings were accurate; the room with the teachers with strong dispositions and stronger content knowledge showed greater literacy gains. Atlas.ti alone did not provide validity; however, it did add additional rigor and

transparency to the analysis process based upon how it was used by all of the researchers (Paulus and Lester, 2016).

The final step was to utilize the Hopscotch method (Jorin Abellan, 2019) to evaluate the steps taken throughout the research process. This web-based tool allowed the researchers to investigate any gaps in the process. During this step, the researchers determined that additional literature was needed on teacher dispositions and their impact on teacher success. Finally, triangulation was confirmed using Hopscotch. The use of multiple data sources, the thorough review of literature, analysis utilizing Atlas.ti, and the evaluation of transferability confirmed triangulation.

## 4. Findings

The findings are organized first by theme. Following the thematic analysis, the findings from the quantitative data (student literacy increases) are included. The discussion is organized by theme as well; however, we begin the discussion with the findings from the quantitative data to weave the implications of that data into the thematic findings. Following the use of Atlas.ti and the coding and networking features, the researchers agreed upon four primary themes. These are gaps in programming, strengths in programming, teacher dispositions, and implications of COVID-19. By “programming,” the researchers intentionally broadly include programs of study followed by each tutor as well as the programming used for the summer program itself.

### 4.1. Gaps in programming

Both lesson plans and observations showed areas where there are opportunities for improvement by the tutors. There was a lot of wasted time, indicated by too much time for certain non-instructional activities (an hour for recess but only 30 min of read-aloud, for example) on lesson plans and also observed by the researchers. We did note that some of the wasted time was due to a lack of expertise in transitions between activities. This is also clear in the lesson plans. There were also large pieces of the day without structured activities, where the teachers noted things like research in the computer lab without specific standards or goals for the time listed. It should be noted that this was primarily found in Classroom B; the lead teacher and supporting teachers in Classroom A did a far superior job of planning and including details within each segment.

There were also times in the lesson plans for both classrooms when activities were mislabeled. For example, there were multiple days when a literacy strategy was listed as being used (for example, having students read aloud to improve fluency) when observation showed this was not the case (the book was read aloud to the children). Another example of this included listing times for interactive read-alouds during the day when in fact the elementary students were watching a video of the book being read aloud instead of engaging in conversations about the books. Additionally, there were limited times in the lesson plans or observations when small groups were utilized effectively. While the tutors were assigned to small groups within the classrooms, these small groups were utilized as behavior control, and very little differentiation of instruction or individualized instruction was noted or planned.



## 4.2. Strengths of programming

The focus of the summer program is literacy. As directors of the program, we have chosen to define this broadly, so math literacy is appropriate. We communicated this to the tutors, and they indicated that they clearly understood this. The lesson plans and observations showed that all activities were aligned with literacy (including reading, writing, and word study). There were also great strategies used throughout the program, particularly in Classroom A. There were leveled texts used throughout the program, and both letter sounds and phonics were included in daily instruction and practice after getting to know the children and what they needed. Small group work included explicit phonics instruction every day of the program for students in Classroom A. In Classroom B there was an insistence, even following multiple rounds of discussion and feedback, to focus on vocabulary and grammar, and on what the students were not able to do. The children did show gains in these areas, but the strategies did not align with the immediate needs of the students (which were also explicit phonics instruction and opportunities to engage in authentic reading and writing).

In both classrooms, the data shows clearly that the tutors cared about the social and emotional needs of the children. Charts to show success weekly, classroom prizes and competitions, classroom jobs and identities, and classroom tee shirts were all evidence of creating a caring environment. When children had concerns, the PSTs were responsive and often brought the children to the researchers' office to create a quiet space for conversation and reflection. The children created cards, notes, and other small tokens daily for the tutors and even the faculty researchers. Observations indicated a warm, caring environment where children were shown and showing care.

During observations, additional strengths of the tutors were evident. In Classroom B, tutors bonded quickly and supported each other. Mirabelle noted a strong desire to help her peers and observation confirmed that the group worked quite well together. They showed comradery in helping each other handle the responsibility of working full-time without many breaks, which was new to each of them. They demonstrated this by offering to help each other—one observation note written by the researchers included a conversation between the tutors where one would “cover” so the other could go warm up lunch and take a quick break. The tutors came to the researchers together (again from Classroom B) when they had questions about classroom management as well. The tutors noticed that children were speaking during lessons, not paying attention, and making comments when a lesson was being delivered. The group wanted one of the researchers to speak to the class about respecting their teachers. They determined a conversation was needed as a group, which showed their reliance on collaboration and comradery.

## 4.3. Teacher dispositions

The students in the program are divided by grade level to maintain the student-teacher ratio mandated by the Protecting Minors division of the university. In this iteration of the program, there were two classrooms. Twenty students were entering 2nd grade, and 20 students entering 3rd grade. In each classroom, there was one lead teacher and three assistant teachers. Lesson plans were submitted weekly by the lead teachers, however, all teachers contributed to the plans. By the

end of week one, the data indicated a stark difference between the two classrooms. After data analysis, it was clear that these differences were in large part due to the dispositions of the teachers. Denise, the lead teacher in classroom A, showed the disposition of a far more experienced teacher. One of the areas where she excelled was providing direct instruction to the other teachers in the room—her peers. In analyzing the lesson plans, conversations are occurring in the planning. For example, in the week one lesson plan, Denise notes that tutorials will be provided for the children to create digital presentations, but the tutors need to spend additional time with each child (in small groups) to ensure understanding. In the week 2 lesson plan, Denise points out that D needs additional one-on-one instruction with letter sounds that should be scheduled during whole group time to allow for coverage and student-teacher ratio.

In observations, it was clear that Classroom A (with Denise as lead) ran much more smoothly than Classroom B. This was in part due to the superior lesson planning, all tutors collaboratively planned and collaboratively executed the plans, but it was also in large part due to Denise's leadership. Her disposition was one of professionalism in front of the teachers and children; any issues she had were voiced in confidence to the faculty. This was clear in how the children behaved; all observations noted that the class ran smoothly and there were never behavior issues.

The other classroom had lesson plan components that were noticeable in the data as well. Unfortunately, Malia and her assistant teachers operated Classroom B without the same level of professionalism, as noted in multiple observations and research logs. The notes indicated that the tutors were often clustered together without engaging children. The lesson plans indicated no instructions for assistant teachers and little evidence of collaboration. The lesson plans felt very much like something to be submitted as an assignment to faculty as opposed to a guide for instruction and the facilitation of learning. There are also notes included in the data from faculty as they looked over, offered feedback for lesson plans, and asked for revisions. Observations did not indicate that these revisions to lesson plans occurred.

Additionally, there were far more non-instructional activities listed in Classroom B's lesson plans than in Classroom A's. In addition to the scheduled outdoor play time (30 min daily), there was an additional hour scheduled in weeks 3 and 4. These were sometimes learning-oriented (literacy activities using sidewalk chalk), but there were not often instructions on what the teachers would be doing to facilitate learning during these times. Lunch was stretched from 30 min to an hour in the week three and four lesson plans as well; lunch became lunch and a movie. While the children enjoyed that time (as noted in observations and faculty logs), the atmosphere became more like a summer camp than an academic space (as was evidenced in Classroom A).

## 4.4. Implications of COVID-19

COVID-19 meant that most teachers in the program had not been in schools to student teach at all; most of them had not even completed observations in person. This led to feelings of insecurity indicated by exchanges between the teachers and the children, the teachers and their peers, and the teachers and the faculty. Faculty observations indicated that assistant teachers felt limited in their teaching



experiences because the lead teacher took control of the classroom. While this was truer in Classroom A, Jimani noticed this in Classroom B as well. In Jimani's case, she noted in a reflection that she needed the children to "treat me like the adult." The planning in Classroom A indicated that the assistant teachers were engaged, however, there were multiple conflicts where Misha wanted more independence. Misha had classroom experience as a substitute teacher, and her planning was quite good. However, Denise saw the vision for the entire class in a way Misha did not; Denise was also responsible for lesson planning and took that seriously. Denise wanted to stick to the lesson plans approved by the faculty.

The data also indicated a reluctance to engage personally, potentially a side effect of COVID-19. The lesson plans and observations showed students listening to books from the tables as opposed to reading books or sharing materials. The lesson plans also indicated technology use where children would each handle a device (such as a computer lab) when a kinesthetic activity (magnetized letters, for example) would have been more appropriate. Additionally, the tutors in both classrooms appeared to be keeping some distance between themselves and the children. Even during group work, the tutors sat a bit away from the group; while all participants were masked there was still a great fear of becoming infected with COVID-19. The observations and faculty log both indicate the fear of "sharing"—both emotionally and physically sharing items.

## 4.5. Student performance

Forty students were identified by the school district for participation in the study. Of the 40, 32 students attended the program regularly. On the dates of the post-assessments, three students were absent. Therefore, 29 students have both pre- and post-assessment administered by the faculty researchers. 14, or 48%, increased literacy by one grade level. 14, or 48%, maintained their reading level. 1, or 0.03%, decreased by one grade level. The "grade level" is roughly correlated to letter sounds (which should be attained before pre-Kindergarten) as PP1 (pre-primer 1), PP2 (pre-primer 2—equivalent to pre-K), PP3 (pre-primer 3—equivalent to kindergarten), and then levels with numbers equivalent to the grade level.

Disaggregating the results by classroom is also important. In Classroom A, 8/14 children, or 57%, maintained their reading level, and 5/14, or 36%, increased by one grade level. In Classroom B, 5/14, or 36%, maintained their reading level. Alternatively, 8/14, or 57%, increased by one grade level. The results are included in [Appendix 1](#). The total percentage of students included who increased by a grade level was 36%.

## 5. Discussion

### 5.1. Gaps in programming

While research on teacher competencies has increased, there is far less literature on the components of quality lesson planning ([Parsons et al., 2018](#); [Kaiser and Konig, 2019](#)). While the teachers in this supplemental field experience vary in their training, their responsibilities as teachers for 4 weeks do not vary. In this study, the difference between the daily functionality of Class A compared to

Class B seemed related to lesson planning upon analysis of data. The differences in competency in lesson planning can be—in part—based on differences in training. The PSTs acting as lead teachers were both in identical moments in their programs of study, though. Additionally, there has not yet been enough research on how teachers make use of their knowledge in a content area and related pedagogy "and relate it to the specific planning situation" ([Konig et al., 2020](#), p. 802).

Lesson planning is complex. In this study, the weaknesses of the lesson plans for Classroom B were related to wasted time and lack of evidence of collaborative planning for the classroom teachers. This is not novel; [Stigler and Miller \(2018\)](#) suggest that expert teachers can plan to incorporate several elements simultaneously while novice teachers are only able to focus on one element of planning (such as the activity as opposed to multiple activities differentiated based upon various abilities in the classroom). The concern for this study is that if teachers do not plan learning tasks that are aligned with the needs of the children (academically and behaviorally), the students will not engage and behavioral issues will be evident ([Konig et al., 2020](#)). For supplemental field experiences, the goal is to add to the experiences possible in a clinical teaching setting. This study provided that framework for the PSTs, and additionally, the findings in a small, qualitative study are strong enough to add to the literature on the necessity of supplemental field experiences.

The elements of planning that were not included are not the only problems noted in the lesson plans. There were places in the lesson plans when items were mislabeled, such as in reading activities. There were other places when another pedagogical tool made more sense, such as choosing to utilize small groups for instruction as opposed to whole-class instruction. The primary concerns for the researchers when this was not in place are: does the PST have an understanding of the tenets of literacy instruction, and is the PST able to be reflexive to student needs if all voices are not heard (often the case in the whole group)? In the case of the first question, the researchers found that in Classroom B the lead teacher did not have as strong a grasp of literacy education. While the program has the strength of offering a reading endorsement to all candidates, Malia was weak in this area. This knowledge is critical for effective teaching in elementary grades ([Griffith et al., 2015](#); [Davis et al., 2019](#)).

The second concern—are teachers able to respond when the appropriate pedagogy is not used and what are the impacts—is also well documented in the literature. Novice teachers often fall back on traditional teaching methods, indicating a proclivity to teach the way each was taught ([Cochran-Smith et al., 2015](#); [Kavanagh et al., 2020](#)). This leads to a lack of responsiveness on the part of the teacher (candidate) due to a lack of confidence in utilizing the best pedagogy ([Kavanagh et al., 2020](#)). This is indeed what the researchers observed; many children were unable to voice answers to questions during whole group instruction despite being able to demonstrate mastery.

### 5.2. Strengths of programming

In the findings, the researchers described the data demonstrating a focus on literacy. Even when Classroom B did not label the literacy practice correctly and/or should have utilized other strategies, the focus remained on literacy throughout the program. This is a key goal of the program, and Classroom B showed more gains in literacy across the program than Classroom A despite these errors. This shows the

strength of the program for PSTs who are all required to earn a Reading Endorsement as Elementary Education majors. The literature emphasizes that literacy instruction is critical in the primary grades (Teale et al., 2020).

The PSTs also showed a good understanding of Social and Emotional Learning (SEL) with the children. Although there are many varying definitions of SEL, it is primarily focused on personal and interpersonal skills (Cherniss et al., 2006). In this study, the elements of SEL that were consistently noticed in observations were positive social relationships, helping children make (or the children making) responsible choices, and helping children (or the children making) good decisions when challenges arise (Rodriguez-Izquierdo, 2018). Noting that summer 2021 was particularly stressful for all participants in what we now recognize was the midst of COVID-19, this is an impressive strength the PSTs all demonstrated.

Finally, the collaborative nature of teaching employed by the PSTs, in particular in Classroom B, was a strength. This may be attributed to the program, but it also could be the chemistry of the teachers. In any case, it is important for this research. Co-teaching is a valuable skill that often takes a great deal of training to accomplish. According to Stang and Lyons (2008), “it is vital that pre-service teachers have the opportunity to observe collaboration... if they are expected to collaborate as in-service teachers in K-12 public schools” (p. 183). Not only were the PSTs in this study able to observe faculty researchers collaborating, but they were also able to collaborate both with those faculty researchers and each other. This training will add to the likelihood that the PSTs will be reflexive practitioners who can collaborate with their peers in the best interest of students (Stang and Lyons, 2008; Darling-Hammond, 2015).

### 5.3. Teacher dispositions

There were noticeable differences between the dispositions of the lead teachers in each classroom, and there were also differences (though more subtle) in the personalities of all of the tutors. In Classroom A, Denise demonstrated her use of guidance for peers in the lesson plans and every researcher observation. Her leadership was natural and effective, as evidenced by her excellent behavior on display across all types of activities in Classroom A. There was an effortless quality to her presence as a teacher, and even the PSTs seemed receptive to her leadership. Her lesson plans included feedback to and from the PSTs in the classroom, and all of her peers were observed speaking with her about the small group plans they executed. Denise supplied the researchers with timely and thorough lesson plans before the deadline each week, and she was receptive to any feedback from the faculty researchers. She also had complete control of her classroom without faculty intervention; she never requested assistance with issues regarding students. While she would often speak with faculty to unpack the events of the day, she was doing so as a colleague more than for advice.

In classroom B, Malia showed a very different disposition as a teacher. She wanted her peers to have the freedom to plan at the moment with the children. Faculty researchers advised against this repeatedly, and indeed faculty researchers provided planning on several occasions to ensure students had enough work to complete in both small group and class activities. Malia loved being a leader, however, the faculty researchers both noted in their observation

journals that it felt as though it was exciting to be in charge as opposed to excitement to understand leadership. The failure to attend to feedback on the lesson plans was noted by the faculty researchers and was a huge concern. In a traditional school setting, novice teachers submit lesson plans to administrators and/or department chairs for feedback (Darling-Hammond, 2015). Novice teachers must heed that feedback to impact student achievement (Cochran-Smith, 2009; Darling-Hammond, 2015). Malia's repeated failure to adjust lesson plans according to feedback seemed directly correlated to her classroom management problems. Every day of the program, Malia needed assistance with behavior management. She sent students to the front of the building to sit with researchers; faculty researchers often sat in the classroom to assist, and assistant teachers asked for assistance when lessons did not keep students engaged. By week 2, the lesson plans and observations show more time dedicated to playing in Classroom B, an effort to keep children engaged without having to do any hands-on teaching.

We agree with research indicating teacher disposition instruments are critical in protecting children, minors in particular (Phelps, 2006). We also agree that in addition to measuring competency with standards and content, teacher candidates must show dispositions beyond academics and pedagogy; pre-service teachers must show competencies in non-academic areas that display their effectiveness as teachers (Council for the Accreditation of Educator Preparation, 2019). However, we also agree with research that states this does not currently exist (Bradley et al., 2020). Bradley and colleagues demonstrate that despite thorough reviews of teacher disposition instruments (TDI), there have not been any in the field that contain internal validity and that are predictive of teacher effectiveness (2020). There are also concerns about TDIs developed with racial bias; there are many objective categories that are too vague and allow for bias among raters (Nweke et al., 2019; Campbell, 2020). Results in this study from student performance indicate that students' literacy gains in Classroom B were marginally greater than those in Classroom A. Were thoughts about the teacher disposition of Malia based upon the faculty researchers' bias? This is another item that needs to be tested (alongside multiple drafts of pilot TDIs) in summer 2022.

### 5.4. Implications of COVID-19

The tutors appeared to have a fear of engaging with the children. While all students were masked, there was a distance between most of the PSTs and the children (Denise was a notable exception who hugged or high-fived children each morning and each afternoon). The faculty researchers noticed this first in observing outdoor play; the tutors were grouped while the children played. The children were allowed to remove masks during outdoor time—and they wanted interaction during that time, including with the faculty researchers. The insecurities of the tutors did not appear to be mirrored by the children at all.

Additionally, the data indicates that tutors were reluctant to allow the children to share materials, so important for the elementary grades. In lesson plans, faculty researchers noted that books and devices were not shared, meaning that even small group reading was often just independent reading in a small group as opposed to collaborative activity. Research is still ongoing across the field on the impacts of COVID-19. However, these findings bear repeated

investigation in the summer of 2022 to determine if these patterns are only due to it being the first summer program for most of the children and tutors post-COVID or if this is a trend due to isolation having extended impacts.

## 5.5. Student performance

In the United States, children from economically disadvantaged families experience a greater reading slide than their more affluent counterparts (Allington and McGill-Franzen, 2018). There is some evidence that students from more affluent families have more learning opportunities in summer (Downey, 2016). In a study including over 300,000 children from 50 countries, socioeconomic status “correlated strongly” with reading achievement (Nicholson and Tiru, 2019, p. 110). Our study is unique in that all of the children are from economically disadvantaged homes, and all of the children entered the program performing at least two grade levels below in reading. However, the findings do correlate with the findings from the 2010 Allington et al. study, which found that children who have access to reading materials in summer improve more than their peers.

Summer bridge programs are effective in helping economically marginalized children catch up with their more affluent peers (Curry, 2002; Nicholson and Tiru, 2019). As noted in our findings, 36% of the participants increased by one grade level. Those children are now more equipped to maintain their reading momentum when school begins. Allington et al. (2010) found that if those students participate in future summers, even greater gains may be achieved. The summer bridge program may be a literacy equalizer for these students and their more affluent peers.

## 6. Implications

These research findings suggest a strong need to provide further support for the PSTs to ensure marginalized youth attending the program, but also those in the current school system, will be effectively served. Focused training on the areas identified throughout the research can provide the PSTs with the skills needed to enhance the children’s experience and learning processes needed to improve their literacy levels. The four main identified areas for further training are lesson planning, teacher dispositions, literacy instruction tenets, and COVID-19-related concerns.

Lesson planning is not an easy task, as it relies on having an effective and diverse set of skills. At the same time, it is one of the main research gaps identified during the literature review completed for this study, which highlights the need to explore further how teachers use both their content-based and general pedagogy knowledge to create lesson plans (Konig et al., 2020, p. 802). Since the study shows the importance of addressing PST’s ability to manage time effectively to avoid wasting time during the learning period, training should focus on helping students develop the needed skills to adequately manage transitions. Based on the research findings, such training needs to include the needed skills to help PSTs understand the role of structured activities and the difficulties caused by mislabeled activities in a lesson plan.

However, the issue could also stem from the knowledge PSTs have in the first place, and not only from the way they make use of it. Their

difficulties creating a stable environment while portraying a caring authority, such as in the case of classroom A, or trusting their colleagues to create a collaborative approach, like what happened in classroom B, show what could be a lack of social–emotional skills in the PSTs’ performance and overall education. In other words, not only the content of what is being thought but also the way said content should be portrayed for children to learn highlights the need to effectively evaluate each PST literacy instruction tenets level. This further emphasizes the need for supplemental field experiences such as this one; PSTs rarely have the opportunity to implement SEL or behavioral interventions during their clinical experiences (Shapiro and Kazemi, 2017).

Literacy instruction tenets are the first step through which PSTs get ready for their professional future. Pedagogical gaps in this content lead to poor choices of tools and low responsiveness to children’s needs in the classroom, ultimately affecting students’ learning process. While ensuring education majors are attaining a sufficient level of these tenets is not the aim of the current study, the findings suggest the need for further support in this area. Through this study, it was possible to note the difference in classroom management between a lead teacher who did not have as strong a grasp of literacy education and how critical it is for effective teaching in elementary grades (Griffith et al., 2015; Davis et al., 2019).

These gaps in literacy instruction tenets could also be explained by a lack of experience. Novice teachers often fall back on traditional teaching methods, indicating a proclivity to teach the way each was taught (Cochran-Smith et al., 2015; Kavanagh et al., 2020). This leads to a lack of responsiveness on the part of the teacher (candidate) due to a lack of confidence in utilizing the best pedagogy (Kavanagh et al., 2020). This is indeed what the researchers observed; many children were unable to voice answers to questions during whole group instruction despite being able to demonstrate mastery. This further highlights the need to address each PST’s teaching style and personality in the classroom and their disposition in their role as teachers.

Teacher dispositions appear to be the cornerstone to developing an effective and integral approach for PST’s training. The lack of collaborative skills portrayed by the PSTs directly affects each of the other PSTs’ areas of interest. The difficulty to associate and work together was displayed differently in several moments. While Denise, in Classroom A, demonstrated natural and effective leadership, she also struggled to incorporate other teachers’ voices and independence. Meanwhile, in Classroom B Malia bonded quickly with the other tutors and created a strong sense of comradery in helping each other handle the responsibility, but they were often clustered together without engaging children and the lesson plans indicated little collaboration. Their lack of responsiveness to faculty feedback reflects the tutor’s overall lack of optimal disposition. Although in observations it was clear that Classroom A (with Denise as lead) ran much more smoothly than Classroom B, the tutor’s dispositions are the one area that showed room for improvement across both classrooms.

Teachers’ dispositions are also critical when addressing COVID-19-related concerns in the classroom and overall school setting. The different ways in which teaching within the context of a pandemic influenced the teachers’ and children’s behavior highlights the need to address mental health needs within the educational setting. The fear to get infected and the already

learned behavior of distancing from one another changed how children and PSTs interacted with each other and, therefore, shaped differently both the teaching and learning processes. COVID-19-related safety measures significantly altered the 20–21 school year, and the learning gaps continue to grow. This is impacting long-term academic outcomes, but it has especially impacted the way children are interacting and learning in the present time.

The obvious need to better understand the mental health barriers present in the classroom after living through a global pandemic is a call to action to continue enhancing and facilitating interdisciplinary efforts in the school system. School-based mental health services hold promise for reaching youth in need. Collaboration between social workers—or other mental health practitioners such as psychologists or counselors—and teachers appear to be the centerpiece to enact change at the school, classroom, and individual teacher levels are given that school influences are mediated by the teacher's role in promoting mental wellness among students (Lynn et al., 2003).

Not only is further training needed, but it should include more disciplines that can provide PSTs with the adequate tools to address children's mental health needs alongside education needs. In both classrooms, the data shows clearly that the tutors cared about the social and emotional needs of the children. Charts to show success weekly, classroom prizes and competitions, classroom jobs and identities, and classroom tee shirts were all evidence of creating a caring environment. When children had concerns, the PSTs were responsive and often brought the children to the researchers' office to create a quiet space for conversation and reflection. The children created cards, notes, and other small tokens daily for the tutors and even the faculty researchers. Observations indicated a warm, caring environment where children were shown and showing care, yet most tutors expressed continuous concern regarding children's disruptive behavior and feeling unsure about how to handle more emotional situations.

PSTs' lack of mastery of understanding children's developmental and psychosocial needs leads to the use of punitive approaches that hinder children's educational development and create more difficulties for the child, their family, and even other school departments. Children miss content and valuable social interactions when sent to the principal's office instead of remaining in class. They also start gaining a negative self-image or reputation from classmates and school staff members. Punitive approaches also create further weight on students' families, who must address and manage children's needs often without receiving effective support. Furthermore, it creates further weight on other already overwhelmed departments within the school setting such as the counselors, social workers, principal, and other positions—all of whom currently fulfill the need of offering the social-emotional support that the classroom or teachers cannot.

## 7. Concluding thoughts

Data from this study indicate that a supplemental field experience provided the PSTs with an opportunity to engage in lesson planning for groups of students. Through our analysis,

we discovered that the PSTs still needed additional support in order to design engaging lessons for the students. We also learned that PSTs needed additional support in collaborating as they designed instruction. Our analysis indicates that there are strengths that this type of field experience provided. PSTs were able to focus on literacy activities and had a strong focus on SEL. PSTs also focused on building relationships with the students despite the restrictions that were implemented due to COVID-19.

The research finding also highlights the need to equip future teachers to create a more positive and containing environment rather than a punitive environment that can hinder children's current mental health needs. Enriching PST's field experiences with training on post-COVID-19 mental health needs would only enhance what we already know about the importance of SEL. The training in the clinical experience of PST education plays a pivotal role in the development of pre-service teachers, particularly as it relates to teaching students from culturally and linguistically diverse backgrounds (Zeichner, 2010; Maddamsetti, 2020).

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

## Ethics statement

The studies involving human participants were reviewed and approved by the Kennesaw State University Institutional Review Board. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

## Author contributions

All authors contributed to the article and approved the submitted version.

## 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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## Appendix 1

Elementary student participants in the study and levels On QRI-6.

Participant	Grade	Pre-test level	Post-test level
1	2	L2	L2
2	2	PP1	PP1
3	2	PP3	PP3
4	2	PP2	PP3
5	2	L1	L2
6	2	PP3	Absent
7	2	Primer	Primer
8	2	L1	L1
9	2	L1	L1
10	2	PP1	PP2
11	2	PP1	PP3
12	2	PP2	PP3
13	2	L2	L2
14	2	L1	Primer
15	2	PP1	PP1
16	2	L2	L2
17	3	Primer	L1
18	3	PP1	PP2
19	3	L1	L1
20	3	PP2	PP3
21	3	L2	L2
22	3	PP1	PP2
23	3	PP1	PP1
24	3	PP3	PP3
25	3	PP1	PP1
26	3	PP3	L1
27	3	L1	L2
28	3	L1	L2
29	3	L2	L3
30	3	L2	L2
31	3	L2	Absent
32	3	L1	Absent



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# Analysis of an “international teaching practicum” as a program for achieving “teacher agency” and strengthening “technological pedagogical content knowledge”

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**Introduction:** This research aimed to study the achievement of teacher agency of Korean pre-service teachers through their experiences in an international teaching practicum (ITP). This study also diagnosed the domestic pre-orientation (DPO) program of G University to seek the possibilities of developing a TPACK strengthening program. The participants of this study were five female Korean pre-service teachers who were in the ITP from 2015–2016.

**Methods:** The data were collected in two different time slots: the teaching diaries and ITP reports from the Korean pre-service teachers, DPO teaching materials, and program instructor’s field notes were collected in 2016, and then, the interview was conducted in 2018.

**Results and discussion:** To study their teacher agency achievement, the three chordal triads of agency, the iterational dimension, the practical-evaluative dimension, and the projective dimension, were spotlighted and used as the lens to analyze the data. In addition, the DPO program was analyzed based on the elements of TPACK competencies. The research shows that the ITP was a trigger experience for the Korean pre-service teachers in terms of the achievement of teacher agency. The participants could project their aspirations and then decide and execute what they had learned from the ITP in their actual Korean classrooms. Also, the need to reconstruct the DPO program to be able to assist the pre-service teachers’ TPACK achievement has been raised.

## KEYWORDS

international teaching practicum (ITP), Korean pre-service teachers, teacher agency, teacher training, TPACK

## 1. Introduction

Since the first COVID-19 case was noted, various kinds of online platforms such as Metaverse, virtual reality, applications (Apps), and other online-based resources have expanded their boundaries in the education area significantly. As people had to keep their distance from each other, the untact education format has been facilitated in schools all over the world. In the meantime, almost every content offering in schools was connected with those systems. Due to COVID-19, the importance of internet- and digital technology-based learning has been strengthened. The need for digital technology has increased, and students in the contemporary world are deeply immersed in the various kinds of digital resources. Therefore, in terms of educating, training, and preparing pre-service teachers,

among the varieties of “competencies,” the digital competencies (Instefjord and Munthe, 2017) have started to be considered one of the key competencies. Moreover, in teacher training schemes, the elaboration of not only content teaching but also internet- and digital-based teaching skills has been raised. With the flow of the contemporary world, e-learning also become one of the crucial parts of teaching and learning. The term e-learning “... is an umbrella term describing any type of learning that depends on or is enhanced by online communication using the latest information and communication technologies. The scope of such learning is very broad” (Nagy, 2005, p. 80). Self-directed learning and teaching require the agentive participation of learners and teachers.

In addition, COVID-19 opened the door to the phase of Industry 4.0, in which information and communication technology has more power in existing industries, including the education industry. As the World Economic Forum (04 April 2016) forecast, the global shift through rapid technology changes (Berkley, 2016; Buehler, 2016; Hallett, 2016), including a Metaverse area, a non-fungible token, and “School in the Cloud” (untact classroom). At this point, teacher agency faces 2-fold issues related to “technological pedagogical content knowledge (TPACK)”: (1) how to accept and utilize the rapid technology into “pedagogical content knowledge (PCK)” and (2) how to guide and educate the young generation, including elementary students, to self-protect themselves when selecting and engaging in virtual realities such as various Metaverse programs and one-person broadcast stations.

To train pre-service teachers, in many countries, various forms of teaching practica have been conducted as an essential part of teacher training schemes. As it is the chance to grasp the sense of “the actuality of the context” of schools, classrooms, students, etc. (Kim et al., 2020, 2021), “teaching practica” has been considered an important stage to support pre-service teachers’ competency strengthening. In practice, pre-service teachers were learning and developing through teaching (Farrell, 2016). In the teaching practicum program, local schools and the pre-service teachers’ universities were critical units of a functional organism as the union of the communities of practices (COP) (Wenger, 1998). Through participation in teaching practica, pre-service teachers could develop their skills. To them, it was a chance to ... “developing their *discourse skills*, their *teaching skills*, and their overall *professional knowledge*” (Farrell, 2016, p. 39, *his italics*). In the context of a given educational policy, teachers are responding and reacting actively while also making “sense of externally initiated policy.” In the procedure, multifarious factors were affecting the procedure (Priestley et al., 2012, p. 198).

The effects of ITP in terms of the participants’ multicultural competencies have been explored, and currently, it is time to explore the possibility of reconstructing the ITP program as a site to strengthen pre-service teachers’ digital competence. This also will influence the pre-service teachers’ teacher agency by assisting them to achieve an understanding of digital utilizing skills as well as an understanding of other kinds of knowledge such as technology (T), pedagogy (P), and content knowledge (CK) and the convergence forms of teaching in education. To explore this, in this study, agency and TPACK

will be used as lenses to analyze the data from the pre-service teachers.

The purpose of this research was to study the effects of an international teaching practicum (ITP) in terms of creating space for the achievement of teacher agency and TPACK competence. This study also attempts to seek a way to develop the ITP program in this study to strengthen the TPACK competence of pre-service teachers. The research questions of this study are as follows:

- (1) Has the international teaching practicum experience brought any changes in pre-service teachers’ personalities, such as attitude, ways of thinking, perceptions of the classroom, teaching, and self?
- (2) In which ways was the Korean teachers’ teacher agency achieved?
- (3) Which components of TPACK have been found in the DPO, and what should be complemented to construct the entire ITP to strengthen TPACK?

## 2. Literature review

### 2.1. Multicultural competencies

Multicultural competencies consisted of three factors: multicultural knowledge, multicultural attitude, and multicultural skill (Wilson, 1993; Willard-Holt, 2001; Kim et al., 2019, 2021, 2022). First, multicultural knowledge is knowing about multiculturalism. It has four subfactors: multicultural society knowledge, multicultural student knowledge, multicultural education knowledge, and multicultural education effect knowledge. Second, the multicultural attitude is about the person’s reaction toward multiculturalism. It has two sub-factors: multicultural society attitude and multicultural education attitude. Finally, multicultural education skill is something that can be achieved via participation in the context, which would be the background of the teachers’ teaching activity in a multicultural classroom. It has two sub-factors: multicultural education environment skill and multicultural education method skill (Park and Kim, 2015). ITP was the place where the pre-service teachers have been strengthening various competencies related to teaching through actual exposure to the site. Also, the effects of an ITP also have been reported in many research studies, and in particular, the participants’ multicultural competence development was reported (Wilson, 1993; Willard-Holt, 2001; Tang and Choi, 2004; Stachowski and Sparks, 2007; Walters et al., 2009; Barton et al., 2015; Kim et al., 2019, 2021, 2022; Jin et al., 2020).

Aligning with the importance of e-learning and technology-based teaching, the importance of student agency and teacher agency has been spotlighted by OECD learning compass 2030 (OECD, 2015; Hughson and Wood, 2020). In recent several years, while teaching practicum, ITP, and other kinds of programs have been conducted by using technologies, the importance of technology-related knowledge and skills of teachers, in other words, digital competence, has been spotlighted. Moreover, the emphasis on the importance of the way of applying tools to their classroom “in meaningful ways” (Doering et al., 2014, p. 235) is important rather than simply following the trend of teaching, that is, not only

the knowledge of technology but also the competence to facilitate the tool to be useful in the classroom is important in terms of discussing the competencies of teachers.

## 2.2. Agency and teacher agency

In much of the research, teachers have been considered agentive beings for change and they also have been considered as curriculum developers (Priestley et al., 2015). The policy has been articulated rather prescriptively and suggests what teachers should do; however, teachers could not avoid being descriptive in terms of implementing what the policy says in their classrooms (Biesta et al., 2015). The classroom is the place where the policy is being implemented, and the teachers are the agent of its implementation, so teachers are also called policymakers. While teachers are very focused on their practice, the policy is rather “ignoring or subverting the cultural and structural conditions” (Priestley et al., 2015) of the practice. Therefore, it often destroys the balance of policy and practice and rather frequently creates tension and conflict. The experience of the individual in each context and time could vary as positive, neutral, or negative, but still, people are learning through the experience. It, indeed, influences an individual’s achievement of the agency. Emirbayer and Mische (1998, p. 970) defined the agency as

... (t)he temporally constructed engagement by actors of different structural environments—the temporal-relational contexts of action—which, through the interplay of habit, imagination, and judgement, both reproduces and transforms those structures in interactive response to the problems posed by changing historical situations.

Biesta and Tedder (2006) defined agency as “not something that people can have; it is something that people do or, more precisely, something they achieve” (cited in Priestley et al., 2015, p. 3, *their italics*). “Agency...(ellipsis)... is both temporal and relational” (Priestley et al., 2015, p. 3), so it is about the relationship in the given time and the space. This recalls Weedon’s perspective on the subject. To them, the individual was “diverse, contradictory, dynamic, and changing over historical time and social space” (Weedon, 1987, 1997 cited in Norton and Toohey, 2011, p. 417). This perception aligns with the agency’s understanding of time and space.

Emirbayer and Mische conceptualized agency as the “chordal triad” (1998, p. 970). Based on the study by Emirbayer and Mische (1998), and by adding up the conceptualization of agency with the value of ecology, Priestley et al. (2015) have reframed a diagram of “the key dimensions of the teacher agency model” (Priestley et al., 2015, p. 30). The model consisted of three dimensions: iterational dimension (past), practical-evaluative dimension (present), and projective dimension (future). The iterational dimension is about one teacher’s personal history as a human being and professional history as a teacher. Life histories and professional histories, including “personal capacity

(skill and knowledge), beliefs (professional and personal), and values” (Priestley et al., 2015, p. 31), are related to the iterational dimension of teacher agency. The practical-evaluative dimension is about everyday life, and it contains three sub-aspects: cultural aspects, structural aspects, and material aspects. Cultural aspects are revealed through the teacher’s verbal and non-verbal ways of expression. These include ways of thinking, speaking, and values (Priestley et al., 2015). Structural aspects are about relationships, roles, power, etc., and it is “concerning the ways in which people are positioned relative to each other” (Priestley et al., 2015, p. 86). Material aspects concern the materials and physical environment of the “day-to-day working environment” (Priestley et al., 2015, p. 33). The projective dimension is about the teacher’s aspiration for the future. This dimension considers the temporality of the individual’s interaction with the given situation and also a series of outcomes of individuals’ interaction with the context in a timescale, from short term to long term (Biesta and Tedder, 2006).

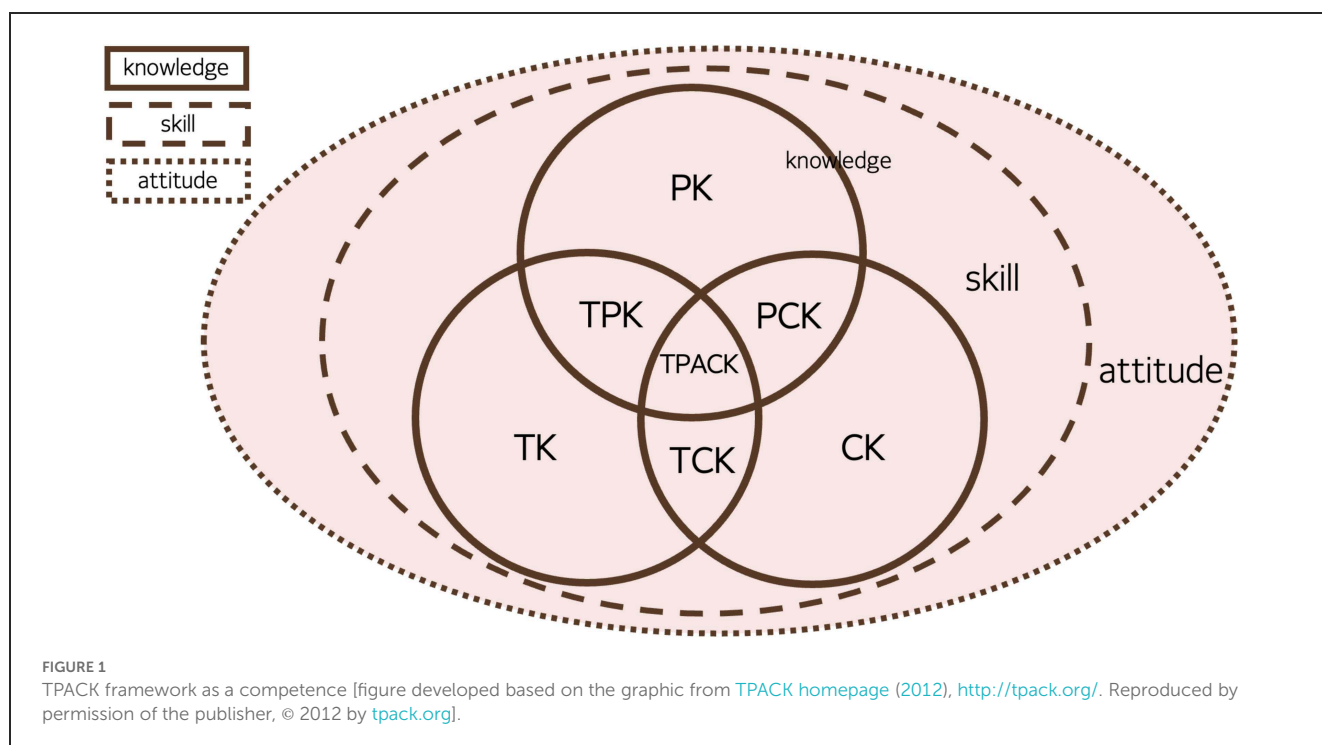
According to Emirbayer and Mische, the practical-evaluative dimension contains five sub-procedures of “*Problematization*,” “*Characterization*,” “*Deliberation*,” “*Decision*,” and “*Execution*” (Emirbayer and Mische, 1998, p. 998–999, *their italics*). Problematization is the starting point of exploring the practical-evaluative dimension of the agency. People recognize the problem and then characterize the problem based on their previous experience and achieve knowledge. “Plausible choices must be weighted in the light of practical perceptions and understandings against the backdrop of broader fields of possibilities and aspirations (here the element of projectivity enters into processes of practical evaluation)” (Emirbayer and Mische, 1998, p. 998). Furthermore, decision refers the moment the individual reaches the moment of choice. After that, the stage of execution by “act rightly and effectively within particular concrete life circumstance” (Emirbayer and Mische, 1998, p. 999) is being followed.

In this study, these procedures have been understood as not only belonging to the practical-evaluative dimension of teacher agency. Rather than that, we have understood the procedure as underlying the full extent of the individual’s experience. The three dimensions of teacher agency are revealed and intertwined. Moreover, the teacher agency is achieved “by the individual-in-transition” (Biesta and Tedder, 2006, p. 20). Teachers’ perceptions, beliefs, and aspirations are all intertwined.

Teachers’ perceptions of and orientations to the knowledge they are presented with may be shaped by belief systems beyond the immediate influence of teacher education (Nespor, 1987, p. 326 cited in Priestley et al., 2015, p. 37).

To sum up, the agency is “... an emergent phenomenon, dependent on the interplay of both the individual (capacity–skills, knowledge, beliefs, etc.) and conditions (cultural, structural, and material resources and constraints)” (Priestley et al., 2015, p. 136), and teacher agency focuses on teachers in their teaching context. In terms of the capacity and conditions of a competitive teacher agency, the agency would attempt to extend its pre-service teachers’ attitudes, ways of thinking, and perceptions of the classroom, teaching, and self in order for them to be active policymakers in their classroom and school.





### 2.3. Technological pedagogical content knowledge

TPACK shows the relationships between various basic components of knowledge (Mishra and Koehler, 2006; Koehler and Mishra, 2008 cited in Schmidt et al., 2009). The role of TPACK in the contemporary world is more important than ever (Cann, 2017; Fries, 2017; Kim, 2018). Rapid technology change, which is directly related to the young generation's jobs in the 4th industrial revolution, is currently creating and forecasting new jobs every day. TPACK is an acronym for “technology, pedagogy, and content knowledge” (Thompson and Mishra, 2007; Niess, 2008b, cited in Niess, 2011, p. 301). The TPACK framework has been revised by Koehler and Mishra (2008) as “content knowledge (C), pedagogical knowledge (P), technological knowledge (T), and the overlaps of these distinct knowledge bases as pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK)” (Niess, 2011, p. 301). In the past, this term was rather spotlighted in the areas such as science, mathematics, and technology (Niess et al., 2009), but currently, it is expanding its area into the humanities and social sciences.

Content knowledge (CK) refers to knowledge in relation to a certain subject itself. It can be subjects such as mathematics, English language, and science (Kim, 2017). Pedagogical knowledge (PK) refers to the knowledge about the process and way of teaching and learning. It contains activities such as learning activity management, evaluation, and teaching plan design (Kim, 2017). Pedagogical content knowledge (PCK), the concept suggested by Shulman (1986, cited in Kim, 2017), means pedagogical knowledge suitable/affordable/applicable for the teaching of certain content. This knowledge contains a “situational-contextual” feature as the applicable pedagogical knowledge could be varied according to a certain area of given content (Kim, 2017). Technological

knowledge (TK) is the knowledge related to technologies that the teacher can use. This comprises the internet, digital videos, and interactive software. Social network services (SNS) such as Facebook and personal blogs also belong to this knowledge area (Kim, 2017). Technological content knowledge (TCK) is, regardless of the teaching behavior, concerned about the knowledge that specific content can be created, studied, and represented using technology (Kim, 2017). Technological pedagogical knowledge (TPK) is the knowledge facilitating teaching-learning strategies of teachers, regardless of specific content areas. This is related to the use of various technologies such as ICT usage in terms of a tool for cooperation (Kim, 2017). Technological pedagogical content knowledge (TPACK) means the knowledge required for teachers to possess in terms of the integration of technology into teaching activities in the area of subject content (Kim, 2017). The detailed elements of each area of TPACK are shown in the Appendix of this study. The researchers of this study consider TPACK as one of the competencies that not only pre-service teachers but also in-service teachers need to achieve. Our understanding of the TPACK framework is shown in Figure 1.

TPACK provides a beneficial framework for the integration of teachers' application of technology with their teaching performance in their classrooms (Kim, 2017). Teachers act based on the cooperative framework of three elements: CK, PK, and TK (Kim, 2017). According to Niess et al. (2009, p. 10), teachers undergo the “Recognizing,” “Accepting,” “Adopting,” “Exploring,” and “Advancing” paths. Teachers initially recognize the need for applying digital technology in their classrooms. Then, they decide and move on to seek the appropriate tool to be implemented. After the teachers accept what they will be using in their classroom, they also require some time to be familiar with the tool themselves. Therefore, the use of the tool in the classroom will be rather limited at the beginning. Then, there will be an exploring period. Sooner or later, as the teacher is incorporating the tool more professionally,

TABLE 1 The entire ITP program of the G University.

No.	Task	Details
1	The start of the entire ITP (international teaching practicum) program	
2	Participant recruitment	4 weeks - ITP program promotion (4 weeks) - ITP participant selection Interview
3	DPO (domestic pre-orientation)	23 h
4	Preparation to go abroad	- Applying for visa - Issuing visa - Host family arrangement
5	Departure	
6	OTP (onsite teaching practicum)	5 weeks (From 2019 January 21 to 2019 February 23)
7	Return and OTP report submission	
8	Evaluation	- Evaluation from the local teachers/ITP operators on the Korean pre-service teachers - OTP report evaluation (G University professors) - Program evaluation from the Korean pre-service teachers
9	Exhibition of OTP report	
10	The end of entire ITP program	

the skill of utilizing the tool of the teacher will be advanced (Niess et al., 2009). “Being able to integrate and use technology for educational purposes involves having a set of generic skills suitable for all situations, both personal and professional, as well as specific teaching-professional skills” (Instefjord and Munthe, 2017, p. 37).

### 3. Research methodology

#### 3.1. G University’s ITP program [domestic pre-orientation (DPO) and on-site teaching practicum (OTP)]

G University is located in the middle part of South Korea. They hold memorandum of understanding (MOU) with several universities abroad and send out their students every year for ITP. The ITP program of G University consists of 10 stages, as shown below (see Table 1).

At stage 1, the ITP program itself is reprogrammed. At the same time, it is the official start of the program. At stage 2, participant recruitment is conducted, and it takes for 4 weeks. At stage 3, domestic pre-orientation (DPO) is being conducted. At this stage, Korean pre-service teachers are trained at G University through various courses. There are various modules such as multicultural aspects, multilingual aspects, English conversation, children’s development, and behavior management. Korean pre-service teachers also have a chance to explore the country and the school where they will be allocated soon. At stage 4, students and school prepare for the actual departure, and then at stage 5, they depart for the country where they are allocated. Stage 6 is the actual

TABLE 2 Domestic pre-orientation program of G University.

Hours	Moderator (lang. of instruction)	DPO (domestic pre-orientation) contents
1	Prof. Lee (Kor.)	ITP orientation
2	Student Kim (Kor.)	Q&A with an ITP experienced Student and Fire Safety Education
2	Prof. Oh (Kor.)	Global behavior manner management and etiquette guide
2	Dr. Ha (Kor.)	ITP and the understanding of the multicultural society (1)
2	Prof. Eun (Kor.)	Teaching plan
2	Dr. Park (Kor.)	ITP and the understanding of the multicultural society (2)
2	Prof. Brook (Eng.)	Survival english (1)
2	Prof. Cho (Kor.)	Classroom English and realtime English
2	Prof. Shin (Kor.)	Teaching demonstration
2	Prof. Brook (Eng.)	Survival English (2)
2	Prof. Brook (Eng.)	Survival English (3)
2	Prof. Brook (Eng.)	Survival English (4)
23 h in total	All names has been anonymized.	

From Kim and Yun (2019, p. 57).

exposure time of 5 weeks abroad (OTP). At stage 7, they return to South Korea and submit an ITP report. Then, the evaluation procedure (stage 8) and ITP exhibition (stage 9) are followed up. After that, the ITP program officially ends (stage 10) (Kim and Yun, 2019; Kim et al., 2022). Among the 10 stages of the entire ITP, the third stage (DPO) and the sixth stage (OTP) could be counted as the main stages of the ITP program.

The domestic pre-orientation (DPO) consists of 23 h of lectures. The detail of the program is shown in Table 2.

As shown above, the program contains the “actual survival skills” that might be needed for Korean pre-service teachers who will be positioned in a linguistically and culturally different atmosphere. The content “ITP and the understanding of the multicultural society” (1) and (2) were conducted to strengthen the pre-service teachers’ multicultural and multilingual perception. Also, there was a session to listen to stories from the previous ITP participants, including Q&A.

#### 3.2. Research participants & data collection

The participants of this study were five Korean pre-service teachers who were in the 2015–2016 ITP program run by G University, and they were all female teachers. The countries where the pre-service teachers were allocated varied. Some were in the United States of America (Tailla, Helen, and Amy), and some were in New Zealand (Paige and Jade). All the participants’ name

TABLE 3 The participants and collected data.

Name [allocated country]	Date of interviewing (2018)	Numbers of teaching diaries produced by the pre-service teachers (January–February 2016)		ITP report (2016)	Fieldnotes by program instructor (2016)
Talia [USA]	October 28 <sup>th</sup> , 2018	8 diaries in Korean	28 <sup>th</sup> of January, 2016	1	
			3 <sup>rd</sup> of February, 2016		
			10 <sup>th</sup> of February, 2016		
			17 <sup>th</sup> of February, 2016		
			27 <sup>th</sup> of February, 2016		
			5 <sup>th</sup> of Aug., 2016		
			12 <sup>th</sup> of Aug., 2016		
			15 <sup>th</sup> of Aug., 2016		
		6 diaries in English	5 <sup>th</sup> of February, 2016		
			12 <sup>th</sup> of February, 2016		
			19 <sup>th</sup> of February, 2016		
			3 <sup>rd</sup> of August, 2016		
			10 <sup>th</sup> of August, 2016		
			16 <sup>th</sup> of August, 2016		
Paige [New Zealand]	Nov. 1 <sup>st</sup> , 2018	5 diaries in Korean	27 <sup>th</sup> of January, 2016	1	
			3 <sup>rd</sup> of February, 2016		
			10 <sup>th</sup> of February, 2016		
			17 <sup>th</sup> of February, 2016		
			24 <sup>th</sup> of February, 2016		
		3 diaries in English	5 <sup>th</sup> of February, 2016		
			12 <sup>th</sup> of February, 2016		
			19 <sup>th</sup> of February, 2016		
Helen [USA]	October 26 <sup>th</sup> , 2018	5 diaries in Korean	20 <sup>th</sup> of January, 2017	1	
			26 <sup>th</sup> of January, 2017		
			2 <sup>nd</sup> of February, 2017		
			10 <sup>th</sup> of February, 2017		
			13 <sup>th</sup> of February, 2017		
		5 diaries in English	19 <sup>th</sup> of January, 2017		
			25 <sup>th</sup> of January, 2017		
			1 <sup>st</sup> of February, 2017		
			8 <sup>th</sup> of February, 2017		
			13 <sup>th</sup> of February, 2017		
Jade [New Zealand]	November 1 <sup>st</sup> , 2018	5 diaries in Korean	28 <sup>th</sup> of January, 2016	1	
			3 <sup>rd</sup> of February, 2017		
			10 <sup>th</sup> of February, 2016		
			17 <sup>th</sup> of February, 2016		
			25 <sup>th</sup> of February, 2016		
		3 diaries in English	5 <sup>th</sup> of February, 2016		
			12 <sup>th</sup> of February, 2016		
			19 <sup>th</sup> of February, 2016		

(Continued)

TABLE 3 (Continued)

Name [allocated country]	Date of interviewing (2018)	Numbers of teaching diaries produced by the pre-service teachers (January–February 2016)		ITP report (2016)	Fieldnotes by program instructor (2016)
Amy [USA]	October 31 <sup>st</sup> , 2018	5 diaries in Korean	30 <sup>th</sup> of June, 2016	1	
			5 <sup>th</sup> of July, 2016		
			14 <sup>th</sup> of July, 2016		
			22 <sup>nd</sup> of July, 2016		
			29 <sup>th</sup> of July, 2016		
		5 diaries in English	1 <sup>st</sup> of July, 2016		
			8 <sup>th</sup> of July, 2016		
			12 <sup>th</sup> of July, 2016		
			18 <sup>th</sup> of July, 2016		
			28 <sup>th</sup> of July, 2016		

has been anonymized. The details of the participants and data collection procedure are shown in [Table 3](#).

The schools where the pre-service teachers were allocated held MOU with G University. In the case of Amy and Helen and Paige and Jade, the interview was conducted as group interviews. Grouping was decided based on the region where the pre-service teachers were allocated for the 2015–2016 ITP participation. In the case of Talia, her allocated region was different from the other pre-service teachers. Therefore, she was in the solo face-to-face interview. For this study, pre-service teachers' bilingually written teaching diaries and ITP reports were collected. Teaching materials used in DPO were also collected. Another set of data from the participants was the ITP report that each participant had to produce and submit to their university. There were also field notes written by the program instructor. Through the field notes from the program instructor, researchers could understand the ITP scene well.

The data were collected in several different time spots. In 2016, the teaching materials used in the DPO and pre-service teachers' teaching journals were collected. In addition to this, the pre-service teachers' teaching diaries were collected while they were in their on-site teaching practicum, and ITP reports were collected right after their completion of the ITP program in 2016. Alongside these data, a field note from the program instructor was collected in the same year. In 2017, the participants were in their preparation for a national examination to be teachers, and no data were collected at that time. Then in 2018, face-to-face group interviews were conducted, and at that moment, the research participants were in-service teachers in Korean schools. All of the data sets were triangulated, and the three were complementing each other ([Denzin, 1978](#)).

### 3.3. Data analysis

The research design and the data analysis procedure are shown in [Table 4](#).

All the interview was voice-recorded at the scene and then transcribed accordingly. The data analysis was based on the in-depth interview, the transcriptions of the conversation, and journals from the research participants. These complemented each other and contained the authenticity of each participant's experience and voice. In addition to this, the 2 years of gap in this study's research design allowed both participants and the researchers to be able to take a close look at the data from a more objective point of view. As agency is defined as “not something that people can *have*; it is something that people *do* or, more precisely, something they achieve ([Biesta and Tedder, 2006](#)),” newcomer teachers take time (at least 2 years) to do and achieve their own multicultural competencies, technology (T), pedagogy (P), and content knowledge (CK) and the convergence forms of teaching in their real classroom. Moreover, through the 2 years of gap, the participants' status was changing. In 2016, they were pre-service teachers, and in 2018, they were in-service teachers. The interview in 2018 was the chance to diagnose their present and past. Their words in 2018 were compared with other data sets they offered to us in 2016, and the interview itself was a chance to remind themselves of their ITP experience retrospectively. The positionality change from pre-service teachers to in-service teachers allowed them to apply a lens of in-service teacher perspective on their own pre-service teacher life 2 years ago. The data themselves, therefore, hold reliability and validity. The teaching journals and the interview transcriptions of the pre-service teachers were coded four times and thematically analyzed using NVivo 12. The researchers followed the thematic analysis phase that Braun and Clarke suggested: (1) “Familiarizing yourself with the data” ([Braun and Clarke, 2012](#), p. 60), (2) “Generating initial codes” ([Braun and Clarke, 2012](#), p. 61), (3) “Searching for themes” ([Braun and Clarke, 2012](#), p. 63), (4) “Reviewing potential themes” ([Braun and Clarke, 2012](#), p. 65), and (5) “Defining and naming themes” ([Braun and Clarke, 2012](#), p. 66). The researchers discussed the raised themes several times and then some vignettes that represent the pre-service teachers' teacher agency enactment through participation in the G University's ITP program were selected. To shed light on “teacher agency” and TPACK competencies in teacher

TABLE 4 Research design.

Category	2016	2016	2017	2018
Program	International Teaching Practicum (ITP)			n/a
Procedure	Domestic pre-orientation (DPO) [taught program]	On-site teaching practicum [practice program]		n/a
Data collection	- DPO teaching materials - DPO teaching materials	- Teaching diaries - ITP report - Fieldnotes from the Program Instructor		- Interview
Data collection period	November 12, 2018–December 17, 2018	January 21, 2019–February 23, 2019		October 2018–November 2018
5 participants' Status	Pre-service teachers			In-service teachers
Data analysis	- DPO contents analysis - DPO diagnosis in relation to TPACK	- Thematic analysis		- Thematic analysis

education, for the analysis of the coded and selected vignettes, researchers read their stories several times carefully. Furthermore, researchers examined the DPO teaching materials in relation to the TPACK elements. The frame for the examination is shown in Table 5.

As shown in the table above, the teaching materials used in each content of DPO were compared with the characteristics of CK, PK, PCK, TK, TCK, TPK, and TPACK. To do so, a tool Schmidt et al. (2009) developed was first analyzed and then developed to be suitable for this study (see Appendix). When the characteristics of each element were clearly shown, researchers marked “●”, and when it seemed like it certainly exists, but not appeared clearly, researchers marked “○.” After the three researchers of this study diagnosed the DPO teaching materials' connection with the CK, PK, PCK, TK, TCK, TPK, and TPACK, the researchers discussed them all together, and then, the final decision was made. The three researchers had several discussions to identify the themes and categories arising from the data. They discussed until they reach an agreement point.

Through the whole procedure of data collection and analysis, not only the triangulation of the data but also the researchers' point of view was achieved. In particular, for the data triangulation, data sets collected in two different time slots were re-analyzed and interpreted by a compare and contrast procedure of the past and the present. Also, researchers applied the TPACK framework as one of the analytical lenses, and it strengthened the validity of the research methods, results, and data interpretation.

## 4. Research results

Through field experience, the Korean pre-service teachers achieved teacher agency. The pre-service teachers achieved broader insights about “diversity,” “being perfect,” and “teacher agency.” These themes appeared in their interview transcripts.

### 4.1. Achieving broader insights about “diversity”

Through the homestay experience, Talia was able to grasp the meaning of the term “diversity.” She said that this opportunity led her to recognize the importance of variety/diversity.

*Talia:...(ellipsis)... Well, the house I home stayed was a very unusual one.*

*Interviewer: Yes.*

*Talia: I was not the only homestay student... There were a lot of homestay people in the house.*

*Interviewer: Yes.*

*Talia: ... (ellipsis)... I had my homestay Mama, Papa, and there was a daughter of them. The daughter was staying with her partner in the house. Then I was there, and there was a Japanese student, and Vietnam student. ... (ellipsis)... I think the homestay was the opportunity that I could think carefully about the variety! I think the realization of the importance of diversity is very important, and I still consider it a very crucial thing to teachers as I am working now as a teacher in this elementary school. Because there are a variety of students in this classroom... Personally, if there's no bad intension on certain behaviors of a student, as a teacher, I think I should accept it and understand it. I've been able to think about it because of the culture shock (laughs) that I experienced at homestay (laugh). It's an opportunity to think outside of what I normally thought it would be?*

*Interviewer: Ah~*

*Talia: Yes, I had that experience, and it was a great experience and a fresh shock to me.*

*(Talia, 28. October 2018, Interview)*

In the homestay where Talia was staying, various nationalities, genders, and relationships existed. It was a “cultural shock” to her, but at the same time, she shifted the meaning of what she experienced. She was showing acceptance toward the differences she encountered and then reconstructing the meaning of the variety. By doing so, Talia's knowledge of cultural differences was



TABLE 5 The frame to diagnose of the DPO program in relation to the TPACK elements.

Contents	CK	PK	PCK	TK	TCK	TPK	TPACK
ITP orientation							
Q&A with an ITP experienced student and fire safety education							
Global behavior manner management and etiquette guide							
ITP and the understanding of the multicultural society (1)							
Teaching plan							
ITP and the understanding of the multicultural society (2)							
Survival Englis (1)							
Classroom Englis and realtime Englis							
Teaching demonstration							
Survival Englis (2)							
Survival Englis (3)							
Survival Englis (4)							

●, Clearly shown; ○, In there, but not clearly shown.

shifting from “something surprisingly different and new from her previous classrooms” to “something expecting that she would have in her future classroom.” Through this experience, Talia could contemplate different ways of treating students in her future classroom. Here, the ITP experience was a “gateway experience” linking the pre-service teachers to their future role as classroom teachers. This finding is consistent with Yun (2016) study on young novice teachers in Korean elementary schools. As they were in a totally new context, they were fully immersed in a practice where the difference was pervasive. In her study, the participants showed their acceptance of those differences and the varieties they were facing in the practice. This acceptance was then linked to their achievement of insights regarding teaching in a multilingual and multicultural context.

Paige’s story shows another form of diversity. In her OTP, Paige had an opportunity to participate in a meeting for a child with special needs. This was a gateway experience in which she could learn how teachers in the school reacted toward the diversity of students with physical or mental impairment.

*There was a meeting about a child with special needs in our class...(ellipsis)... it has been an occasion to sincerely reflect on myself, seeing those who were seeking appropriate approach for children with special needs from an “educational” point of view. To be honest, I have been living in the same classroom as a special child, but I have somewhat considered him as being on an isolated island in the classroom....(ellipsis)...There was also the question of allocation of the student as it seemed much better for him to allocate him in a classroom for special needs. ... (ellipsis)... To me, it was a grateful moment to completely change my mind about special education. Right after the meeting was over, I could begin to treat the child as same as any other child in the classroom and could start to recognize him as a classmate of mine, truly.*  
(Paige. 17. February 2016, Teaching Diary)

She described the meeting that was conducted during the lunch period. There were eight people present: the vice-principle, the homeroom teacher, the child’s mother, two special education

teachers and two facilitators of curriculum design, and Paige herself. While Paige was sitting in the meeting, she recalled her previous mindset and self-portrait as a teacher who considered children with special needs as a group separate from the rest of the class. However, through observing the meeting, her perception regarding differences among people in a community of practice was expanded, allowing her to understand and accept *students in diversity as they are*, not as different. Being an agentive teacher is possible through achieving the knowledge that could enhance the agency of the teacher. To Paige, the layer of the experience becomes the knowledge, and it becomes the agentive knowledge.

## 4.2. Achieving broader insights about “being perfect”

In their stories, Helen and Jade described their personalities as “perfectionist.” Helen’s story shows her expectation to be perfect in her English language use.

*There has been fear that we must be perfect in our study... (ellipsis)... but even in Korea, foreigners are not asked to be perfect when they speak. ... (ellipsis)... in a way, as you said before, we are asked to be perfect, so that makes us nervous, (I could achieve insights to understand myself) and think like, “What if a person isn’t perfect (in performing one’s job)?” and “Well, I can simply ask somebody (about it in order to obtain an answer).”*  
(Helen. 26. October 2018, Interview)

Helen believed that to be successful in Korea, she had to be perfect. Therefore, the value of achieving perfection in English use seemed to be settled as an important part of her personality. However, in the ITP experience, she struggled with English, and this led her to be flexible in her understanding of the term “linguistic capacity.” While the English language was her particular area of difficulty, her ITP experience facilitated the wider expansion of her

understanding of the concept of “being perfect” in using a foreign language, i.e., she became much more relaxed toward this and was able to accept linguistic diversity and variety. This acceptance brought about personality change as her concept of perfection was broadened.

“Being perfect” was a huge part of Jade’s personality. For example, she could not bear to make even small mistakes in her PowerPoint presentations (PPTs). However, after participating in the ITP, she became less determinative in her teaching. Her perfectionist personality had prevented her from believing herself to be “perfect” in everything and then led her to be inflexible in the selection of themes and textbook content that she presented to students in the classroom.

*I am a bit of... perfectionist. So I have a tendency that I have to finish everything perfectly, and if I miss a thing, I normally feel nervous. However, well at least about the textbook... I don't know if it's because I've been there, but I have been able to consider the progress of my class... the progress of the next class is not the thing that I need to consider. Also, if there's something that seems not meaningful in children's learning, now I can skip that part. This influenced me rather hugely as now I can decide the part to opt out boldly... Because if I hadn't been there, I would've thought that I need to cover all the single pages of the textbook. However, I've been able to know that I can lead the children to learn even though I do not follow every content (of the textbook). I also have found that the textbook is not the answer, and this changed my personality a little bit. ... (ellipsis)... I am really fastidious. (for example) if there's a small change in a PPT file, (laughter) I have to (inaudible), but nowadays I feel like... well... I don't need to do so. ... (ellipsis)... since I've been there, I've learned a lot about things... that I need to put the burden down and confront things, I cannot be enough and it doesn't matter, well it might not seem good to others if I maintain (my original personality) ...*

*(Jade. 01. Nov. 2018, Interview)*

As a result of the ITP experience, Jade became more flexible. This change was reflected in her own classroom, where she was able to be selective when working with textbooks and to use or skip chapters according to what she considered most suitable for the students.

*... So, I am trying to do a lot of events and activities by using real-life materials, not only textbooks. Now I can say that what I have seen and learned in the ITP is that even apart from the textbook, children can learn how to read and write enough. For example, now I can decide on chapters to skip and then bring the students to the library to find books that related to the achievement criteria of the chapter of the skipped textbook. ...*

*(Jade. 01. Nov. 2018, Interview)*

In 2018, Jade was an in-service teacher who created a new culture in her classroom. This was part of the new wave of change in her Korean school, and it was an import of new culture into her Korean school. She achieved insights to mingle with different cultures for the better.

### 4.3. Achieving broader insights about “student agency”

At the OTP scene, the local teachers were teaching their students by allowing them to actually see, feel, and touch. It was a very impressive way of teaching, and to Amy, it looked very effective.

*In the United States.....at the last school... they were giving students safety guidance... for it, they took the students with them, they took them to the cafeteria, then taught about the safety guidance in there by let them think about what kinds of accidents may happen in there.... (Inaudible)... I thought that teaching students by let them actually see and experience things is really effective.*

*(Amy. 31. October 2018, Interview)*

This recalls one participant of Yun (2016) study who was a bit surprised by the Korean school system as Korean students tend not to be allowed to use scissors by themselves due to the “safety” reason, whereas using scissors by themselves was common to students in American primary schools. In American schools, safety guidance was given. Then, the students could join in the activity as active individuals.

## 5. Discussion

This section presents discussions in response to the research questions for this study as follows: (1) Has the international teaching practicum experience brought any changes in pre-service teachers’ personalities, such as attitude, ways of thinking, perceptions of the classroom, teaching, and self? (2) In which ways was the Korean teachers’ teacher agency achieved? and (3) Which components of TPACK have been found in the DPO, and what should be complemented to construct the entire ITP to strengthen TPACK?

### 5.1. Korean pre-service teachers’ personality change and teacher agency achievement

The Korean pre-service teachers’ narratives revealed the process of their personality change and teacher agency achievement. The pre-service teachers’ experience in the OTP scene was about experiencing diversity and learning to be flexible. These became their identities in practice (Lave, 1992).

First, especially in Talia’s case, the context shaped the Korean pre-service teachers’ positioning among others, and the context influenced their teacher agency achievement. Based on their previous experience in Korean schools, the participants possessed a certain form of cultural competence. Concerning cultural competencies, Emirbayer and Mische (1998) noted that “Bourdieu’s notion of habitus proves highly useful in showing how different formative experiences, such as those influenced by gender, race, ethnicity, or class backgrounds, deeply shape the

web of cognitive, affective, and bodily schemas through which actors come to know how to act in particular social worlds” (p. 981). The homestay experience allowed Talia to recognize the importance of diversity by having the chance to think carefully about variety. She could apply her previous experience at the OTP homestay where she was surrounded by differences similar to those in her current classroom to project a classroom where diversity is pervasive. The “culturally-located, location-specific knowledge, such as indigenous knowledge or sensory knowledge needed to thrive or survive in particular places, is seen as not valuable for students to acquire” (Ivinson, 2019 cited in [Hughson and Wood, 2020](#), p. 13). The context created location-specific knowledge and then influenced the Korean pre-service teachers’ positioning in the practice. This affected the expansion of their identity not only as teachers but also as agentive individuals.

Second, through the interaction in the OTP context, the Korean pre-service teachers could recognize and problematize the Korean educational atmosphere, which was not inclusive compared with the American local schools. What Paige saw at her OTP school was the harmony of the vice-principal, homeroom teacher, mother of the child, two special education teachers, two curriculum design facilitators, and Paige herself. The local school was accepting and creating “the space as a whole,” where the members worked together for harmony. The projective dimension of agency refers to the “creative reconstructive dimension of agency” ([Emirbayer and Mische, 1998](#), p. 984). To see the projective dimension of the participants’ agency, the “focus upon how agentic processes give shape and direction to *future possibilities*” ([Emirbayer and Mische, 1998](#), p. 984, *their italics*) should be considered. In her teaching diary written in 2016, the experience was described as the grateful moment that influenced the change of her mind about special education.

Third, Helen and Jade could escape from their perception of “being perfect.” Especially for Helen, being perfect was about English language use. She was worried about her language mistakes, and the worry triggered her nervousness. Through the ITP experience, she could expand her understanding of the term “perfection” and the function of language in the situation of conversation. Along with her previous lifetime experience, English was perceived as a “performative action,” rather than an “interactive action.” This led Helen to be more focused on the perfect English sentence utterance, neglecting its social and interactional function. According to Bakhtin, language itself is social. Language is “situated utterances in which speakers, in dialogue with others, struggle to create meanings” (Bakhtin, 1981, 1984, 1986 cited in [Norton and Toohey, 2011](#), p. 416). Through the ITP, Helen could re-establish the notion of the English language, which is “social and interactional,” rather than a “performative” one.

In the case of Jade, she was a very determinative person and paid lots of attention to creating the perfect teaching material. Before the ITP, Jade was paying more attention to being the teacher who prepared things perfectly in advance, but later, the focus was expanded to be able to include the interlocutors of her classroom. Jade gained insights about the teacher’s role in the classroom. Through the ITP experience, she recognized the importance of interaction with the students in the classroom. She decided to

act more rather than relying on the textbooks. Her decision to be more active and selective in terms of teaching and interacting with her students also influenced the creation of a new culture in her current classroom and the achievement of her teacher agency. Her expectation to be a subjective teacher became a reality in 2018, when she was a teacher who could “make daily decisions that are difficult, involving compromise and conflict with their aspirations, feeling coerced by what [she] might see as arbitrary and unnecessary intrusions into [her] work” ([Priestley et al., 2015](#), p. 33).

Fourth, it was also the chance to be able to recognize students in classrooms as agentive beings. In Amy’s story, the local school teacher led the students to explore the real scene and then let them see and feel the practice. The safety guidance was given prior to the activity, and the things the students should avoid were explained at the scene. Teachers in the local school were creating a space to think about possible dangers in a certain area for their students. Through the experience, Amy could project her future teacher aspiration to be a person who let her students actually experience things, and she also admitted that it was a very effective way of teaching.

Though there is no significant boundary among the three chordal triads of agency, the characteristics of dimension from the participants’ stories categorized and summarized as in [Table 6](#).

All the dimensions of teacher agency were intertwined, each one becoming part of another, and “influenced the projective dimensions of their agentic orientations” ([Priestley et al., 2015](#), p. 95). All the experiences of the past, present, and future became meaningful sites of learning that create the path of the participant ([Anderson et al., 1996](#)).

## 5.2. Which components of TPACK have been found in the ITP, and what should be complemented to construct the ITP to strengthen TPACK?

As discussed in the previous section, Korean pre-service teachers achieved insights about diversity, differences, and agency through actual exposure to the scene ([Kim et al., 2020](#)). The entire ITP program offered the chance to look back at the Korean pre-service teachers’ past experience compared with the current experience, and then, they could project their future.

At the same time, the DPO played the role of the bridge to link the Korean pre-service teachers with the OTP local schools. Video clips and other internet-based resources used in the DPO allowed the Korean pre-service teachers to grasp the image and atmosphere of the scene they will be allocated for OTP. Also, it offered ideas for creating teaching materials and ways to implement them in their own teaching.

[Figure 1](#) is one of the teaching materials that was actually used in the domestic pre-orientation programs: “ITP and the understanding of the multicultural society.” The slides contained many YouTube video clips, for example, “Westerners who see the world with nouns and Asians who

TABLE 6 The participants' achievement of teacher agency in the ITP.

Name	Iterational dimension (life histories)	Practical-evaluative dimension (experience-status quo) (cultural/structural/material aspects)	Projective dimension (future aspiration) features of achieved teacher agency
Talia	◆ Not many chances to experience ethnical/cultural/ linguistic diversity	◆ Cultural aspect - experiencing diversi	◆ Change of attitude/mind/perception, ways of thinking toward ◆ diversity/variety ◆ special education ◆ language as a tool for the interaction ◆ Change of attitude/mind/perception, ways of thinking toward the classroom, teaching, and self ◆ creation of new classroom culture ◆ students as the subjective beings
Paige	◆ Not many chances to think about the needs of inclusive education	◆ Cultural, structural aspects - experiencing "inclusive education"	
Helen	◆ No mistakes are allowed in her English language use	◆ Cultural aspect - escape from the "perfectionist" point of view	
Jade	◆ No mistakes are allowed in her teaching material preparation	◆ Structural, material aspects - being flexible in terms of using textbooks and conducting lessons	
Amy	◆ Not many chances to experience student-centered classroom atmosphere	◆ Cultural, structural aspects - let the children to themselves under the adults' guidance	

see the world with verbs" (EBS docu-prime, 2009). This video clip is about the differences between the East and the West in terms of language, culture, and educational policy. The technology is integrated to link their students to the "future reality."

Through the DPO program, the pre-service teachers could grasp the sense of utilizing video clips and photos, among others. It may be helpful in terms of indirectly transferring the knowledge of using technology in classes. Other DPO sessions' teaching materials were also reviewed, and they all contained similar technological features, such as video clips, photos, interview extracts, and teaching materials used in elementary school. The researchers of this study examined the current DPO program's teaching resources to observe whether the teaching courses in each session were enough to assist the pre-service teachers' TPACK competence as summarized in Table 7.

As shown above, the elements of CK, PK, PCK, and TK were rather significantly demonstrated in the teaching materials of the DPO program. However, the other elements of TCK, TPK, and TPACK were not clearly demonstrated. This seems because the DPO program itself was not designed to include technologies or digital competence-focused sessions, and therefore, the vivid purpose of leading the pre-service teachers to achieve technology-related competence did not appear on the surface. Though the elements of TCK, TPK, and TPACK was not significantly shown on the surface of the programme, they were underlying the whole DPO & ITP programme of G university.

To reinforce the TPACK competence strengthening, the DPO program of G University needs to draw out the technological aspects on the surface to contain sessions to enhance the understanding of various technologies that could be used in the classroom. Also, the DPO program needs to be re-designed in a convergence form of technology, contents, and pedagogy so that the elements of TPACK could be fulfilled.

## 6. Conclusion

This study sought answers to the following three research questions: (1) Has the international teaching practicum experience brought any changes in pre-service teachers' personalities, such as attitude, ways of thinking, perceptions of the classroom, teaching, and self? (2) In which ways was the Korean teachers' teacher agency achieved? and (3) Which components of TPACK have been found in the DPO, and what should be complemented to construct the entire ITP to strengthen TPACK?

To answer research questions (1) and (2), the combination of the three dimensions, the iterational, practical-evaluative, and projective dimensions of their action, were shown via the Korean pre-service teachers' stories through their narration that contains imagination and the reflection of their experience in the ITP (Biesta and Tedder, 2006). The entire ITP experience became the trigger of the Korean pre-service teachers' teacher agency achievement by influencing their attitude, ways of thinking, and the perceptions of classroom, teaching, and self. The OTP experience was a huge step forward for these Korean pre-service teachers as it was a procedure of layering their experience and learning in a totally new context. Through the actual allocation into the OTP country and OTP schools, which brought the engagement in good quality of "temporal-relational contexts-for-action" (Priestley et al., 2015, p. 22), the Korean pre-service teachers could achieve teacher agency.

To answer research question (3), the DPO program and its teaching resources were examined to see whether they were enough to assist the Korean pre-service teachers' TPACK competency achievement. Among the elements of TPACK, the elements of CK, PK, PCK, and TK were shown. However, the other elements of TCK, TPK, and TPACK were not shown clearly. To strengthen the whole ITP program to be more effective in terms of boosting the pre-service teachers' knowledge and skills, the DPO program certainly needs to continue focusing on the skills and knowledge of technology and its implementation. Through the DPO, the Korean pre-service teachers were trained. The original intention of

TABLE 7 Diagnose of the DPO program in relation to the TPACK elements.

Contents	CK	PK	PCK	TK	TCK	TPK	TPACK
ITP orientation	●					○	○
Q&A with an ITP experienced student and fire safety education	●			○		○	○
Global behavior manner management and etiquette guide	●					○	○
ITP and the understanding of the multicultural society (1)	●			●	○	○	○
Teaching Plan	●	●	●	●	○	○	○
ITP and the understanding of the multicultural society (2)	●			●		○	○
Survival English (1)	●	●	●			○	○
Classroom English and realtime English	●	●	●			○	○
Teaching demonstration	●	●	●	●	○	○	○
Survival English (2)	●	●	●			○	○
Survival English (3)	●	●	●			○	○
Survival English (4)	●	●	●			○	○

●, Clearly shown; ○, In there, but not clearly shown.

facilitating the DPO program was to create scaffolding that could connect the pre-service teachers to the place where they will be facing soon. It is necessary to design the entire ITP program to be a program that helps to strengthen the varieties of competencies required of teachers in the contemporary world. Therefore, to strengthen the effectiveness of ITP, the DPO program needs to include content that could be helpful in the way of achievement of knowledge of “technologies” along with multicultural, multilingual, pedagogical, and content knowledge. At the same time, e-learning should be interactive (Nagy, 2005). Therefore, the DPO also needs to contain interaction through using technologies. Technology (T) among TPACK forms of teaching might be more needed in a kind of COVID-19 or Metaverse education, and applying chat GPT in the whole procedure of ITP could be one of the options of technology-implemented learning for future generations. To strengthen the effectiveness of the whole program of the ITP, the role of the DPO is very important.

To conclude, two of the Korean pre-service teachers narrated their ITP experiences as follows:

*ITP pre-orientation program was the experience like dipping a toe in cold water before fully immersing both feet in it*

['찬 물에 확 들어가기 전에 발가락 한 번 담가보는 정도의 경험'(in Korean)]

(Jade. 01. Nov. 2018, Interview)

*Well, I am sitting in the classroom with the students, but I can expand my experience to schools, society and the global community, and the ITP was the gate of all the expanded stories. “I have been to America, and I met these students there. They were doing this in their classroom.” Then I can give my students some topics in relation to the stories. The starting point of this, to me, this is the international teaching practicum.*

(Amy. 31. October 2018, Interview)

The reality of Korean school was expressed as a pool of cold water, and the ITP experience was the moment that allowed Jade

to possess responsiveness toward happenings and daily repeated tasks of her currently given context in terms of interacting with space and time. In terms of the competitive teachers who achieved teacher agency, the ITP experience itself witnessed them as global policymakers in their classrooms and schools through the pre-teachers’ ITP. The ITP certainly impacted their attitude, ways of thinking, and perceptions of the classroom, teaching, and self.

The limitations of this study might be two Korean contextual issues. First, it is difficult to “do” and “achieve” teacher agency in the same environment because teachers in public schools in Korea have to transfer to other schools every 4 to 5 years. Second, as the distribution of students from various family backgrounds in Korean primary schools diverges from region to region, it is difficult to secure an opportunity to “do” and “achieve” ITP-related teacher agency. Therefore, there is a low possibility for a “Follow Up Study”.

However, this study also holds a significant strength. There were five pre-service teachers who were able to “do” and “reach” teacher agency through students from various family backgrounds, and it is highly appreciated that they were the first to do such research in ITP because they were able to participate in research interviews.

## Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.



## Author contributions

YK is the first author of this research paper and one of the instructors of the program for this study. She produced field notes in relation to this study and contributed to the data collection, analysis, and manuscript composition procedures. SY is the corresponding author of this paper. She contributed to the data collection, analysis, and manuscript composition procedures, mainly focusing on data analysis and manuscript production. YS is the whole project manager of the underlying research project that this research paper contributed to and involved in the data collection, analysis, and manuscript composition procedure. All authors have collected and analyzed the data set altogether, discussed revealed themes several times, and then produced this research paper.

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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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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2023.1200092/full#supplementary-material>

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# A cognitive task analysis of the teacher skills and knowledge required for differentiated instruction in secondary education

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Providing differentiated instruction (DI) is a complex teacher task that many secondary school teachers do not master well. In the current study, a cognitive task analysis of this teacher task was conducted by analyzing how expert teachers do this and why, resulting in an inventory of the necessary teacher skills and knowledge for providing DI, and a description of the factors that influence the complexity of DI. The results of this analysis show what providing DI in secondary education entails, which is valuable for designing teacher professional development programs for DI at that level.

## KEYWORDS

teacher professional development, differentiated instruction, teacher skills and knowledge, cognitive task analysis, secondary education

## Introduction

Teachers are increasingly expected to adapt their teaching to their students' needs, since this can have a positive effect on students' achievement (Deunk et al., 2018; Smale-Jacobse et al., 2019). Implementing differentiated instruction (DI), however, is something teachers struggle with (Smale-Jacobse et al., 2019). To be able to support teachers in providing DI, we need to identify the teacher knowledge and skills required for DI. Van Geel et al. (2019) conducted a cognitive task analysis of DI in primary education. Since we cannot assume that the results are fully the same for secondary education, the current study aimed to identify the knowledge and skills teachers in secondary education need in order to adapt their teaching to students' varying needs. The results can be used to improve initial as well as in-service secondary teacher professional development (TPD) for DI.

## DI entails more than strategies

DI is a teaching approach “in which teachers proactively modify curricula, teaching methods, resources, learning activities, and student products to address the diverse needs of individual students and small groups of students to maximize the learning opportunity for each student in a classroom” (Tomlinson et al., 2003, p. 121). Providing DI is a complex teacher task, as teachers are required to have an accurate picture of the learning levels of all their students and then adapt their explanations and assignments to those differing levels, while keeping in mind the goal they are working toward in the lesson (Deunk et al., 2015).

Teachers use various strategies to provide DI, such as ability grouping (e.g., to create a group of low-achieving students who receive more explanations), or the use of a computerized system to support DI (Deunk et al., 2015, 2018). The effects of these various strategies on student achievement also vary (Deunk et al., 2018; Puzio et al., 2020). Examples include studies showing that between- or within-class homogeneous ability grouping can have a positive effect, no effect, or even a small negative effect, and studies showing that DI supported by computerized systems can have a small to moderate positive effect on student achievement (Deunk et al., 2015, 2018).

Smale-Jacobse et al. (2019) conducted a review of the research on within-class DI in secondary education. Although positive effects were found in general, only 12 studies were included, which led to their most important conclusion being that there are not enough good studies about the effectiveness of DI in secondary education. Although the evidence is limited, it seems that providing DI can positively influence student achievement. Next to student achievement, DI can also affect students' socio-emotional outcomes. Pozas et al. (2021) studied the perceptions of 379 students from 23 Austrian secondary school classes (both inclusive and regular classes) and found that students' ratings of their teachers' DI was positively associated with their school well-being, social inclusion, and academic self-concept.

The effectiveness of providing DI, however, mainly depends on what the teacher actually does. The quality of DI depends on the degree to which a teacher deliberately, proactively, and successfully adapts instruction to their students' needs (Tomlinson et al., 2003; van Geel et al., 2019). Differentiating teachers ensure that students do not receive assignments that are too difficult or too easy for them, as in that case, learning does not take place (Joseph et al., 2013). When assignments are neither too difficult nor too easy, students work in their zone of proximal development, where they work on a task just above their abilities while receiving coaching and support (Vygotsky, 1978). When students receive instruction suited to their learning needs, they all can perform at a high level. The goal of DI is to provide the opportunity to excel to students of all levels (Tomlinson, 2015). It thus is likely that DI could improve student performance provided that the instruction matches the learning needs of the students. Given the previous, the definition of DI used in the current study is: the deliberate adaptation of teaching and learning activities to the learning needs of the learners.

## What does providing DI require from teachers in secondary education?

Van Geel et al. (2019) studied what providing DI requires from teachers in primary education. They found that the implementation of DI by teachers starts even when preparing the lesson series (phase 1) and preparing the lesson itself (phase 2). High-quality preparation facilitates providing DI during the lesson (phase 3). Finally, teachers evaluate their lessons (phase 4), and the results are used to prepare for the next lesson(s). Each of these four phases was further decomposed by Van Geel et al. (2019) into the constituent skills that are necessary to perform that phase. For these skills, teachers need knowledge about students and subject-matter knowledge. Van Geel et al. (2019) argued that providing high-quality DI means that teachers adapt their instruction to the systematically determined needs of all learners. Smale-Jacobse et al. (2019) argue that to systematically determine the

learners' needs, DI is inseparable from other teacher behaviors like continuous monitoring and (formative) assessment. This is not only done during the lesson: before the lesson teachers should have clear goals, use pre-assessment, and plan instruction before the lessons, and evaluate their students' progress toward the lesson goals after the lesson.

Research has shown that secondary school teachers find it hard to provide DI. Maulana et al. (2023) compared DI with other domains of effective teaching (learning climate, classroom management, clarity of instruction, activating teaching, and teaching learning strategies) and found that DI was often observed to be the lowest (i.e., most complex) in the case of the Netherlands, Indonesia, South Africa, and South Korea. This was only different in Pakistan (second lowest) and the United Kingdom (highest, i.e., least complex). Porta and Todd (2022) found that the secondary school teachers in their study of a school in Australia showed a willingness to provide DI in their lessons, but also mentioned challenges like having a lack of time for the implementation of DI or having too many students in one class making it harder to spend enough time with individual students. National research has found that Dutch teachers do not master all the skills needed for providing DI. As only 43% of secondary school teachers adapt their instruction (versus 65% of primary school teachers), and 41% of the teachers adapt assignments (versus 80% in primary education), this is especially true in secondary education (Inspectie van het Onderwijs, 2016).

A first explanation for why Dutch secondary school teachers provide less DI than their colleagues in primary education might be a difference in their initial teacher training. While 85% of beginning teachers in primary education indicated that they were sufficiently prepared for providing DI, this was the case for only 55% of beginning secondary school teachers (Inspectie van het Onderwijs, 2015a,b). Secondly, because secondary school teachers see many different students for only a couple of hours a week, they might find it harder than primary school teachers to know their students and their cognitive abilities and needs (van Casteren et al., 2017). And finally, the perceived need for DI may be lower for secondary school teachers, as Dutch secondary schools work with a system wherein students are tracked based on their cognitive abilities, which means that when starting secondary school (around the age of 12), students are assigned to either the pre-vocational, senior general, or pre-university track (EP-Nuffic, 2015; van Casteren et al., 2017). Students in the same track all take the same exam to graduate at the end of their secondary school period (Inspectie van het Onderwijs, 2016), which might lead to teachers believing they do not have to provide DI. This is unjustified, as identical graduation requirements within tracks does not mean that all students have to get there the same way, as tracked classes are more heterogeneous than is often assumed and students still have different achievement levels (Wilkinson and Penney, 2014). Hence, providing them all with the same learning goals, subject-matter content, and assignments may lead to students feeling not challenged, or not supported enough (Inspectie van het Onderwijs, 2019). To provide Dutch secondary school students with better learning opportunities, Dutch secondary school teachers are advised to implement high-quality DI in their lessons.

As mentioned earlier, however, providing DI is a complex teacher task. Hence, TPD to support teachers in the context of secondary education in mastering DI is necessary (Porta and Todd, 2022). To design such TPD, it is important to know what teachers should

be taught. Although research on DI in secondary education is growing, it is not yet known what teachers need to be able to do and know, to provide DI in secondary education. To gain insight into what providing high-quality DI requires from teachers, the current study aims to answer the following two research questions.

Research question 1: What skills are required from teachers in secondary education in order to provide DI?

Research question 2: What knowledge is required from teachers in secondary education in order to provide DI?

To answer research questions 1 and 2, the current study describes what expert teachers do to provide high-quality DI, what their reasoning behind their DI activities is, and what knowledge DI requires from teachers. It was chosen to study mathematics teachers specifically, so the results can be compared to the study of [van Geel et al. \(2019\)](#) which was focused on DI in mathematics lessons in primary education. In order to design professional development trajectories or to support teachers in their practice, factors related to the (perceived) complexity of providing DI will be identified. Hence, the third research question is:

Research question 3: What factors make providing DI in secondary education more or less complex?

## Method

As the required skills and knowledge for teachers to provide DI in secondary education were not yet known, a cognitive task analysis (CTA) was conducted in the current study, to identify, analyze, and structure both the skills and knowledge that experts (in our case, teachers who differentiate well) use while carrying out a complex task ([Clark, 2014](#)). The teachers observed in the study do not necessarily have to differentiate perfectly during the observations. The goal of the CTA is to identify patterns across the data gathered from a group of teachers competent in providing DI. Also, the results thereafter were discussed with content experts (e.g., researchers with expertise on DI, secondary school teacher trainers), to both validate and, if needed, add to the findings of the classroom observations. A CTA as a research method was chosen because this emphasizes practice, resulting in an overview of DI that is attainable for teachers which could provide a good base for future TPD design and to be able to compare findings in secondary education to those of [van Geel et al. \(2019\)](#) in primary education.

The steps followed for conducting the CTA stem from [Clark et al. \(2008\)](#) and are shown in [Table 1](#), as first presented in [van Geel et al. \(2019\)](#). The first step was aimed at acquiring a basic understanding of DI in secondary education. For that purpose, a literature review was combined with classroom observations followed by interviews, as explained in section 2.2 describing the data collection. The second step was to identify knowledge representations, in order to decide how to present the data gathered in steps 3 and 4. A skill hierarchy was chosen to present the skills necessary for providing DI. Underlying knowledge required to execute these skills and factors that influence the complexity of

TABLE 1 CTA activities in the present study.

CTA Steps according to <a href="#">Clark et al. (2008)</a>	Activity in this study	
Step 1: Gathering of information that is necessary for carrying out the CTA	a.	Literature review
	b.	Lesson observations to map out real-life tasks and class situations that require DI skills
Step 2: Identify knowledge representations	This was chosen based on 4C/ID <ul style="list-style-type: none"> <li>- Skill hierarchy</li> <li>- Overview of underlying required knowledge</li> <li>- List of complexity-related factors</li> </ul>	
Step 3: Use of elicitation methods	a.	Lesson observations followed by semi-structured interviews (cued recall)
	b.	Expert meeting with teachers
Step 4: Analyze/verify data acquired	a.	Iterative qualitative analysis of data from observations, interviews and expert meetings with expert teachers
	b.	Expert meeting with content experts
Step 5: Shaping the results for the intended end product	In a later study, the results will be used to design and develop a TPD program for DI.	

providing DI were listed. Step 3 concerned the use of elicitation methods to gather information from teachers on how they provide DI. This was done through lesson observations followed by semi-structured interviews (cued recall), which are the same activities as those in step 1 (i.e., the gathering of data for steps 1 and 3 was done simultaneously, for the most part). An expert meeting with teachers both verified and expanded on the information already gathered during the observations and interviews. In step 4, the data gathered thus far were analyzed and verified by the researchers. Subsequently, during a meeting with experts in DI and/or secondary mathematics (i.e., content experts), this analysis was verified. The fifth and final CTA step concerned shaping the gathered information so it can be used for what comes next, which in this case will be the design and development of a TPD intervention for DI based on the four-component instructional design (4C/ID) model of [van Merriënboer and Kirschner \(2013\)](#).

## Participants

For the lesson observations and expert meetings, 11 mathematics teachers who differentiate well and 10 content experts (mathematics or DI) were selected. In this section, the selection procedure and participants' characteristics are described.

### Expert teachers

This study involves cooperation between the University of Twente and a Dutch school board that governs about 50 secondary schools. School leaders, mathematics department heads, and other colleagues within said school board were asked to identify mathematics teachers who were above average at providing DI. This resulted in a group of 11 teachers with a wide variety of years of experience, the educational levels they teach and what years they



teach. More information about the participating mathematics teachers can be found in [Table 2](#).

## Content experts

After the expert meeting with teachers, an expert meeting for content experts with expertise on DI and/or secondary mathematics was organized (see step 4b in [Table 1](#)). These experts were recruited by the researchers via connections with the Teacher Development department at the University of Twente, searching on LinkedIn, and websites of educational advisory companies, in combination with the snowballing method in which participants were asked if they could suggest additional experts in DI. This resulted in a total of 10 content experts: three secondary teacher trainers, three researchers with a focus on DI, two educational consultants, one school inspector, and one secondary mathematics teacher.

## Data collection

Data collection started with lesson observations followed by semi-structured interviews (as described in step 3a in [Table 1](#)). After all observations and interviews had been conducted, the expert teacher meeting took place, as shown in step 3b. In step 4b, a meeting with content experts took place, during which the data gathered up to then were extended and verified. During all of these steps, the data were analyzed and re-analyzed in an iterative process in which each step started with data from the previous step as input.

## Lesson observations followed by an interview

To map out what skills are necessary to provide DI, expert teachers were observed for two consecutive lessons with the same class of students to analyze the coherence between the lessons and those lesson's goals. Permission for collecting data from both observations and interviews was granted by the ethical committee

of the University of Twente. Prior to data collection, students (or their parents, depending on the student's age) had to give active informed consent. The observed lessons were video recorded for eight of the 11 participants (three teachers did not want to be recorded for either personal or school organizational reasons, in which case the researcher took notes). Video recordings of the observed lessons were used only as input for the interviews.

Every observation was directly followed by a semi-structured interview, to gain insight into the reasoning of teachers when implementing DI. Additionally, more information was gathered about the necessary skills for providing DI, which are not visible in lesson observations. These interviews included three parts. The first part included questions about the teacher's background (e.g., years of teaching experience). In the second part, the researcher selected specific situations from the recordings or notes from the observations using an overview of classroom situations that (might) call on DI skills, based on [van Geel et al. \(2019\)](#) and [van de Grift et al. \(2011\)](#). The researcher then asked the teacher to elaborate on their in-class thoughts and reasoning during those classroom situations ([O'Brien, 1993](#)). The third and last part of the interview consisted of five lead questions followed by multiple follow-up questions. The first four lead questions concerned the four phases of DI according to [van Geel et al. \(2019\)](#). One of the phases, enacting a lesson, had mostly been discussed already during part two of the interview, and during this part, the interviewer asked (in Dutch) about any topics that were yet unclear, with questions such as "How do you adapt your instruction to the needs of the students?" or "To what extent do you give students responsibility for their learning and choices?" For the other three phases (preparing a lesson series, preparing a lesson, and evaluating a lesson), the interviewer asked what these phases entailed for them, what they did in those phases and whether each phase is important for providing DI. The fifth and final lead question related to the complexity of providing DI, including follow-up questions such as "In what kind of situations

TABLE 2 Characteristics of participating expert teachers.

Name <sup>1</sup>	Teaching experience (years)	Number of classes taught	Mean number of students per class	Educational level of observed class	Grade
Amy	3	5	29	Pre-vocational	7
Anna <sup>2</sup>	3	5	30	Pre-vocational/senior general	7
David	9	8	29	Senior general	10
Emily <sup>2</sup>	10	6	31	Pre-university	8
Jennifer <sup>2</sup>	18	5	29	Pre-vocational	9
Kelly <sup>2</sup>	25	2	27	Pre-university	9
Robert <sup>2</sup>	25	5	23	Pre-university	11
Sandra	16	3	25	Pre-university	12
Sharon <sup>2</sup>	10	9	28	Pre-university	10
Steven	3	7	29	Pre-university	7
Thomas	4	4	27	Pre-university	10

<sup>1</sup>All names are pseudonyms to preserve anonymity.

<sup>2</sup>Also participated in the expert meeting with teachers.

is providing DI easy or difficult, and why?” and “What do you think teachers need to provide DI well?”

### Meeting with expert teachers

After all classroom observations and interviews were conducted, all of the 11 expert teachers were invited to the expert teacher meeting to verify the outcomes from the observations and interviews. Six of the participating teachers (as indicated in Table 2) were able to join this meeting. The first goal of the meeting was to identify the complexity-related factors. The teachers were divided into two groups, with the assignment to describe five situations during lessons in which a teacher should use DI skills. Next, they had to order these situations from simple to more complex and discuss what makes the situations more or less complex. This resulted in a ranking of the factors that make implementing DI easier or harder, in their view. The outcomes from both groups were discussed with the entire group.

The second goal of the meeting was to map out the teacher's steps, actions, and decision points when differentiating and what knowledge it requires to do that. The teachers were asked to design a standard approach for how teachers ideally differentiate for each of the four phases (lesson series preparation, lesson preparation, teaching during the lesson, and lesson evaluation). This was followed by a plenary discussion, to synthesize all procedures into a single joint procedure. Further discussion concerned what a teacher's DI actions and decision points are, what knowledge a teacher needs for carrying out each of the steps, and when a teacher executes a step correctly. During this meeting, the research team guided the teachers by asking questions and requested examples or clarifications if necessary. The research team took notes and the meeting was recorded.

### Meeting with content experts

During this meeting, the results of the lesson observations, interviews, and the expert meeting with teachers (i.e., the preliminary skill hierarchy (see section 2.3 Data Analysis), the ranking of complexity-related factors, and overview of required knowledge) were presented to the content experts. The first goal was to reach consensus on the necessary skills for providing DI by presenting the already-collected data to participants in the study (i.e., member-checking; Stalmeijer et al., 2014). The second goal was to describe how the skills in the skill hierarchy should be carried out, to be used as a basis for performance objectives. The content experts first used the skills identified in the skill hierarchy to choose the top three most important skills for providing high-quality DI. Next, participants were divided into three groups, and each group was asked to draw up the criteria for one of the skills from the top three. They had to draft criteria for inadequate, adequate, and good performance for a particular DI skill. The identified performance level descriptors do not contribute to answering the current research questions, and will therefore not be included in the results section of this paper. Notes were taken during this meeting as well, and the meeting was recorded.

## Data analysis

The data for this cognitive analysis included the transcripts of the interviews (for which the recordings of the lesson

observations were used as input) and the notes and recordings from both expert meetings. First, the data from the interviews and the expert meeting with teachers were analyzed. Codes were assigned to the actions and the reasoning of teachers, the knowledge they used and the factors that make providing DI more or less complex. These codes were subsequently clustered into categories. The first four categories were the four phases of DI: the preparation of the lesson series, preparation of the lesson, teaching during the lesson and evaluation of the lesson (van Geel et al., 2019); the fifth category was the knowledge teachers required for providing DI, and the sixth category concerned the complexity-related factors. Next, the codes within each of the categories were grouped (e.g., a group called “monitoring” within the category “teaching during the lesson”). The first four categories (i.e., the four phases of DI) and the corresponding code groups were put in a draft skill hierarchy. For the fifth and sixth categories and their corresponding code groups, (i.e., “required knowledge” and “complexity-related factors”), detailed lists were created. Finally, the draft skill hierarchy and the draft lists of both the required knowledge and the complexity-related factors were discussed during the content expert meeting to both verify and expand them. In the next section, the outcomes will be presented in more detail.

## Results

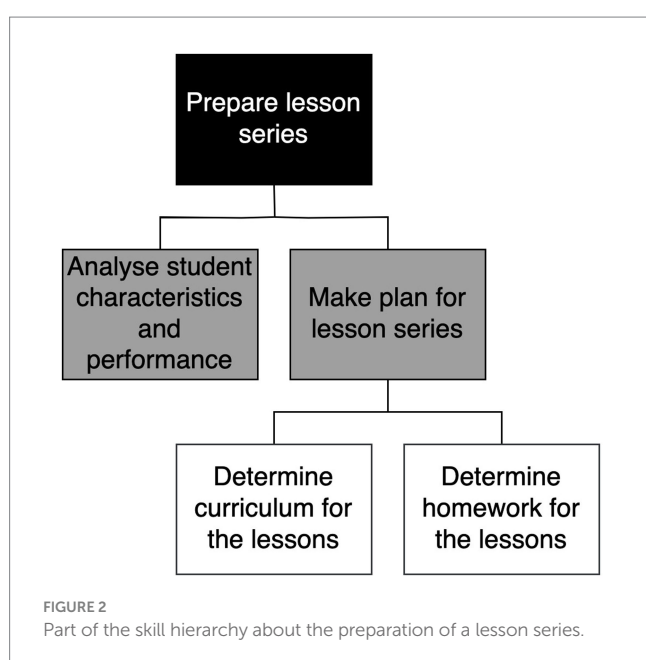
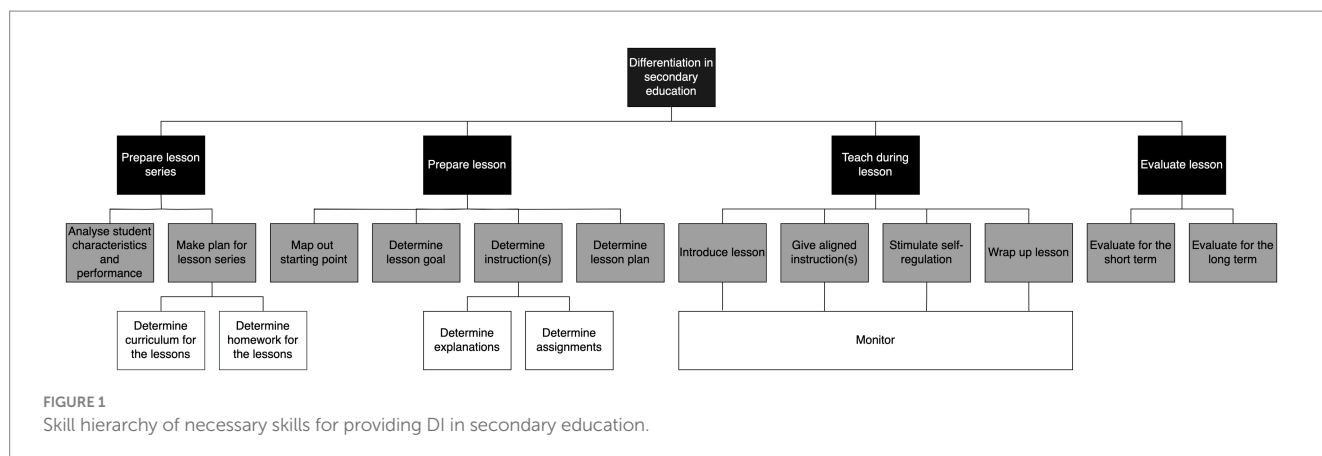
### Skill hierarchy

Our respondents confirmed that for DI in secondary education, the four closely interrelated phases (preparing a lesson series, preparing a lesson, teaching during the lesson, and evaluating a lesson) also play an important role. All of these phases can be decomposed into constituent skills (see Figure 1). The skills that are next to each other within a phase have a temporal relationship and can be carried out consecutively, simultaneously, or in random order. For the skills that have a vertical relationship, the lower skill is required or supplementary for the higher skill. This means that the performance of a higher skill or phase is only possible when a teacher enacts the skills identified below. Although some skills or phases may seem to be independent of the skills positioned below, for providing DI these underlying skills are deemed essential.

In the rest of this section, the constituent skills will be described per phase. For each of the skills, the number of teachers who were observed doing or who mentioned the skill will be stated. While most skills were used by all teachers, at least nine of the 11 teachers performed all the skills. An exception is ‘to determine the lesson goal’ during lesson preparation, which was mentioned by seven teachers. As the content experts emphasized the importance of this skill, it was decided to include this skill as well. In the rest of the paragraphs, examples will be given of how teachers enacted the specific skill.

### Preparing a lesson series

When preparing the lesson series (generally lasting 4 to 8 weeks), teachers lay the foundation for providing DI. In this phase, teachers



analyze student characteristics and performance and they make a plan for the lesson series, wherein they determine both the curriculum and the homework for the lessons. The relationships between the necessary skills are shown in [Figure 2](#).

In this study, all teachers analyze student characteristics and performance when preparing a lesson series for a class. Teachers analyze their students' achievement level and preferences to see whether students have achieved earlier stated learning goals or not. They do so by combining different resources including tests, observations, and information from colleagues.

One source of information is a previous or earlier lesson series with related goals, to paint a picture of where the students stand regarding the goals of the lessons in the upcoming lesson series. Because inadequate performance can have various causes (e.g., some students may have difficulties grasping a certain topic, while other students may have made a lot of mistakes in how they wrote down the solutions), teachers try to explain those performances by talking to students and observing student behavior. Teachers

analyze how well the students, in general, did on the test they took at the end of a previous lesson series by checking both the grades and whether there were any frequently made mistakes. They also map out what topics the students still find hard and take these as points of attention for (the planning of) the upcoming lesson series. Besides that, teachers look at the results and mistakes of those students who did not achieve the goals of the earlier lesson series, or who performed below expectations. Teachers have diagnostic conversations with students to analyze why the student performed differently from what was expected and to discuss with the student how both the student and the teacher can ensure they will do better next time.

Another source of information for the teachers are colleagues: other mathematics teachers within the school or teachers who teach different subjects to the same students. Teachers indicated that it is important to know the students themselves as well, and to combine the information from colleagues with their own experiences. When starting a new school year with classes with students they have never taught before, some expert teachers find it important to look at students' results from previous school years, while others find it important to get to know the students themselves without bias. The content experts agreed with the latter, stating that looking at students' data while not yet knowing the students themselves (well) could lead to a self-fulfilling prophecy; therefore, they advised being careful with it. There are, of course, exceptions where information should be shared between colleagues, for example, when a student has a visual impairment and should sit in the front of the class to see the teacher well.

Combining the information from all of the different available resources, teachers assess students' achievement levels. Especially for low-performing students, teachers check if they have mastered the earlier goals that are necessary for new, upcoming goals. The teachers specified that they find it important to know upfront whether the students have sufficient prerequisite knowledge, because if they do not, the teachers can take this into account in their planning. Teachers deem it important to know what part/topic (of mathematics) high-performing students are good at. Teachers keep in mind that those students might not need as much instruction for that subject, and often give high-performing students more freedom in choosing what assignments to complete.

All teachers mentioned that they make a plan for a lesson series. They first need to consider the yearly timetable in which the subjects to be taught and exams and other summative tests are specified and established by all the teachers of the mathematics department. Although these timetables are drawn up for all grades, there is more room for flexibility in the lower grades, due to the absence of exams. In the plan for the lesson series, teachers develop a timetable for when to attend to what content and in how much time. A teacher might need to develop multiple timetables as they can differ for (groups of) students, depending on their individual learning needs. To develop a plan for a lesson series, teachers need to master two constituent skills: determining the subject matter for the lessons, and determining the homework for the lessons.

All teachers mentioned that they *determine the subject matter during their lesson series preparations*. Teachers start with checking what is scheduled in their planning for the whole year. They check what the subject and approach of the textbook are, what the learning goals for the students are, and, from experience and subject knowledge, what difficulties there might be. When teachers determine the subject matter for the lessons, they primarily stick to the textbook, but adapt it when they think something else would be more suitable for addressing the learning needs of the students. What is suitable for the student is determined based on experience from previous years, the analysis of student characteristics and performance, and lesson evaluations from a previous lesson series. For example, teachers might plan extra time to better explain a topic from the previous period that was still unclear or difficult for most students. This can result in different plans or activities for two classes from the same track and year, or even a different plan for a specific student.

Along with determining the subject matter, 10 teachers stated that at this point they *determine the homework* for the lessons, and the 11th teacher determines homework during lesson preparation. For homework, teachers primarily consider the assignments from the textbook. Most teachers make sure they have completed the assignments themselves first, which they might have already done in an earlier year. This, together with teaching experiences from earlier years, is used to judge what assignments the students should complete to reach the goal of every lesson. There is special attention for closing assignments at the end of a chapter in the textbook, which are used to measure whether the student understands the theory taught so far and has achieved the learning objectives of that chapter. Four of 11 of the teachers specify the homework for different levels during this phase. An example was a teacher who labels homework assignments as basic, extra practice and challenging. In this way, students are challenged at their own learning levels, and stimulated to self-regulate their learning. The subject matter and homework for each lesson that are decided upon make up the planning for the lesson series.

## Preparing a lesson

When preparing a lesson, the teacher extends the foundation laid when preparing the lesson series by mapping out their students' starting point and determining the goal of the lesson, instruction and lesson plan. For teachers to determine the instruction(s), they must determine what explanations and assignments are going to be used during the lesson. The necessary skills for lesson preparation are

depicted in [Figure 3](#) and will be further elaborated upon in the rest of this section.

All teachers look back at the previous lessons for the class to map out the starting point. The teachers' goal is to know about the students' prior knowledge and learning needs. Teachers look back at the evaluation of the previous lesson to check whether the learning material was transmitted as planned and whether there were any problems. For example, there might still be a lot of questions, and students could experience difficulty grasping the theory. Teachers also check on for whom this was the case. They map out the starting situation so that they can take this into account during the rest of the lesson preparation.

Along with this, seven teachers determine the goal of the lesson, which is the second constituent lesson preparation skill. The content experts emphasized that it is very important to determine the goal of the lesson when providing DI, and that the goal should be connected to the bigger picture of what the class has already discussed and what are they working toward. Teachers decide what they want the students to be able to do or to understand at the end of the lesson. For example: "you can use quadratic formulas in contextual sums" or "you know the difference between a quadratic and a linear formula." To formulate the lesson's goal, teachers look at what is scheduled in the curriculum and they take into account the mapped-out starting point. In addition to determining the goal of the lesson for the group as a whole, some teachers also formulate additional goals for specific students or groups of students.

All teachers determine instruction(s) when preparing a lesson. To do this, all teachers first *determine the explanations*. Teachers think about how they will explain the theory in order to achieve the lesson's goal. They check whether the explanation in the textbook or a PowerPoint used earlier are suitable, where problems might arise (e.g., parts that might provoke a lot of questions from students) based on experience from previous years, and whether or not they want to use specific materials or software for the explanation, for example, to visualize something. However, teachers also take into account the mapped-out starting point and learning needs of this specific class of students. Based on this, teachers decide what they want to demonstrate, whether they can explain the theory differently, or whether they need to prepare extra explanations. Content experts mentioned that teachers should be able to think of alternatives for their explanation of the subject matter, in case it becomes clear during the lesson that the planned explanation does not work for everyone. When deciding on the explanations, teachers often decide what they want to explain to the whole group and how. They might decide that there are students who do not need any explanation at all (i.e., high-performing students who can immediately start completing assignments on their own), and might prepare additional explanations for students who generally find mathematics difficult or have trouble with a certain goal. Based on the analysis of student characteristics and performance during the lesson preparation and/or the evaluation of earlier lessons, the teachers identify which student(s) need these additional explanations. Finally, content experts indicated that it is important when preparing a lesson that teachers think about how they want to attend to the needs of both the low- and high-performing students.

Along with determining the explanations, all teachers *determine the assignments* for students, to practice with the new theory and



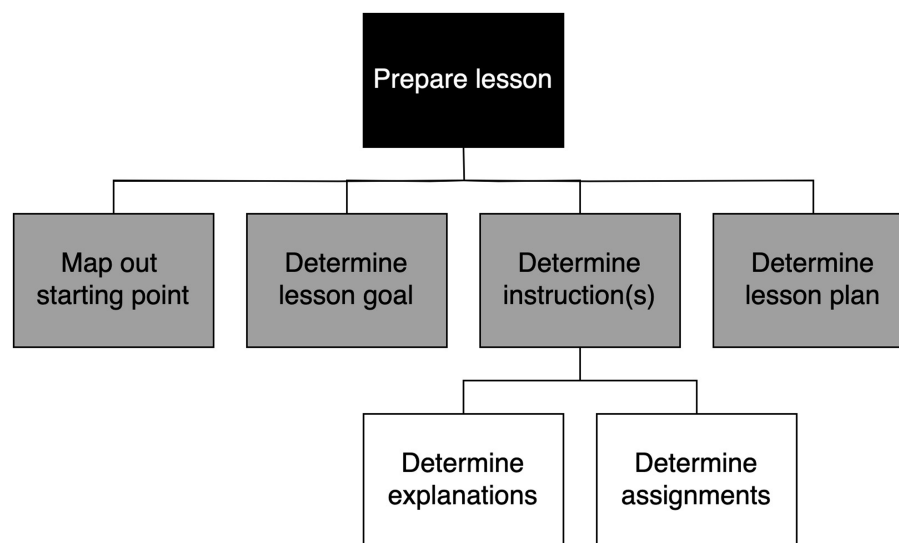


FIGURE 3  
Part of the skill hierarchy about preparing a lesson.

check whether or not the students understand it. These can be assignments from the textbook, from the internet, or self-made, and can be traditional paper-and-pencil written assignments, some form of a game, practicum, or another kind of assignment. To adapt these assignments to the differing learning levels of students, teachers might choose two or multiple assignments that vary in complexity and let students choose which one they will do, for example. Another way of differentiating assignments is to offer a harder, more complex assignment as an option for high-performing students, which the content experts identified as important. Textbooks often already include “learning paths” (i.e., a path from starting goals, through intermediate goals, toward the final learning goal) for students of different levels (e.g., a learning path with more complex assignments for high-performing students). Teachers said that they use the learning paths from the textbook when they think they are appropriate but also that they design learning paths and combinations of assignments themselves when they believe the ones the textbook offers are not suited to their students’ learning needs. The more challenging assignments are given instead of, and not along with, the regular assignments. Moreover, teachers sometimes decide upfront what assignment they would like to work on during extended instruction (i.e., longer instruction with more explanations and practice together with the teacher) with the students who need it. Content experts argued that it is important that the teacher deliberately chooses assignments that suit the initial situation and learning needs of the students.

The explanations and assignments together make up the instruction. The teachers decide what they want to do and how they want to do this. For the teachers, instruction thus means not only the explanation of subject matter, but also the use of learning activities and assignments during the lesson, with the aim being for the students to reach the goal of the lesson.

Finally, during lesson preparation, the teachers determine the lesson plan. This was done by nine of the teachers. Teachers decide what they are going to do, for how long, what they will do with the whole class, and what is obligatory for all, or only for a

specific group of students. This is also where teachers decide if and when they want to discuss the homework from the previous lesson. Teachers also indicated that they find it important to make time during the lesson for any individual questions students may have.

### Teaching during a lesson

When teaching a lesson, teachers make use of four constituent skills. A teacher starts by introducing the lesson. Next, teachers give instruction(s) aligned to the learning needs of the students, while simultaneously stimulating the students’ self-regulation. This phase ends with teachers wrapping up the lesson. As can be seen in [Figure 4](#), these four skills have one shared constituent skill, which is monitoring. The rest of this section will further elaborate on all the necessary skills for the third phase.

*Monitoring* is an important underlying skill for all constituent skills in this phase. All teachers in the CTA continually monitored the progress and understanding of their students with regard to the goal of the lesson, using various strategies. What monitoring looks like for each of the skills in this phase will be detailed in the description of the skill itself.

This phase starts by introducing the lesson. All teachers explain the subject of the lesson and four teachers explicitly pay attention to the goal of the lesson. It was stressed by the content experts that introducing and explaining the goal of the lesson is very important. They encouraged teachers to explain what the students will learn, why that content is important and what it will yield for the students. Teachers also often state what the schedule for the lesson is going to be and what is compulsory for all or only for specific students.

When introducing the lesson, teachers check what the prior knowledge of the students is, for example, through discussing homework, asking and answering questions, or whole-class discussion of an assignment. In this way, the teacher not only monitors but also activates students’ prior knowledge, so that students can relate the new lesson material to what they have already learned.



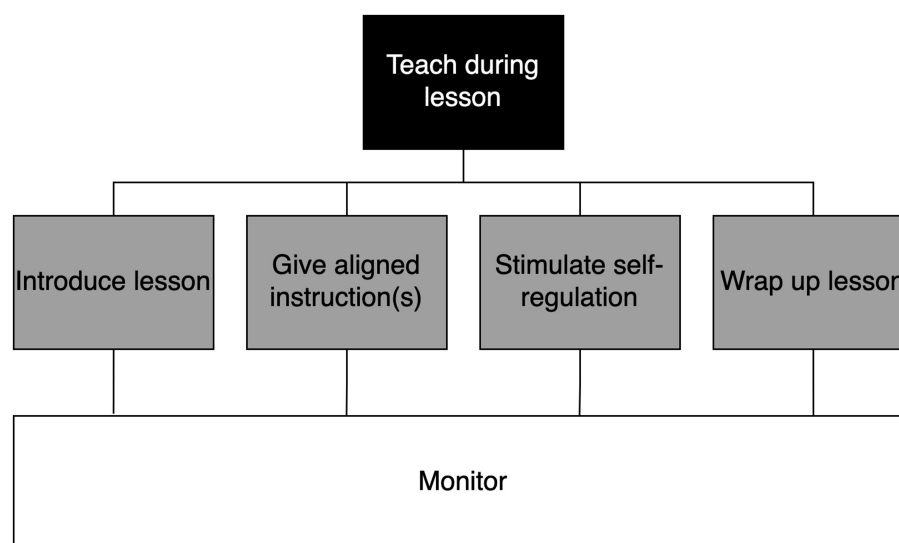


FIGURE 4

Part of the skill hierarchy about teaching during a lesson.

All teachers provide adapted instruction(s). According to content experts, this is the most crucial constituent skill for providing DI. Instruction includes explanations, assignments, and all other instruments to help students achieve the goal of the lesson. Teachers adapt this instruction to the learning needs of their students, based on their constant monitoring. For example, when teachers notice that there are many similar questions, they might choose to give an extra explanation to a selected group of students or even the class as a whole. The content experts indicated that a teacher should give all students guidance that is adapted to their learning needs.

The observed lessons frequently followed the same pattern. After introducing the lesson, teachers started with general class instruction about that lesson's theory. Teachers specified that they try to keep the general class instruction short to ensure that it is not too long for the students who do not need it. Some teachers give high-performing students the choice of whether or not to follow this instruction or to work independently. After this general class instruction, teachers in the observed lessons often gave extended instruction to students who had not fully grasped the subject matter yet. The goal is to make sure all students reach the goal. Depending on the number of participating students, teachers choose to do this in front of the class or in a small group. Teachers often do an assignment together with the students to provide guided practice, but they can also give more elaborate explanations using simpler words or visualizations.

Three teachers mentioned that they offer a more in-depth explanation to explain underlying theories or a higher-level assignment to challenge the students. Sometimes students may choose which one they prefer to do and other times the teacher decides what is most suitable based on what they have seen in their monitoring. High-performing students can work on these instead of following the general class instruction or can start after the instruction. During the meeting with content experts, it was specified that a teacher has

provided adapted instruction well when students at all levels feel challenged.

Stimulating students' self-regulation is a skill that all teachers mentioned. Teachers involve students during the lesson by giving them responsibility for their learning process. They can do this, for example, by giving them the choice to not to follow the general class instruction and/or extended instruction, or by giving choices about what assignments to do as their homework. Teachers stimulate self-regulation by helping students to form an image of where they stand in the learning process and what they still need to do to attain the goal of the lesson. For example, teachers can indicate that if students find a certain assignment hard to do, they should do more practice using an easier version of that assignment. When stimulating students' self-regulation, teachers take on the role of a coach, continually monitoring whether the students are making the right choices by asking the students questions about their learning process.

Wrapping up the lesson was identified as constituent skill based on observations and explanations of ten teachers. The teachers in the expert meeting stated that this should be part of every lesson. In practice, teachers were sometimes still answering questions in class, which left them with no time to explicitly wrap up the lesson. When teachers do wrap up the lesson, they do so by discussing a difficult assignment, giving an extra tip, taking stock of any unanswered questions, and/or mentioning the homework, based on their monitoring during the lesson. While teachers look back at the lesson, they often summarize how the lesson went, how the work ethic of the students was, and by asking students their opinion about the lesson. Content experts found it important that teachers check during the wrap-up whether or not the goal of the lesson has been achieved. Teachers do so by asking the students questions about the lesson or by giving an assignment to check if the students can put into practice what they have learned.

## Evaluating a lesson

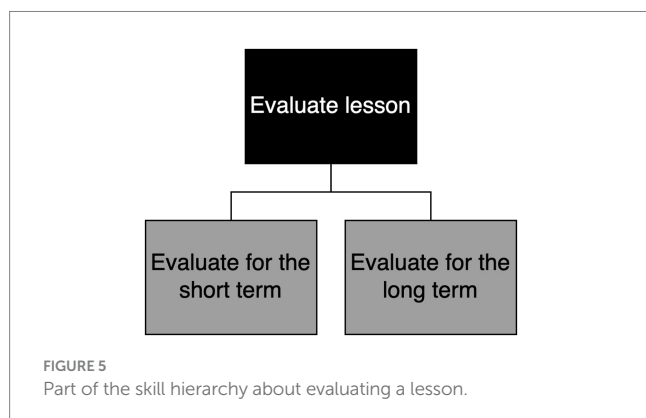
After the lesson, teachers look back at the lesson, which, as can be seen in [Figure 5](#), consists of evaluating for the short term as well as for the long term.

All teachers evaluate for the short term. Teachers reflect on how the lesson went, what kind of questions were asked, and whether or not all students achieved the goal of the lesson. First of all, the teacher evaluates the group of students who received the lesson. A teacher might find out that the explanation during the extended instruction was too hard for some of the low-performing students. Teachers think about what they can do differently in the next lesson so the students can learn the content and achieve the goal of the lesson. Some teachers make notes of this, while others think about it and take it into account when preparing the next lesson. Content experts stressed that it is important that the teacher not only looks at the class as a whole, but also zooms in on individual students. Second, teachers can evaluate a group or groups of students who are going to experience the same lesson, namely, a parallel class. If this lesson did not go the way the teacher planned, they might change some things so that the parallel class will not run into the same problems and will achieve the goal of the lesson, while the first group of students maybe did not.

Along with evaluating for the short term, all teachers also evaluate for the long term. They reflect on what they could do differently next school year. Teachers do not just look at one lesson, but evaluate multiple lessons at once, or even all lessons within a lesson series. For example, when teachers notice that they are going through the subject matter too quickly, they take this into account when preparing the lesson series in the next school year. They can make notes in their curriculum material manual and plan to take more time for this topic. Furthermore, all teachers check how well the explanation of the subject matter worked; if it did not work very well, they will consider changing things for next year. The teachers often make notes about this in their own textbook.

## Required underlying knowledge

To provide DI by deploying all of the constituent skills, teachers also need specific knowledge. In this CTA, three types of knowledge emerged: knowledge about students, general didactic-pedagogical knowledge, and subject-matter knowledge.



All teachers indicated that it is important to have knowledge about the students. First, a teacher must know the level of all individual students per class. A teacher in secondary education sees a lot of different students per week, which makes it hard to always have all this knowledge about every specific student available. Getting to know the students takes time. Teachers mainly gather information by continually monitoring during the lessons. They acknowledged that it is important to know which students find mathematics hard, which students are good at math, and which students are in between those two groups. It is also important that a teacher knows how motivated and independent students are.

Next, teachers need to have general didactic-pedagogical knowledge: knowledge about how students learn and what activities can help them learn, which teachers mostly gather when monitoring during a lesson. Teachers use this knowledge, for example, to decide how they can help an insecure student or a student who is good at math.

Finally, teachers need subject-matter knowledge: pedagogical content knowledge (PCK) for math, knowledge of the curriculum, and knowledge of the learning path. PCK is important for knowing how to explain math subject-matter content. Knowledge about the learning path is important so a teacher can take a step back or a step forward. In this way, a teacher can respond to the needs of low- and high-performing students. Knowledge of the curriculum relates to knowledge of the textbook and the assignments in the textbook. With this knowledge, teachers can use and explain subject-matter content well in the class.

## Complexity-related factors

In the CTA, various factors were identified that influence the complexity of providing DI in secondary education. Multiple class characteristics influence the complexity (see [Table 3](#)), for instance, having a bigger class size with more students makes it harder to know the learning needs of every individual student. School organization also matters as having little preparation time makes it hard to plan explanations for different learning levels. A higher information richness, i.e., if the teacher has access to good information about their students' achievement level makes providing DI easier. Finally, if the curriculum supports DI by offering the teachers assignments and/or explanations at different levels, providing DI is easier than if the teacher has to determine assignments/explanations on various levels by themselves. How complex it is for a teacher to provide DI depends on a combination of all of the complexity-related factors, which can be found in [Table 3](#).

## Discussion and conclusion

DI refers to how teachers adapt their instruction to the continually monitored needs of all learners ([van Geel et al., 2019](#)). At the start of this study, it was unknown what teacher behaviors and knowledge are necessary for DI in secondary education and whether they are similar to what providing DI in primary education requires. This research has filled that gap by investigating the actions and reasoning of DI experts when providing DI, together with what knowledge teachers need for providing DI and what factors make providing DI more or less

TABLE 3 Factors influencing the complexity of DI.

Factor	Aspect	Explanation
Characteristics of a class	Class size	Teachers indicated that they find providing DI easier when the class size is smaller, as that makes it easier to have an overview of their students.
	Variation in student levels	The higher the difference between and variation within the groups of low- and high-performing students, the harder it is to differentiate. Teachers then must consider many and very different levels.
	Classroom ambience	When the ambience in a class is not good, that asks for a lot of the teacher's attention, which makes it harder to differentiate. When the ambience is good, students will feel more comfortable answering and asking questions, providing more information for the teacher.
	Class attitude	If (a large part of) the students do not work independently when they should, providing DI is harder.
School organization	Preparation time	Teachers mentioned often that they do not have much time to prepare a lesson. This makes it harder for them to think upfront about how they would like to differentiate during the lesson.
	Number of activities	Teachers stated that their planning of activities within a year is very tight and that they do not have much room for revisiting topics from the previous period.
	Time spent with students	The more time a teacher spends with the same students, the easier it is to get to know them and to identify their educational needs.
	Lesson duration	When lessons last longer, there is more room to provide instruction in different ways and as such to respond to the varying needs of the students.
	Physical space in classrooms	If there is more space, a teacher can use a table for instruction and sit apart with a smaller group of students. If a classroom is quite full, this is harder.
Data regarding student achievement	Information richness	Teachers gather information about students' progress by monitoring during lessons and in (summative) tests they administer. Having the right information gives more insight into the students' learning needs, which makes it easier to differentiate.
Support from the curriculum	Assignments at different levels	If the textbook has differentiated assignments according to different levels, it is easier for a teacher to align the assignments to the varying needs of the students.

complex. This has been done through a CTA, where providing DI in a real-world context was studied through lesson observations, interviews with teachers, and expert meetings.

The rest of this section is divided into two parts. The first part addresses the three research questions: (1) "What skills are required from teachers in secondary education to provide DI?," (2) "What knowledge is required from teachers in secondary education to provide DI?," and (3) "What factors make providing DI in secondary education more or less complex?." The second part of this section compares the required teacher knowledge and skills for providing DI between the contexts of primary and secondary education.

## What does providing DI require from teachers in secondary education?

This study showed that four phases are important for providing DI in secondary education, in which teachers use various skills and different types of knowledge, and that a number of factors influence the complexity of DI. Furthermore, the in-depth interviews revealed that the quality of DI depends on the deliberate adaptations a teacher makes, based on their knowledge.

In the first phase, preparation of a lesson series, teachers lay the foundation for providing DI. Teachers analyze student characteristics and performance, to add to their already-existing knowledge about their students. They use their subject-matter knowledge to make a

plan for the lesson series, determining both the curriculum and the homework. Curriculum material can support teachers in preparing for DI in a lesson series; for example, it is easier to determine assignments at varying levels when the textbook material already provides assignments for different achievement levels.

In the second phase, lesson preparation, teachers map out the students' starting point. Teachers determine the goal of the lesson and the lesson plan, and prepare the required instruction(s), for which they use their didactic-pedagogical knowledge to determine both explanations and assignments so as to ensure that their students can reach the goals.

Teaching during the lesson is the third phase. Teachers introduce the lesson, provide instruction(s) aligned to the learning needs of the students and stimulate the students' self-regulation. Finally, they wrap up the lesson. During the lesson as a whole, teachers monitor the progress and understanding of their students, and continually expand and refine their knowledge about students. Providing DI during the lesson is more complex when lessons are shorter, as that leaves less time to provide a variety of types of instruction to attend to all students' learning needs. Enough physical space in classrooms enables teachers to sit apart with a smaller group of students, which is experienced as helpful for DI.

In the fourth and final phase, evaluating a lesson, teachers evaluate whether or not students have reached the goal of the lesson in the short term. Teachers also evaluate for the long term, where they consider if they could do anything differently in the next school year,

such as changing the order of topics in the curriculum/learning path, using other activities that help students to learn better, or planning more time for a certain topic.

In the theoretical framework it was mentioned that for high-quality DI teachers should adapt their instruction deliberately and proactively (Tomlinson et al., 2003; van Geel et al., 2019). It is thus not surprising that lesson (series) preparation and lesson evaluation were deemed important phases for providing DI in the current study. This is in line with the findings of Smale-Jacobse et al. (2019), who argue that providing DI during the lesson cannot be separated from lesson preparation (e.g., state clear goals and plan instructions) and lesson evaluation (e.g., evaluate students' progress toward the lesson goals). To provide DI, various strategies can be used, such as ability grouping or making use of a computerized system to support DI (Deunk et al., 2015, 2018). In the current study, teachers often chose ability grouping (as providing for example extended instruction was part of a common lesson), the use of computerized systems to support teachers in providing DI was not mentioned.

From the CTA it appeared that the core skill for providing DI is continually monitoring students' learning and progress. In all phases, teachers identify their students' learning level. This goes from analyzing performance in the preparation for the lesson series and mapping out starting points in the lesson preparation, to observing students' expressions and behavior, asking them questions and checking their work during the lesson. In their evaluation, teachers monitor to what extent each student reached the goal of the lesson. Continual monitoring contributes to teachers' knowledge about their students. Smale-Jacobse et al. (2019) too found that continuous monitoring is inseparable from DI. Students only learn if their assignments are neither too easy or too difficult for them and if they work in their zone of proximal development (Vygotsky, 1978; Joseph et al., 2013). Teachers need the knowledge they gather through continually monitoring students' progress for providing DI: teachers can only provide instruction that is suited to the learning needs of their students if they have thoroughly identified those learning needs.

## How does providing DI in secondary education compare to primary education?

As not much was yet known about the teacher skills and knowledge required for providing DI, van Geel et al. (2019) conducted a CTA in primary education in mathematics classes. By conducting a CTA in secondary mathematics education, the current study enables us to compare the required knowledge and skills in these two educational sectors. In general, although the contexts are quite different (e.g., teachers in primary education have only one class of students, while the teachers in secondary education in this study had an average of 5 classes of students), we have identified many similarities in the phases and required knowledge and skills necessary for providing DI. In the subsequent paragraphs, we will elaborate on the similarities and differences between DI in primary and secondary education.

Providing DI in secondary education happens in the same four interrelated phases as were found in primary education (van Geel et al., 2019). Teachers in both primary and secondary education start with preparing a coherent set of lessons, which is called a lesson period (primary education) or lesson series (secondary education). Next,

teachers zoom in and prepare a single lesson. This is followed by teaching the lesson itself. Finally, teachers evaluate how the lesson went and if they need to adapt anything in the future. Although the constituent skills required for DI in the various phases are also rather similar, some differences can be identified, too. For example, in the preparation of the lesson period in the CTA by van Geel et al. (2019), the determination of subject matter and homework are not explicitly mentioned, but creating groups within the class and determining goals are. The last is also mentioned in the CTA for DI in secondary education, but during the preparation of the lesson, not the lesson series. Another example is monitoring, which is a constituent skill for "giving adapted instruction(s)" in the CTA by van Geel et al. (2019). While this is true for the CTA in the current study as well, 'monitoring' here is a constituent skill for the phase of teaching during a lesson as a whole. It can be concluded that although the focus is slightly different or the skill is used in a different phase, providing DI in primary and secondary education generally makes use of the same phases and skills.

What knowledge is necessary for providing DI is also mostly similar between primary and secondary education. For secondary education, three types of knowledge were found: knowledge about students, subject-matter knowledge, and didactic-pedagogical knowledge. Although the last type of knowledge was not explicitly mentioned in the study by van Geel et al. (2019), they did mention that primary school teachers need to know, for example, what kind of problem-solving strategies the students will understand, which is an example of didactic-pedagogical knowledge.

Regarding the complexity-related factors, in both primary and secondary education the composition of the group, school support, and available data on the students' progress were mentioned (van Geel et al., 2019). A difference is that van Geel et al. (2019) mentioned "the content of the lesson" explicitly as a factor influencing the complexity of providing DI.

In sum, the current study confirms the findings of van Geel et al. (2019) in an additional context, as the data gathered through CTAs in both primary and secondary education led to mostly similar results, which means that providing DI in both contexts requires approximately the same skills and knowledge and is made more or less complex by mostly the same factors.

## Limitations and suggestions for future research

Although we studied teachers who are considered to be above average in terms of DI skills (within a Dutch school board) and we looked for patterns across this group (which led to a stable pattern), we cannot guarantee that the 11 participating teachers are the best in the country at providing DI in secondary education. In this study, content experts proved more normative and sometimes more ambitious than the observed teachers. However, the common patterns led to the skill hierarchy, knowledge types overview, and complexity-related factors, which we think are a good basis for the development of a professional development trajectory, as they emerge from school practice and therefore should have high feasibility. On the other side, although the current study provides rich insight into the constituent skills in the four phases, each skill in itself could be analyzed in more detail in order to obtain an even better understanding of how teachers exactly enact these skills and which underlying knowledge and skills are required.



All expert teachers worked for the same large school board, which only has schools in the Netherlands. For a future study, the results could be verified in a broader context, such as teachers of a different Dutch secondary school board or even secondary schools in other countries. As all teachers were mathematics teachers, the results of this study cannot be generalized to teachers teaching other subjects. Hence, it would be interesting to verify the results with teachers of other subject domains, such as other STEM (e.g., physics or chemistry) subjects or languages (e.g., English or French). All participating teachers taught classes that were mostly theoretical. For a future study, it would be interesting to see if teachers who teach more practical lessons (e.g., in vocational education) use the same knowledge and skills for providing DI as the teachers in the current study. Furthermore, since the factors related to complexity (as described in Table 3) cannot be influenced by individual teachers, more research is needed into how to support DI at school or even at the system level.

## Practical implications

In secondary education in the Netherlands, teachers do not yet implement DI in their lessons very often and often do not feel equipped for it (Inspectie van het Onderwijs, 2015a; van Casteren et al., 2017). Providing DI is a complex skill, and pre-service as well as in-service teacher education could give teachers more support to be equipped for providing DI. This study has mapped out what skills and knowledge are required for teachers to provide DI, which can be used to design such TPD. In addition, complexity-related factors were investigated that can be used to manipulate situations to create scaffolding for the complexity. In this way, situations where providing DI is less challenging can be created wherein teachers can gradually develop the required skills. As we found several complexity-related factors at the school level, school leaders can play an important role in facilitating the complex task of DI for their teachers, for example, by providing them with more preparation time, or smaller class sizes.

As mentioned in the introduction, secondary school teachers do not yet provide much DI. Nevertheless, the current study shows that providing DI in secondary education can be achieved, as the data are based on practice. Hence, TPD based on insights from the current study could help teachers to provide (better) DI. Although providing high-quality DI is not something that happens very often yet (Inspectie van het Onderwijs, 2015a), the data obtained from experts in this research are inspiring and prove that it is possible.

## Data availability statement

The datasets presented in this article are not readily available because the data include video observations and recorded interviews

that are not anonymized. Requests to access the datasets should be directed to [k.meutstege@utwente.nl](mailto:k.meutstege@utwente.nl).

## Ethics statement

The studies involving humans were approved by the Ethical committee of the University of Twente. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

MV, MG, and AV contributed to the design of the study. MV contributed to data collection. MV and KM performed the analysis of the data and wrote sections of the manuscript. All authors contributed to manuscript revision, read, 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.

The reviewer EK declared a past co-authorship with the authors MG to the handling Editor.

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