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Lifelong Learning and Metacognition in the Assessment of Pre-service Teachers in Practice-Based Teacher Education

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Initial teacher education should prepare pre-service teachers to develop effective teaching and lifelong learning tendencies. This study aimed to identify the component to consider in pre-service teachers' assessment processes that promote lifelong learning and develop metacognition skills. For this, it analyzed how the planned and implemented actions by the teacher educators in Practice-based Teacher Education programs promoted metacognition and lifelong learning in the pre-service teachers. The method was a mixed explanatory sequential design. Quantitative and qualitative instruments were applied. Information was obtained from the learning and assessment resources (72 syllabi and 14 assessment tasks) and pre-service teachers' opinions (survey: n = 231, interviews: n = 8). The findings identified three main components: (i) authentic and relevant assessment tasks, (ii) prior communication of instructions and evaluation criteria, and (iii) frequent performance-focused feedback from peers and teacher educators during and at the end of assignments. The study results can be valuable in teacher education programs to strengthen assessment processes, promote lifelong learning tendencies, and develop metacognitive skills among the teachers in training.

Keywords: teacher education, higher education, assessment task, educational innovation, practice-based, complexity

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INTRODUCTION

Preparing the new generations for success in the knowledge society is a worldwide challenge. Many countries have come to understand the fundamental importance of effective teaching, which requires well-prepared teachers. Thus, the United Nations published its declaration in Organización de Naciones Unidas (2015), "Transforming our World: The United Nations 2030 Agenda for Sustainable Development," which approved one of its Sustainable Development Goals to guarantee inclusive and equitable quality education and promote lifelong learning opportunities for all. Goals were set for the quality of teaching and the availability of qualified teachers. Thus, quality education for all children and young people and the training of competent teachers are priorities to advance sustainable development in the world in the coming years.

Adapting to a changing world and an uncertain future requires rethinking the future school's role and the profile that teachers of the 21st century should have. The skills needed to function between now and 2025 are analytical thinking and innovation, active learning and learning strategies, complex problem solving, critical thinking and creativity (World Economic Forum, 2020). Teachers must ensure that they themselves and all their students have developed the necessary skills to continue learning and adapt to new situations (Sanz-Ponce and González-Bertolín, 2018). Therefore, teacher trainers must prepare teachers to learn and acquire new skills and knowledge throughout their professional lives (Hahl and Mikulec, 2018), in particular, active learning. For active learning, learners must know how to learn autonomously and permanently. This implies thinking and being aware of how they learn, a metacognitive component (Griffith, 2017; Kallio et al., 2018). The metacognitive skills of planning, monitoring, and evaluation are necessary for this competence (Mutambuki et al., 2020). At the same time, active learning has an attitudinal component because the willingness to learn is associated with lifelong learning (Berkhout et al., 2018; Schwartz et al., 2018). Lifelong learning tendencies are curiosity, motivation, perseverance and self-regulation (Solmaz and Aydin, 2016). Besides having teaching competencies, teachers must use their thinking to learn, understanding themselves as learners throughout their lives (Kallio et al., 2018). In addition, they must be change managers, analyzing their practices to introduce relevant improvements, continuously advancing as professionals (Ramírez-Montoya et al., 2021). In short, expert teachers are required in teaching practice who, simultaneously, are excellent learners.

Metacognitive Skills and Lifelong Learning Tendencies

Metacognitive thinking is necessary to continue learning and adapting to new situations. According to Binkley et al. (2012), metacognition is a required skill for the 21st century, and learning is recognized as contributing to social justice, sustainable development, and global citizenship (UNESCO, 2019). Metacognition refers to individuals' awareness, judgments, and beliefs about their cognitive potential and the conscious acts of cognitive operations (Flavell, 1976; Zohar and Barzilai, 2013; Yerdelen-Damar et al., 2015). According to Burón (1996), metacognitive maturity implies knowing what one wants to achieve and how to achieve it. Understanding this distinction between metacognitive knowledge and metacognitive skills (Barzilai and Zohar, 2014) prepares the shaping of metacognitive thought. Metacognitive skills refer to the steps to regulate and modify the progress of cognitive activity. It incorporates active planning, monitoring, and evaluation of processes during the execution of a cognitive task (Yerdelen-Damar et al., 2015). These abilities make the individual more aware of the mental processes involved in the action.

The development of metacognitive skills in pre-service teachers is relevant because it prepares them to learn from their pedagogical actions, anticipate them, review their teaching while doing it, and reflect on the results and strategies applied. Being a profession that directly impacts the lives of others, the inclusion of these skills in initial teacher education programs becomes highly relevant. However, despite the recommendation that metacognition be a core component of teacher preparation (Duman, 2018; Halamish, 2018), teachers' programs and studies to promote metacognitive competencies are still scarce (Pino, 2019). Furthermore, the form and content of teaching that can effectively promote the development of metacognition in pre-service teachers have not been described (Kyriakides et al., 2020). In developing a learner, combining cognitive and attitudinal aspects is necessary.

The pre-service teacher faces multiple challenges during their training process and will continue to do so in the exercise of the profession. They will find themselves in unfamiliar cultural contexts that may challenge their understanding of the world, making it necessary to develop new dispositions, knowledge, and skills (Bennet and Moriarty, 2016). The willingness to learn continuously is one of the ten skills denominated for the 21st century (Binkley et al., 2012). The European Commission (2001) defined lifelong learning as any learning activity undertaken throughout life to improve knowledge, skills, and competencies with a personal, civic, social, or work perspective. Different authors and organizations have established components of lifelong learning. For instance, Solmaz and Aydin (2016) focused on four tendencies to develop in pre-service teachers: perseverance, motivation to learn, curiosity, and self-regulation. These four tendencies are attitudinal aspects that mobilize lifelong learning.

These dispositions are not innate and can be developed. The orientation toward lifelong learning must result from the learning experience (Solmaz and Aydin, 2016; Oates, 2019). Lifelong learning is usually associated with adult and workers' education (Şentürk and Duran, 2020). In fact, initiatives have recently emerged to study its role in teleworking (Bjursell et al., 2021) and the diversification of work (Shan et al., 2021). However, promoting lifelong learning is not only framed in continuing education and improvement of workers but also in initial training (Lauder, 2020). Its inclusion in training programs is recommended, especially for teachers, to encourage lifelong learning and promote this in their teaching (Halamish, 2018; Matsumoto-Royo et al., 2021a). Thus, educational institutions must critically review their training proposals (Ramírez-Montoya, 2021). Moreover, assessment practices in training programs can promote lifelong learning (Nguyen and Walker, 2016). However, there are few specific initiatives related to promoting lifelong learning in initial training at universities (Makarova et al., 2017). Thus, it is necessary to have evidence of the development of these tendencies in teacher education programs.

Practice-Based Teacher Education: Effective Teaching by Future Teachers

Practical training has traditionally been ascribed to experiences in the field, which in some programs takes place only at the end of the training journey. This occurs despite repeated calls to seek greater integration of theory and practice to improve the preparation of teachers (UNESCO and OREALC, 2014; Darling-Hammond, 2017; Montes and Ziegler, 2018). Practice-based

teacher education closely links theory and practice and offers pre-service teachers opportunities to learn teaching practices and promote student learning (Zeichner and Peña-Sandoval, 2015), especially in courses taught on campus (Jenset et al., 2018; Canrinus et al., 2019a; Dalinger et al., 2020). The courses is characterized by considering fundamental teaching practices that correspond to essential pedagogical skills (Dalinger et al., 2020). These practices have been called core practices (Grossman et al., 2009). Core practices include general and content-specific practices. They consist of strategies, routines, and actions that teachers can unpack and learn (Core Practices Consortium, 2020). Pre-service teachers learn these through systematic approaches to teaching practices that focus on learning the work of teaching (Jenset et al., 2018). Thus, relevant methodologies have been established for this training.

Practice learning conditions need practice opportunities. Examples of practice opportunities are planning for teaching (Jenset, 2017), practicing or rehearsing the teacher's role (Amador, 2017), reviewing teaching models (Kloser et al., 2019), and taking the pupil's perspective (Canrinus et al., 2019b), among others. The practice opportunities are not topic-specific but contextualized in the school's educational reality (Jenset et al., 2018). For pre-service teachers to master teaching, practice opportunities should be frequent in the educational training, offering a rich repertoire of learning activities and assessment tasks from the beginning of the teacher preparation program. Including practice opportunities in learning activities allows pre-service teachers to gradually approach the complexity of teaching and achieve its mastery in protected spaces with expert accompaniment.

Assessment of Learning by Practices

A teacher training program that highlights pre-service teachers' experiential learning focuses the assessment of learning on relevant performances. The assessment tasks collect information on learning and they are consistent with the teaching methodologies of the practice (Arbaugh et al., 2015). The pre-service teachers perform activities that integrate core practices and discover the connections between theoretical learning and practical work (Virtanen et al., 2017), achieving coherence between what is taught and what is evaluated. The selection of assessment tasks is carried out considering their authenticity, contextual tasks conducted by pre-service teachers to bring them closer to the professional world (Gulikers et al., 2006; Ashford-Rowe et al., 2014). Thus, the more meaningful tasks allow pre-service teachers to relate theoretical ideas to everyday experiences. They then can integrate them into their own practice and teaching habits (Álvarez, 2017). The assessment tasks contribute to the professional training of the pre-service teacher.

Assessment processes also constitute instances of learning. For this, the previous information provided to the evaluated person must contribute to the student's autonomy and guide a correct practice (DeMink-Carthew et al., 2017; López-Pastor and Sicilia-Camacho, 2017). Their understanding of the quality of their performance is essential. Their performance and the context of the evaluations should be discussed with the students (Adalberon, 2021; Glasserman Morales and Ruíz Ramírez, 2021). In experiential learning, many essential skills require hands-on training, supervised practice, and rigorous feedback (Grossman and Pupik Dean, 2019). Teacher educators must learn to provide feedback that provides pre-service teachers with information on their competencies, best practices, and what they need to improve (Allen and Wright, 2014; Richmond et al., 2019). Feedback is advantageous for pre-service teachers to enhance their learning (Pastore et al., 2019). It is provided by both teacher educators and pre-service-teacher peers, complemented by instances in which the pre-service teacher analyses their performance and reflects on their practice (Matsumoto-Royo and Ramírez-Montoya, 2021). Peer assessment and self-assessment of an individual's learning are equally important (Leko et al., 2015), encouraging the development of teaching skills and the knowledge of data collection in the classroom with the feedback of their future students (Snead and Freiberg, 2019). Thus, incorporating self-assessment and peer feedback processes offers opportunities to improve learning and develop pre-service-teacher teaching skills.

This study aimed to identify the components to consider in pre-service teachers' assessment processes that promote lifelong learning tendencies and metacognition skills. It analyzed how actions planned and implemented by the teacher educators in practice-based teacher education programs promote metacognition and lifelong learning in the pre-service teachers.

The research question was: What components that promote lifelong learning and metacognition should be considered in the pre-service teacher learning assessment processes?

Unlike other studies focusing on measuring metacognitive skills and lifelong learning tendencies in pre-service teachers, this study examines the conditions necessary to promote these in the learning assessment processes of pre-service teachers. It is a novel response to the need for highly effective and flexible teachers to face future challenges.

MATERIALS AND METHODS

Study Design

This is a sequential descriptive mixed-method study (Creswell, 2014). Quantitative data were collected in the first phase with the "Teaching and assessment strategies for pedagogical practice" instrument (Matsumoto-Royo and Ramírez-Montoya, 2020) and the "Metacognition and Lifelong Learning in the Teaching and Assessment of Future Teachers" questionnaire (Matsumoto-Royo et al., 2021b). Qualitative data were collected from assessment tasks observations and pre-service teachers' interviews in the second phase. This information was used to deepen quantitative results (Klassen et al., 2012).

Contextual Background

This study was performed in teacher education for early childhood, elementary, and secondary students offered by a private University in Chile. According to the National Education Council of Chile (CNED, 2021), the careers that train teachers in Chile had an enrollment that was more than 9.2% of the total enrollment in Chilean universities. The country has 509

teaching programs in public and private universities, fifty-nine per cent for secondary education, 18% for elementary education, 12% for early childhood, and 11% for special education (CNA, 2018). Most pre-service teachers are young people who have graduated from secondary education and have had to meet minimum score requirements in a national evaluation to apply. They are predominantly women, especially in early childhood, elementary and special education programs (Mizala et al., 2011; CNED, 2021). The teacher education programs offer undergraduate studies leading to a professional degree and a bachelor's degree. The typical duration of the programs is four to five years. One- or two-year secondary teacher programs are also offered for graduates.

During the last decade, a series of educational reforms were generated in Chile in various areas to ensure a quality education; a series of regulations and actions addressed deficiencies, among them, the poor integration of practical training in teacher education programs (OECD, 2018; Flores-Lueg and Turra-Díaz, 2019). The country has established compliance standards for the initial training of teachers in the universities that offer these programs. However, these do not specify the training model. Those are defined by each institution. The Universidad del Desarrollo is a private institution that implemented a practice-based curriculum in all its teacher education programs. The programs provide explicit opportunities to learn the pedagogical practice as a complete curriculum oriented and designed to prepare teachers to graduate with professional training (Universidad del Desarrollo, 2016). The programs promote the teaching of core practices in iterative cycles that involve the representation, decomposition, and approach to teaching, thus integrating theoretical and practical content.

Participants

The study analyzed resources designed by teacher educators and the pre-service teachers' opinions. In the quantitative phase, all the course syllabi created by teacher educators (total 72) were reviewed. All pre-service teachers enrolled in the teacher education programs of Universidad del Desarrollo during the year 2020 (total 231) were surveyed. Then, in the qualitative phase, the content of assessment tasks applied by the teacher educators (total 14) was investigated, and in-depth interviews were conducted with the pre-service teachers (total 8). **Tables 1**, **2** present the characteristics of the samples.

Data-Collection Procedures

To collect quantitative data, we reviewed the syllabi using the *Teaching and Assessment Strategies for Pedagogical Practice* instrument. The instrument is a checklist for collecting information about practice opportunity approaches in the teaching and assessments planned. In addition, we applied the *Metacognition and Lifelong Learning in the Teaching and Assessment of Future Teachers* questionnaire. Its validity and reliability (Cronbach's alpha 0.93) had been previously reported in the articles cited in section "Study design." The instrument uses a Likert scale to collect information about practice opportunities in the teaching and assessment, metacognitive skills, and lifelong learning planned. The survey was conducted online using the Qualtrics application.

After the quantitative data, we requested evidence of the highest frequency assessment tasks designed and applied by the teacher educators to collect qualitative data. The evidence included videos of the application of executable tasks and documentation of deliverable tasks (**Figure 1**). The observations considered assessment content, looking at three components: instruction, evaluation grid, and feedback. The performances of the pre-service teachers were not considered in these evaluations. The procedure makes it possible to collect information about practice approaches in the assessment. All deliverable task components were in written format. Oral speeches were transcribed for executable task evidence. The content of the texts was segmented by numbered lines. The interviews lasted 45–50 min and were conducted using an interview guideline to collect information on the training program assessments, which provided the pre-service teachers with practice opportunities and the development of metacognitive skills and lifelong learning training. Because of the pandemic and suspension of face-to-face classes, we had to conduct interviews using the Zoom video platform.

Data Analysis

We analyzed quantitative frequencies and percentages data to investigate the actions foreseen in the assessment tasks planned and implemented by the teacher educators. Cumulative frequencies were calculated for each program. Then, we reviewed text content lines for qualitative data, looking for unambiguous references; data were recorded in a double-entry

TABLE 1 | Syllabus and assessment tasks.

Program education level	Quan (Syllabus) *n* = 72	Qual (Assessment tasks) *n* = 14
Secondary	18	4
Elementary	30	5
Early childhood	24	5

TABLE 2 | Socio-demographic characteristics of the pre-service teachers.

		Quan *n* = 231	Qual *n* = 8
Gender	Woman	223	7
	Man	7	1
	Prefer not to answer	1	–
Age (years)	<20	14	2
	20–22	95	2
	23–25	90	2
	>25	32	2
Program	Early childhood	114	3
	Elementary	91	2
	Secondary	26	3
Years in program	1	43	2
	2	41	2
	3	55	2
	4	67	2
	Five or more	25	–

table (Leech and Onwuegbuzie, 2007). The constant comparative method was deductive and inductive (Glaser and Strauss, 1967). Previous categories (practice opportunities, metacognitive skills, and lifelong learning training) were derived from the characteristics of the studied phenomenon and the definitions found in the literature (Corbin and Strauss, 2008).

To investigate the relationship between planned actions in the study programs implemented by the teacher educators and the development of metacognition and lifelong learning perceived by the pre-service teachers, we performed structural equation modeling (SEM) with the quantitative data from the questionnaire. Then we did qualitative data analysis using a constant comparative method. The previous categories were derived from the definitions found in the literature regarding practice opportunities, metacognitive skills and lifelong learning tendencies. Using ATLAS.ti9, the fragmented texts were associated with codes. Each new segment was compared with previous codes, so similar segments were assigned to the same category (Leech and Onwuegbuzie, 2007). After this, the co-occurrences among the codes were explored, and each was revisited, revising the original texts. Data triangulation was performed to develop a more plausible interpretation of the findings (Creswell and Clark, 2017) to establish the components that promote lifelong learning and metacognition in the pre-service teacher learning assessment processes.

RESULTS

Syllabus

Regardless of the education level, the teacher educators in the three programs planned learning activities that offered practice opportunities (**Figure 2A**). These were present from the first semester of the programs, and their frequency varied throughout the training. In all three programs, practice opportunities doubled or tripled in the second half of the training and decreased in the last semester when the practicum was scheduled (**Figure 2B**). The latter was not noticeable in the secondary program because it lasts just 1 year, so the practicum is parallel with didactic or practice courses.

Regarding the planning frequency of each practice opportunity, the results were highly diverse (**Figure 3**). The practice opportunities most planned were *plan for teaching and teacher role* and *practice or rehearse teacher role*. The practice opportunities least planned were *take the pupils' perspective*, *analyze pupils' learning,* and *talk about field placement/student teaching experiences*.

The assessment tasks planned in the courses were deliverable (62%) and executable (38%). Within these two categories, subtypes were distinguished; the majority (with nearly 100 records) were teaching plans (deliverables) and simulations (executable; **Figure 4**).

Questionnaire

The data from the questionnaire show that the model in which the Practice opportunities dimension is a predictor of the Metacognitive skills and Lifelong learning tendencies dimensions presents adequate indices (CFI value 0.95; TLI value is 0.943; SRMR is below.05, and RMSEA equals.045). The SEM results indicate that Practice opportunities is a significant predictor of both Lifelong learning tendencies and Metacognitive skills. The standardized effect in the explanation of Metacognitive skills by the mentioned dimension is positive with a coefficient $\beta = 0.67$ ($SE = 0.100$, $p < 0.001$), noting that Practice opportunities explains 45% of the variance for this factor. In turn, the standardized effect in the explanation of Lifelong learning tendencies by the Practice opportunities factor is positive with a coefficient $\beta = 0.59$ ($SE = 0.131$, $p < 0.001$), explaining 35% of the variance (**Figure 5**).

Assessment Tasks Applied

The review of applied assessment tasks found that tasks typical of a practicing teacher were found in almost all (13 of 14).

"At the start of the meeting, he presents himself, parents are welcomed and asked to introduce themselves (if necessary)" (Course PVP316).

Several assessment tasks presented explicit evaluation criteria (9 of 14).

"Clarifies the chosen vocabulary through synonyms, paraphrases, onomatopoeia, and gestures" (Course PVL224).

In addition, almost all the assessment tasks analyzed included descriptive feedback in which the evaluator referred to or commented on the observed performance (11 of 14). The agent who provided the feedback was the course teacher in all of them. There was also feedback from a second teacher, an assistant, or peers in some cases.

"I emphasize that you tried several 'talk actions.' You did not stay with the typical ones. You made us add information; you asked us for examples and counterexamples, and you were able to lengthen the conversation twice" (Course EBL312).

"I followed the words of the teacher. The teacher managed to show the classmates why the author writes what he writes, how he writes it, and the reasons for reading it, so congratulations" (Course EBL113).

In some assessment tasks, the feedback was paraphrased as a description of compliance.

"Class organization stands out. Despite the forced closure, there were very clear and sequenced moments." (Course PFE173).

In others, the feedback focused on deficiencies or performance gaps observed.

"It is important to describe what instructions the students will receive to frame the exercise and how many students will do this activity." (Course PFE175).

In several assessment tasks, comments included advice on resources and/or performance:

"There were some language mistakes in your PowerPoint, for example, 'fell sleep,' 'to played,' or 'to took.' It is a good idea to download a language corrector such as Grammarly and have the corrector check your material before publishing it. I use it, and it's great." (Course PFE176).

As emerging categories, it was observed that some feedback asked the appraisee questions or challenged them to improve performance in the next opportunity.

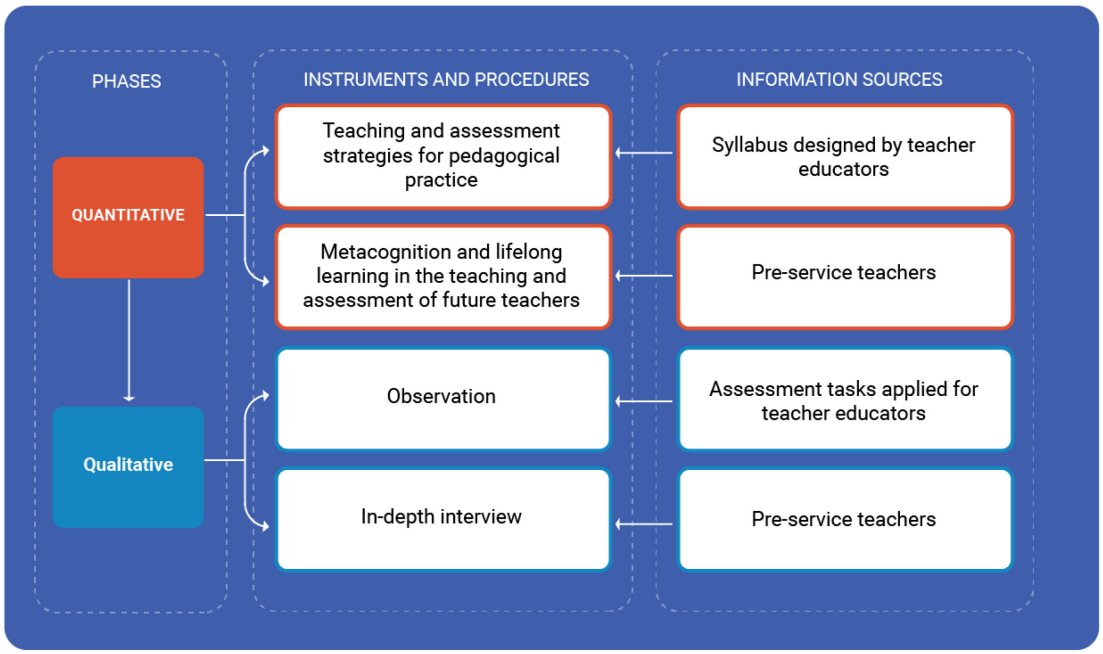


FIGURE 1 | Instruments and information sources.

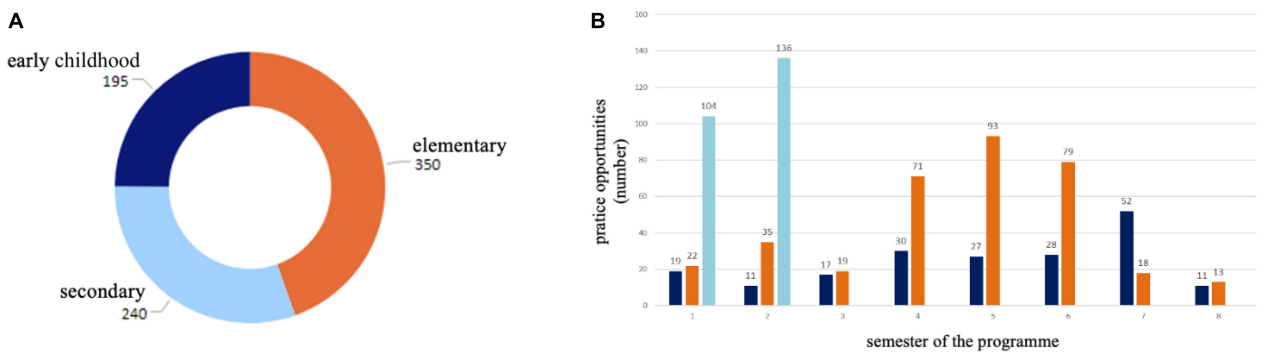
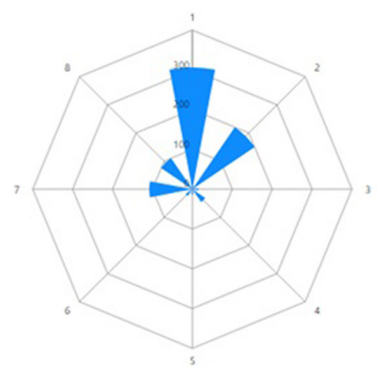


FIGURE 2 | Frequency of practice opportunities in learning activities planned to be performed during on-campus coursework, by program (total) **(A)** and semester of the program (absolute number) **(B)**.



code	name	courses (number)
po1	Plan for teaching and teacher role	64
po2	Practice or rehearse teacher role	53
po3	Analyze pupils' learning	9
po4	Include teaching materials, artifacts and resources	20
po5	Talk about field placement / student teaching experiences	8
po6	Take pupils' perspective	12
po7	See models of teaching	39
po8	See connection to national or state curriculum	32

FIGURE 3 | Frequency of each practice opportunity in learning activities planned to be performed during on-campus coursework.

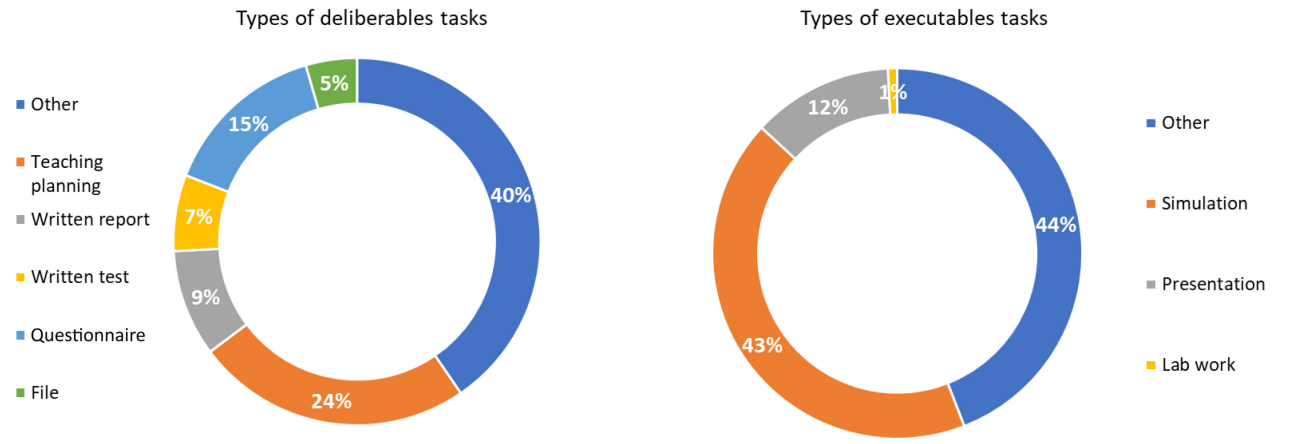


FIGURE 4 | Types of planned assessment deliverables and executables.

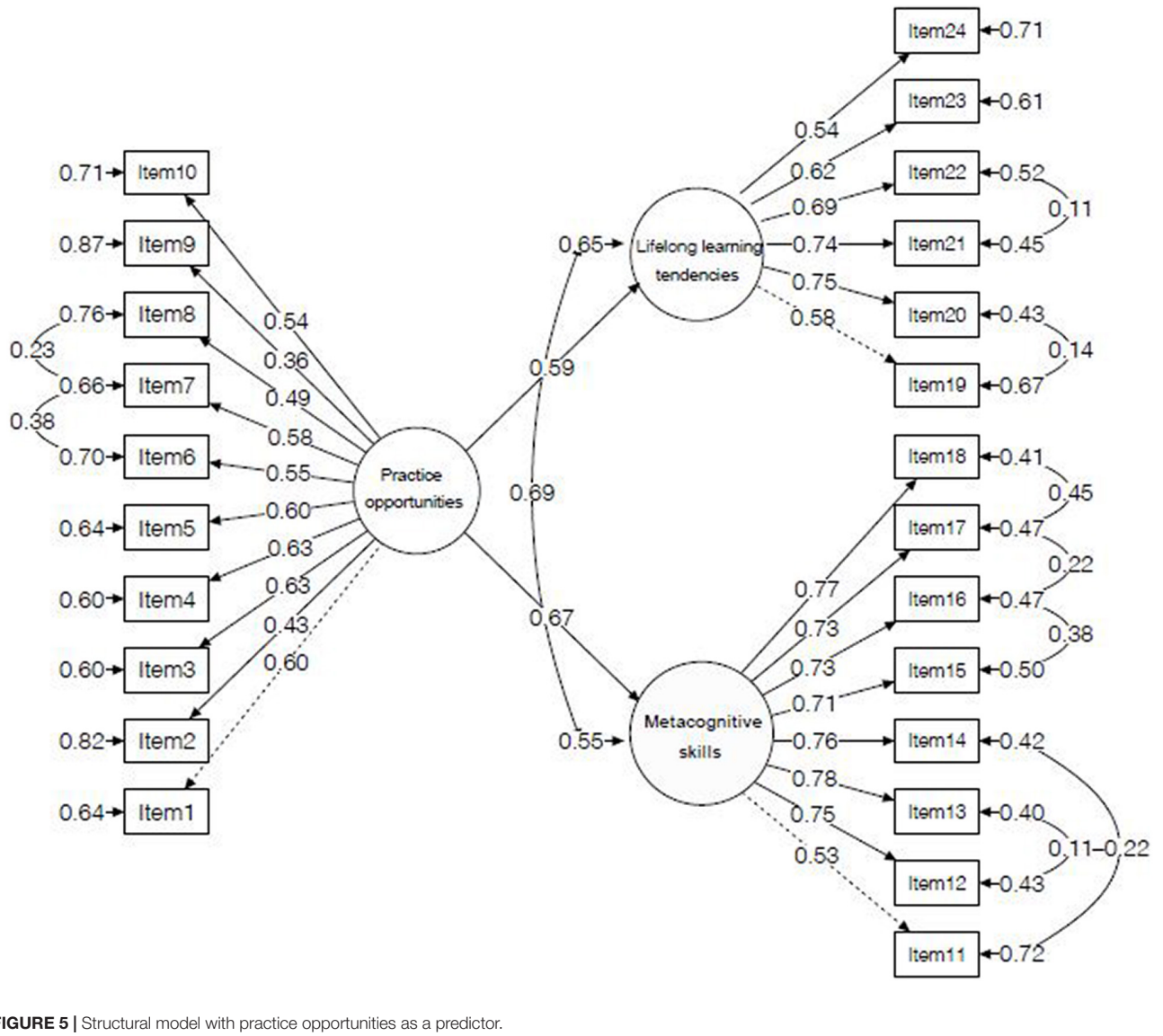


FIGURE 5 | Structural model with practice opportunities as a predictor.

"Based on the situation presented, what is the specific error? What do you mean twenty numbers?" (Course EBM116).

"As I discussed in classes (and if you find it challenging), I think it would be good to organize an upcoming class without the support of a technological resource (video, for example). This will help you to see other forms of teaching that could be interesting" (Course PFE173).

Semi-Structured Interviews

The interviews indicated that some course activities or actions of the teacher educators in the assessment tasks promoted the development of lifelong learning tendencies in the pre-service teachers (PST). **Figure 6** presents the synthesis of the findings. Pre-service teachers reported that the instructions provided by their teacher educators inspired them to be curious and go beyond what was known or taught.

PST 2: "For one task, the didactics teacher said we could send it in some innovative format. And I did a podcast; it was very good."

Carrying out contextualized assignments in the teaching task generated greater motivation for the pre-service teacher toward learning activities and the profession.

PST 8: "the key is to link it with schools, show examples of the classes so that the teachers tell us 'I did this evaluation, and that's how it worked.' That way, we see it concretely, not so abstract. I think it's the way to motivate."

The pre-service teachers reported that applying the content in practical tasks was more complex and challenging. They had to persevere in the activity, using different tools, going to sources and taking ideas from various actors.

PST 4: ". . . we can know the content very well but putting it into practice is difficult. . . there were some frustrations because it was not an easy job. Many times, I was like, 'I don't know what we're going to do.' Then that moment of frustration would pass; then it was, 'How do we continue?' So we spend a whole day working on the project and all day looking for the idea. We searched the internet and the bibliography. The teachers gave us examples to put into practice, and the group also contributed."

For the pre-service teachers, the simulations and the feedback they received from their teacher educator or peers during or after promoted self-regulation.

PST 1: "after simulating and making corrections based on feedback, one changes the planning, corrects it."

Pre-service teachers pointed out some actions implemented by the teacher educators in the assessment tasks that promoted the development of metacognitive skills. **Figure 7** presents the synthesis of the findings.

Pre-service teachers noted that they were often provided with assessment task instructions and guidelines in advance, detailing the criteria considered in assessing performance. Its content helped them plan their execution.

PST 6: "In my case, I take the rubric and begin to understand: 'Let's see this part. . . and I would have the full score if I do such and such a thing and start to verify. . . oh, now, then I am missing this part.'"

Making teaching plans was common in different courses and involved metacognitive planning.

PST 1: ". . .in all branches, we are always considering planning all the time."

PST 3: "I think of the idea in my head, and then I sit down to write it, but I already have it ready in my head. And when I'm writing, I kind of check how I could do it and how it could be better with this element.add one more question in the questions part. so I go, little by little, putting together the planning."

In group simulations, they developed metacognitive monitoring processes. This occurred from the verbal and non-verbal feedback provided by their peers in the role of children.

PST 1: ". . . the reactions of your peers who are acting like children and who ignore the ideas that I present to them or do not understand what I explain to them - they give information that makes you think. It's a process that happens in your mind very quickly, very quickly, you pick up that information. Nobody is telling you, but something happens in you during the simulation that makes you correct yourself."

At the end of the simulation, the feedback peers gave helped them identify aspects of their own performance that could be improved or better achieved.

PST 1: " I think that the simulations are what help us the most. . . they give you both positive and negative feedback. That's where you learn the most. ('I have to improve this, I have to change this, this is good, I could do better.') They are the best when evaluating us."

DISCUSSION

The actions planned in practice-based teacher education programs promote developing lifelong learning tendencies and metacognitive skills in pre-service teachers. The practice opportunities in the programs created by the teacher educators in the teaching and evaluation activities were observed frequently in each program and in almost all the courses analyzed (**Figures 2**, **3**). These opportunities were a significant predictor of developing lifelong learning tendencies and metacognitive skills in pre-service teachers (**Figure 5**). The presence of practice opportunities in learning activities was also reported in other studies (Gotwals and Birmingham, 2016; Mitchell and Reid, 2017; Kang and Windschitl, 2018; Johnson Lachuk et al., 2019) not so much in assessment tasks. We know that practice opportunities prepare pre-service teachers for performance in highly complex contexts such as school classrooms (Klette et al., 2017) and that these experiences lead to the awareness of what is executed (their thinking) (Lu and Wang, 2022; Sams, 2022). This finding reinforces the idea that practical training triggers the reflective processes of the pre-service teacher and the development tendencies for lifelong learning.

When pre-service teachers have opportunities to systematically plan instruction and simulate teacher roles throughout the training program, they also develop

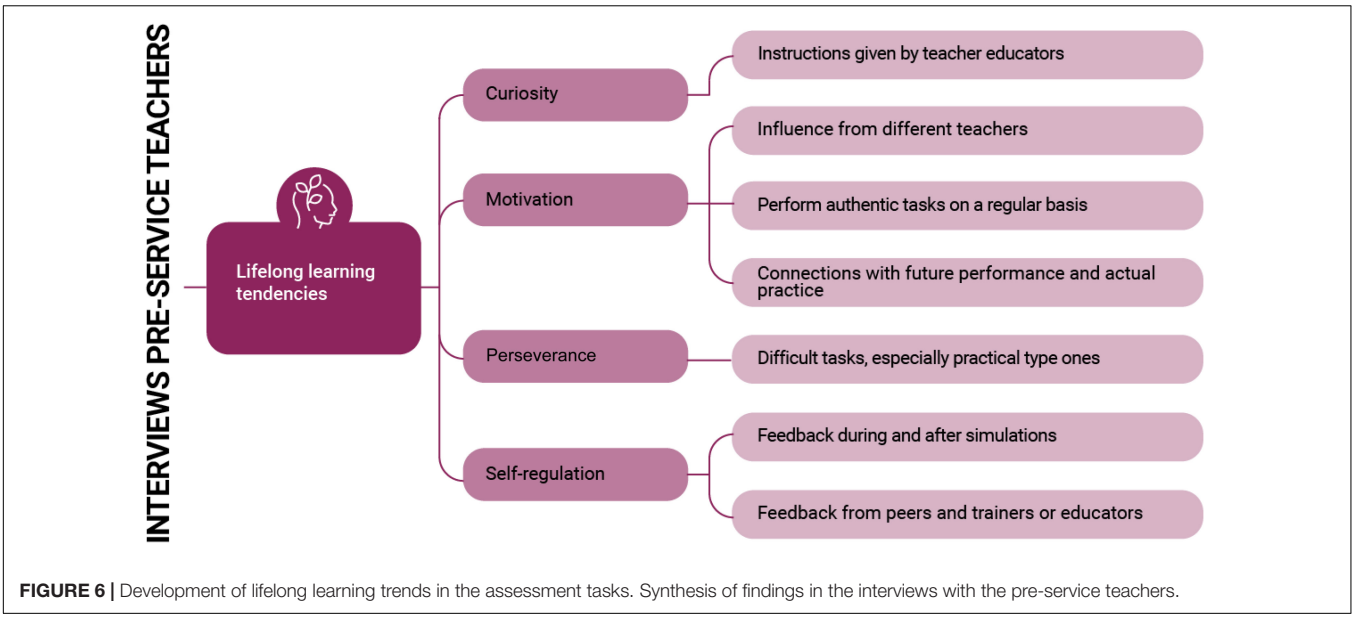


FIGURE 6 | Development of lifelong learning trends in the assessment tasks. Synthesis of findings in the interviews with the pre-service teachers.

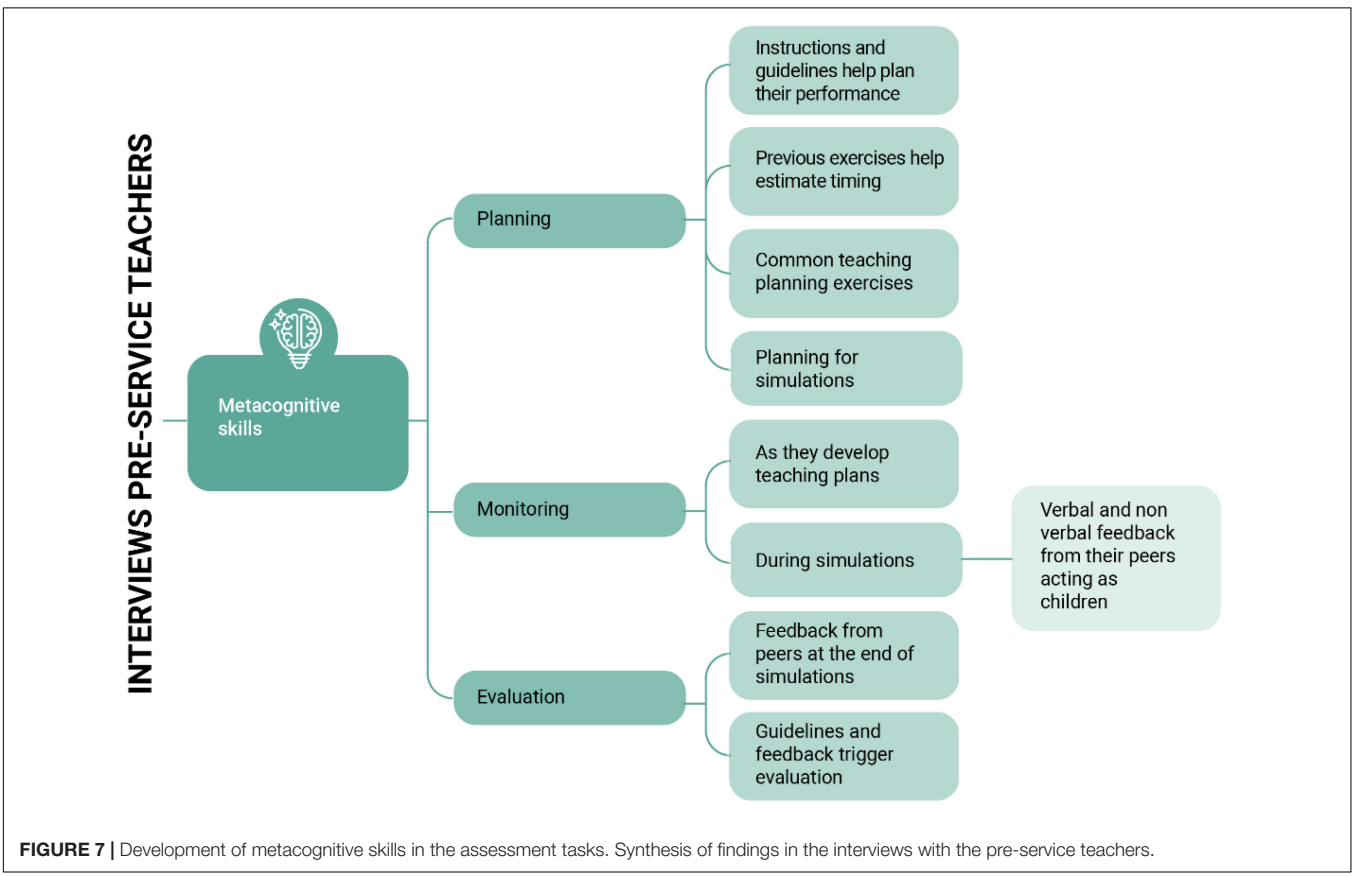


FIGURE 7 | Development of metacognitive skills in the assessment tasks. Synthesis of findings in the interviews with the pre-service teachers.

metacognitive planning and monitoring skills. In this study, the teacher educator prepared and offered the pre-service teacher frequent opportunities to plan and simulate the role of the teacher, which is evidenced in **Figures 3**, **4**, **7**. Previous evidence reported that the systematic exercise of planning in teaching led to repeatedly experiencing metacognitive planning processes (Moshman, 2018) and that the simulations allowed the evaluation of complex performances (Codreanu et al., 2021), triggering the revision of the original plan due to monitoring behavior and making timely corrections (Veenman, 2017). Frequent simulations reproduced the interactions between teacher and students in a school classroom, providing the

metacognitive monitoring necessary for adjusting the actions while the actual teaching was developed.

The assessment tasks that constitute practice opportunities frequently offered to the pre-service teachers also favor lifelong learning tendencies, particularly motivation and perseverance. As shown in **Figure 6**, the practical assessment tasks that allow pre-service teachers to integrate their knowledge into contextual performances corresponding to functions performed by a teacher in the school require perseverance and motivation. Some authors have insisted that assessment tasks for professional practices that involve complex performances in which the pre-service teachers integrate conceptual, procedural contents, and provisions must be relevant (Darling-Hammond and Snyder, 2000; Virtanen et al., 2017), common in the teaching profession, attuned to the needs of the workplace (Nicholson Perry et al., 2017; Oliveri and Markle, 2017), and increase students' confidence (Sokhanvar et al., 2021). The teacher educators must select authentic, realistic tasks that approximate the complexity of teaching and help develop the perseverance and motivation of the pre-service teachers.

What the teacher educators communicate to the pre-service teachers before carrying out the assessment tasks affects the development of their curiosity. In turn, if the evaluation criteria are also shared, the metacognitive planning processes are involved. The pre-service teachers interviewed pointed out that the instructions given by the teacher educators before carrying out the assessment tasks encouraged them to go beyond what was known and that when they were informed about the quality criteria or evaluation guidelines, they planned their performance well (**Figures 6**, **7**). Previous studies have reported that teacher educators should support and inspire pre-service teachers who are not inherently curious and challenge them to go beyond their comfort zones (Jivanjee et al., 2015; Faulkner and Latham, 2016). The authors agree that understanding the quality of their performance is essential (Adalberon, 2021). In addition, when pre-service teachers receive explicit instructions on metacognitive strategies from teacher educators, they develop more (Vrieling et al., 2018). The instructions and quality criteria communicated by the teacher educators in the assessment task should also involve the modeling of metacognitive processes and encourage the curiosity of the pre-service teachers.

Feedback plays an essential role in triggering pre-service teachers' metacognitive evaluation and self-regulation processes. Its content should focus on the pre-service teachers' performance to reinforce the quality criteria of the task, point out deficiencies or gaps, give advice, invite the evaluation of the pre-service teacher based on questions, or improve the performance at a future opportunity. As observed in the assessment tasks, the feedback content was varied. As **Figure 6** shows, peer and teacher educator feedback, particularly during and after the simulations, is associated with self-regulation. In addition, the feedback given by the peers at the end of the simulations allowed the pre-service teachers to review their actions and recognize strengths and weaknesses in their performances (**Figure 7**). The feedback offered possibilities for action and encouraged them to set goals beyond simply correcting mistakes (Torres et al., 2020). As we saw in this study, pre-service teachers appreciated the opportunity to receive feedback on their performance with authentic assessment tasks (Sokhanvar et al., 2021); also, the feedback provided by peers allowed greater understanding and involvement in their own learning (Snead and Freiberg, 2019; Vázquez et al., 2021). Therefore, feedback is highly relevant in training models that utilize practices and is necessary to guide the understanding of content; thus, agents providing it must do so timely.

This study showed that the actions planned in practice-based teacher education programs promote developing lifelong learning tendencies and metacognitive skills in the pre-service teachers when they are based on practice opportunities that are assessed. Since no significant differences were found either by the pre-service teachers'gender or by the programs education level, we assume that the impact of the program is not associated with specific courses or teachers educators, but instead with the overall actions of the program and its teachers. For example, when the pre-service teachers have opportunities to plan instruction systematically throughout the training program, they develop metacognitive planning skills. In addition, when the pre-service teachers experience frequent simulations, the interactions generated between teachers and students influence metacognitive monitoring. Authentic, realistic tasks like those of a practicing teacher must integrate the complexity of teaching, theoretical knowledge, and practical skills and draw upon motivation to learn and perseverance. The moment the teacher educators communicate the instructions and quality criteria for the assessment tasks affects the pre-service students' curiosity and metacognitive planning. The content of the feedback, when it is given, and who provides it are relevant aspects that trigger pre-service teachers' metacognitive evaluation and self-regulation processes.

CONCLUSION

This study sought to answer the question: What components promoting lifelong learning and metacognition should be considered in the pre-service teacher learning assessment processes? According to the results of this study, we can distinguish at least three core components. The first corresponds to assessment tasks as practice opportunities, that are relevant and integrate content and skills customarily exercised in the profession (authentic), such as planning the teaching and simulating the teacher's role. This tasks, contribute to the development of metacognitive planning and monitoring skills, as long as they are carried out frequently in the various courses offered throughout the curriculum. This implies developing guidelines from the program so that in the courses taught on campus, their teacher educators, plan and apply evaluations whose tasks maintain these characteristics that in addition, promote motivation and perseverance in pre-service teachers.

The second core component, corresponds to consider in the assessment processes prior communication of the instructions and evaluation criteria to the pre-service teacher. Besides explaining the task, the communication should

inform its relevance to the professional context, possible new ways to solve it, and should support the planning of objectives, strategies, time, and resources to execute it. This component is critical to the development of metacognitive planning skills and to arouse the curiosity of pre-service teachers.

The third component, is frequent feedback provided by the peers and the teacher educators during and after the tasks. It should focus on the pre-service teachers' performance. The input must help the pre-service teachers reflect (for example through questions) on foreseen objectives, their performance, and the implemented strategies. This promotes pre-service teachers' metacognitive evaluation. Besides, the feedback should guide them, to recognize achievements and challenges, and encourage to consider the recommendations in their future performance. This promotes pre-service teachers' self-regulation processes. Certainly, feedback with the aforementioned characteristics is a contribution to the learning process of pre-service teachers; but it could imply a great challenge for most programs, in particular to provide it during pre-service teacher's performance (and not only after), and the consideration of peers in this process.

These components are added to those that must be considered in any learning assessment process with expected learning objectives. The assessment tasks must be relevant. The evaluation criteria and instructions must be clear, understandable, and feasible. The feedback must be clear and timely to safeguard the validity and reliability of these processes.

This research has value to all universities looking to update their teacher education programs, enrich the assessment process, and contribute to the transformation of pre-service teachers into teaching experts, who are active and lifelong learners prepared to cope with future education challenges. Future research should involve implementing the components that promote lifelong learning and metacognition in the learning assessment processes of practice-based teacher education programs or other program types. It could lead to comparative studies of training programs based on practices in other institutions or programs oriented toward different approaches.

Finally, it is necessary to point out that this study has some limitations. The three programs studied belong to the same institution; therefore, the findings cannot be generalized. Another limitation could be the effects of the COVID-19 pandemic on the participants' responses. The confinement could have affected the results because the participants could be in socio-affective situations that may bias their historical memories.

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 Ethics Committee of Universidad del Desarrollo approved this study. The Directors of the three programmes authorized the study and provided the syllabi. Teacher educators and pre-service teachers provided written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

KM-R, MR-M, and LG-M: conceptualization, formal analysis, resources, writing—original draft preparation, and writing—review and editing. KM-R and MR-M: methodology. KM-R: software and data curation. MR-M and LG-M: supervision. All authors have read and agreed to the published version of the manuscript.

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REFERENCES

Adalberon, E. (2021). Providing assessment feedback to pre-service teachers: a study of examiners' comments. *Assess. Eval. High. Educ.* 46, 601–614. doi: 10.1080/02602938.2020.1795081

Allen, J. M., and Wright, S. E. (2014). Integrating theory and Practice in the pre-service teacher education practicum. *Teach. Teach.* 20, 136–151. doi: 10.1080/13540602.2013.848568

Álvarez, I. M. (2017). Evaluar para contribuir a la autorregulación del aprendizaje. *Electron. J. Res. Educ. Psychol.* 7, 1007–1030. doi: 10.25115/ejrep.v7i19.1362

Amador, J. M. (2017). Pre-service teachers' video simulations and subsequent noticing: a practice-based method to prepare mathematics teachers. *Res. Math. Educ.* 19, 217–235. doi: 10.1080/14794802.2017.1315317

Arbaugh, F., Ball, D. L., Grossman, P., Heller, D. E., and Monk, D. (2015). Deans' corner: views on the state of teacher education in 2015. *J. Teach. Educ.* 66, 435–445. doi: 10.1177/0022487115602314

Ashford-Rowe, K., Herrington, J., and Brown, C. (2014). Establishing the critical elements that determine authentic assessment. *Assess. Eval. High. Educ.* 39, 205–222. doi: 10.1080/02602938.2013.819566

Barzilai, S., and Zohar, A. (2014). Reconsidering personal epistemology as metacognition: a multifaceted approach to the analysis of epistemic thinking. *Educ. Psychol.* 49, 13–35. doi: 10.1080/00461520.2013.863265

Bennet, M., and Moriarty, B. (2016). Lifelong learning theory and pre-service teachers' development of knowledge and dispositions to work with Australian Aboriginal students. *Int. J. Pedagog. Learn.* 11, 1–9. doi: 10.1080/22040552.2016.1187645

Berkhout, J. J., Helmich, E., Teunissen, P. W., van der Vleuten, C. P. M., and Jaarsma, A. D. C. (2018). Context matters when striving to promote active and lifelong learning in medical education. *Med. Educ.* 52, 34–44. doi: 10.1111/medu.13463

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., et al. (2012). "Defining twenty-first-century skills," in *Assessment and Teaching of*

21st-Century Skills, eds P. Griffin, B. McGaw and E. Care (Dordrecht: Springer), 17–66.

Bjursell, C., Bergmo-Prvulovic, I., and Hedegaard, J. (2021). Telework and lifelong learning. *Front. Sociol.* 6:642277 doi: 10.3389/fsoc.2021.642277

Burón, J. (1996). *Concepto y Estudio de la Metacognición*. Enseñar a Aprender: Introducción a la Metacognición, 9–28.

Canrinus, E. T., Klette, K., and Hammerness, K. (2019a). Diversity in coherence: strengths and opportunities of three programs. *J. Teach. Educ.* 70, 192–205. doi: 10.1177/0022487117737305

Canrinus, E. T., Klette, K., Hammerness, K., and Bergem, O. K. (2019b). Opportunities to enact Practice in campus courses: taking a student perspective. *Teach. Teach.* 25, 110–124. doi: 10.1080/13540602.2018.1526171

CNA (2018). *Carreras de Pedagogía: Análisis de Fortalezas y Debilidades en el Escenario Actual. Serie Estudios sobre Acreditación*. Santiago: Chile

CNED. (2021). *Informe de Tendencias de la Matrícula de Pregrado de Educación Superior*. Santiago: Chile.

Codreanu, E., Sommerhoff, D., Huber, S., Ufer, S., and Seidel, T. (2021). Exploring the process of preservice teachers' diagnostic activities in a video-based simulation [Original Research]. *Front. Educ.* 6:626666. doi: 10.3389/feduc.2021.626666

Corbin, J., and Strauss, A. (2008). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*, 3rd Edn. Thousand Oaks, CA: Sage Publications, Inc.

Core Practices Consortium (2020). *Core Practice Consortium*. Available online at: https://www.corepracticeconsortium.com/ (accessed April 10, 2020).

Creswell, J. (2014). *A Concise Introduction to Mixed Methods Research*. Thousand Oaks, CA: Sage Publication.

Creswell, J., and Clark, V. (2017). *Designing and Conducting Mixed Methods Research*. Thousand Oaks, CA: Sage publications.

Dalinger, T., Thomas, K. B., Stansberry, S., and Xiu, Y. (2020). A mixed-reality simulation offers strategic Practice for pre-service teachers. *Comput. Educ.* 144:103696. doi: 10.1016/j.compedu.2019.103696

Darling-Hammond, L. (2017). Teacher education around the world: What can we learn from international practice? *Eur. J. Teach. Educ.* 40, 291–309. doi: 10.1080/02619768.2017.1315399

Darling-Hammond, L., and Snyder, J. (2000). Authentic assessment of teaching in context. *Teach. Teach. Educ.* 16, 523–545. doi: 10.1016/S0742-051X(00)00015-9

DeMink-Carthew, J., Grove, R., and Peterson, M. (2017). The influence of the core practices movement on the teaching and perspectives of novice teacher educators. *Stud. Teach. Educ.* 13, 87–104. doi: 10.1080/17425964.2017.1289083

Duman, B. (2018). The relationship between the entrepreneurship characteristics and metacognitive awareness levels of pre-service teachers. *J. Educ. Train. Stud.* 6:152.

The European Commission (2001). *Making a European Area of Lifelong Learning a Reality*. Brussels: European Commission.

Faulkner, J., and Latham, G. (2016). Teacher qualities for 21st century learning. *Aust. J. Teach. Educ.* 41, 137–150.

Flavell, J. H. (1976). "Metacognitive aspects of problem-solving," in *The Nature of Intelligence*, ed. L. B. Resnick (Hillsdale, NJ: Erlbaum), 231–235.

Flores-Lueg, C., and Turra-Díaz, O. (2019). Contextos socioeducativos de prácticas y sus aportes a la formación pedagógica del futuro profesorado. *Educar Rev.* 35, 267–285.

Glaser, B., and Strauss, A. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago: Aldine, 139.

Glasserman Morales, L. D., and Ruíz Ramírez, J. A. (2021). Características del aseguramiento de la calidad educativa: un mapeo sistemático 2016-2020. *Rev. Complut. Educ.* 32, 337–348. doi: 10.5209/rced.70182

Gotwals, A. W., and Birmingham, D. (2016). Eliciting, Identifying, interpreting, and responding to students' ideas: teacher candidates' growth in formative assessment practices. *Res. Sci. Educ.* 46, 365–388. doi: 10.1007/s11165-015-9461-2

Griffith, R. (2017). Preservice teachers' in-the-moment teaching decisions in reading. *Literacy* 51, 3–10. doi: 10.1111/lit.12097

Grossman, P., Hammerness, K., and McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teach. Teach.* 15, 273–289. doi: 10.1080/13540600902875340

Grossman, P., and Pupik Dean, C. G. (2019). Negotiating a common language and shared understanding about core practices: the case of discussion. *Teach. Teach. Educ.* 80, 157–166. doi: 10.1016/j.tate.2019.01.009

Gulikers, J., Bastiaens, T., Kirschner, P. A., and Kester, L. (2006). Relations between student perceptions of assessment authenticity, study approaches and learning outcome. *Stud. Educ. Eval.* 32, 381–400.

Hahl, K., and Mikulec, E. (2018). Student reflections on teacher identity development in a year-long secondary teacher preparation program. *Aust. J. Teach. Educ.* 43, 42–58.

Halamish, V. (2018). Pre-service and in-service teachers' metacognitive knowledge of learning strategies. *Front. Psychol.* 9:2152. doi: 10.3389/fpsyg.2018.02152

Jenset, I. (2017). *Practice-Based Teacher Education Coursework: An Examination of the Extent and Characteristics of How Teacher Education Coursework Is Grounded in Practice Across Six Teacher Education Programs in Finland, Norway and California, US*. Doctoral thesis. Oslo: Universitetet i Oslo.

Jenset, I., Klette, K., and Hammerness, K. (2018). Grounding teacher education in practice around the world: an examination of teacher education coursework in teacher education programs in Finland, Norway, and the United States. *J. Teach. Educ.* 69, 184–197. doi: 10.1177/0022487117728248

Jivanjee, P., Pendell, K. D., Nissen, L., and Goodluck, C. (2015). Lifelong learning in social work: a qualitative exploration with social work practitioners, students, and field instructors. *Adv. Soc. Work* 16, 260–275.

Johnson Lachuk, A., Gísladóttir, K. R., and DeGraff, T. (2019). Using collaborative inquiry to prepare pre-service teacher candidates who have integrity and trustworthiness. *Teach. Teach. Educ.* 78, 75–84. doi: 10.1016/j.tate.2018.11.003

Kallio, H., Virta, K., and Kallio, M. (2018). Modelling the components of metacognitive awareness. *Int. J. Educ. Psychol.* 7, 94–122. doi: 10.17583/ijep.2018.2789

Kang, H., and Windschitl, M. (2018). How does practice-based teacher preparation influence novices' first-year instruction? *Teach. Coll. Rec.* 120, 1–44.

Klassen, A. C., Creswell, J., Clark, V. L. P., Smith, K. C., and Meissner, H. I. (2012). Best practices in mixed methods for quality of life research. *Qual. Life Res.* 21, 377–380.

Klette, K., Hammerness, K., and Jenset, I. (2017). Established and evolving ways of linking to practice in teacher education: findings from an international study of the enactment of practice in teacher education. *Acta Didactica Norge* 11, 1–22.

Kloser, M., Wilsey, M., Madkins, T. C., and Windschitl, M. (2019). Connecting the dots: secondary science teacher candidates' uptake of the core practice of facilitating sensemaking discussions from teacher education experiences. *Teach. Teach. Educ.* 80, 115–127. doi: 10.1016/j.tate.2019.01.006

Kyriakides, L., Anthimou, M., and Panayiotou, A. (2020). Searching for the impact of teacher behavior on promoting students' cognitive and metacognitive skills. *Stud. Educ. Eval.* 64:100810. doi: 10.1016/j.stueduc.2019.100810

Lauder, H. (2020). The roles of higher education, further education and lifelong learning in the future economy. *J. Educ. Work* 33, 460–467. doi: 10.1080/13639080.2020.1852499

Leech, N. L., and Onwuegbuzie, A. J. (2007). An array of qualitative data analysis tools: a call for data analysis triangulation. *Sch. Psychol. Q.* 22, 557–584.

Leko, M., Brownell, M., and Sindelar, P. K. M. (2015). Envisioning the future of special education personnel preparation in a standards-based Era. *Except. Child.* 82, 25–43. doi: 10.1177/0014402915598782

Lu, H., and Wang, Y. (2022). The effects of different interventions on self-regulated learning of pre-service teachers in a blended academic course. *Comput. Educ.* 180:104444. doi: 10.1016/j.compedu.2022.104444

López-Pastor, V., and Sicilia-Camacho, A. (2017). Formative and shared assessment in higher education. Lessons learned and challenges for the future. *Assess. Eval. High. Educ.* 42, 77–97. doi: 10.1080/02602938.2015.1083535

Makarova, O. Y., Andreeva, M. I., Baratova, O. A., and Zelenkova, A. V. (2017). "Supplementary professional education as a socially relevant component of lifelong learning," in *Proceedings of the International Conference on Linguistic and Cultural Studies*, Tomsk.

Matsumoto-Royo, K., and Ramírez-Montoya, M. (2020). "Teaching and assessment strategies in practice-based teacher education," in *Proceedings of the 8th International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM 2020)* (España: Universidad de Salamanca).

Matsumoto-Royo, K., and Ramírez-Montoya, M. S. (2021). Core practices in practice-based teacher education: a systematic literature review of its teaching and assessment process. *Stud. Educ. Eval.* 70:101047. doi: 10.1016/j.stueduc.2021.101047

Matsumoto-Royo, K., Ramírez-Montoya, M. S., and Conget, P. (2021a). Opportunities to develop lifelong learning tendencies in practice-based teacher education: getting ready for education 4.0. *Future Internet* 13:292. doi: 10.3390/fi13110292

Matsumoto-Royo, K., Ramírez-Montoya, M.-S., and Conget, P. (2021b). Diseño y validación de un cuestionario para evaluar oportunidades de práctica pedagógica, metacognición y «lifelong learning», brindadas por los programas de formación inicial docente. *Estudios Sobre Educ.* 41. doi: 10.15581/004.41.009

Mitchell, D. M., and Reid, J. A. (2017). (Re)turning to Practice in teacher education: embodied knowledge in learning to teach. *Teach. Teach.* 23, 42–58. doi: 10.1080/13540602.2016.1203775

Mizala, A., Hernández, T., and Makovec, M. (2011). Determinantes de la elección y deserción en la carrera de pedagogía. *Proyecto* 1:30.

Montes, N., and Ziegler, S. (2018). Los desafíos de la formación de los docentes del futuro. Entrevista a Cristian Cox Donoso. *Propuesta Educ.* 49, 57–60.

Moshman, D. (2018). Metacognitive theories revisited. *Educ. Psychol. Rev.* 30, 599–606.

Mutambuki, J. M., Mwavita, M., Muteti, C. Z., Jacob, B. I., and Mohanty, S. (2020). Metacognition and active learning combination reveals better performance on cognitively demanding general chemistry concepts than active learning alone. *J. Chem. Educ.* 97, 1832–1840. doi: 10.1021/acs.jchemed.0c00254

Nguyen, T. T., and Walker, M. (2016). Sustainable assessment for lifelong learning. *Assess. Eval. High. Educ.* 41, 97–111. doi: 10.1080/02602938.2014.985632

Nicholson Perry, K., Donovan, M., Knight, R., and Shires, A. (2017). Addressing professional competency problems in clinical psychology trainees. *Aust. Psychol.* 52, 121–129.

Oates, S. (2019). The importance of autonomous, self-regulated learning in primary initial teacher training [Curriculum, Instruction, and Pedagogy]. *Front. Educ.* 4:102. doi: 10.3389/feduc.2019.00102

OECD (2018). *Educación en Chile*. Paris: OECD. doi: 10.1787/9789264288720-es

Oliveri, M. E., and Markle, R. (2017). Continuing a culture of evidence: expanding skills in higher education. *ETS Res. Rep. Series* 2017, 1–8. doi: 10.1002/ets2.12137

Organización de Naciones Unidas (2015). *Resolución aprobada por la Asamblea General el 25 de Septiembre de 2015. Resolución 70/1. Transformar nuestro mundo: la Agenda 2030 para el Desarrollo Sostenible*. New York, NY: ONU.

Pastore, S., Manuti, A., and Scardigno, A. F. (2019). Formative assessment and teaching practice: the point of view of Italian teachers. *Eur. J. Teach. Educ.* 42, 359–374. doi: 10.1080/02619768.2019.1604668

Pino, A. A. D. (2019). La evaluación de la acción docente desde un enfoque metacognitivo. *Rev. Infancia Educ. Aprendizaje* 5, 398–402.

Ramírez-Montoya, M. S., Loaiza-Aguirre, M. I., Zúñiga-Ojeda, A., and Portuguez-Castro, M. (2021). Characterization of the teaching profile within the framework of education 4.0. *Future Internet* 13:91. doi: 10.3390/fi13040091

Ramírez-Montoya, M. S. (2021). Obsolescencia del conocimiento vs formación para el desarrollo sostenible: voces de protagonistas en el marco del COVID 19. *Texto Livre Ling. Tecnol.* 14:e33840. doi: 10.35699/1983-3652.2021.33840

Richmond, G., Salazar, M. D., and Jones, N. (2019). Assessment and the future of teacher education. *J. Teach. Educ.* 70, 86–89. doi: 10.1177/0022487118824331

Sams, N. L. (2022). *Praxis Preparation for Preservice Teachers: Using Online Tools to Engage in Productive Struggle*. Pittsburgh: University of Pittsburgh.

Sanz-Ponce, R., and González-Bertolín, A. (2018). La educación sigue siendo un "tesoro". Educación y docentes en los informes internacionales de la UNESCO. *Rev. Iberoamericana Educ. Superior* 9, 157–174. doi: 10.22201/iisue.20072872e.2019.25.347

Schwartz, Ann, C., William, M., McDonald, Arshya, B., Vahabzadeh, et al. (2018). Keeping up with changing times in education: fostering lifelong learning of millennial learners. *Focus* 16, 74–79. doi: 10.1176/appi.focus.20170004

Şentürk, Ş, and Duran, V. (2020). Lifelong learning tendencies of trainers in adult education. *Int. J. Eval. Res. Educ.* 9, 1–9. doi: 10.11591/ijere.v9i1.20365

Shan, H., Cheng, A., Peikazadi, N., and Kim, Y. (2021). Fostering diversity work as a process of lifelong learning: a partnership case study with an immigrant services organization. *Int. Rev. Educ.* doi: 10.1007/s11159-021-09929-3 [Epub ahead of print].

Snead, L. O., and Freiberg, H. J. (2019). Rethinking student-teacher feedback: using a self-assessment resource with student teachers. *J. Teach. Educ.* 70, 155–168. doi: 10.1177/0022487117734535

Sokhanvar, Z., Salehi, K., and Sokhanvar, F. (2021). Advantages of authentic assessment for improving the learning experience and employability skills of higher education students: a systematic literature review. *Stud. Educ. Eval.* 70:101030. doi: 10.1016/j.stueduc.2021.101030

Solmaz, D., and Aydin, G. (2016). Evaluation of lifelong learning tendencies of pre-service teachers. *Anthropologist* 24, 55–63. doi: 10.1080/09720073.2016.11891989

Torres, J., Strong, Z. H., and Adesope, O. O. (2020). Reflection through assessment: a systematic narrative review of teacher feedback and student self-perception. *Stud. Educ. Eval.* 64:100814. doi: 10.1016/j.stueduc.2019.100814

UNESCO (2019). *Annual Report 2018 UNESCO Institute for Lifelong Learning*. Paris: UNESCO

UNESCO, and OREALC (2014). *Temas Críticos Para Formular Nuevas Políticas Docentes en América Latina y el Caribe: El debate actual*. Chile: Universidad Católica Santiago.

Universidad del Desarrollo (2016). *Modelo de formación práctica 2017-2021*. Zaragoza: Facultad de Educación.

Veenman, M. V. (2017). Assessing metacognitive deficiencies and effectively instructing metacognitive skills. *Teach. Coll. Rec.* 119, 1–20.

Virtanen, P., Niemi, H. M., and Nevgi, A. (2017). Active learning and self-regulation enhance student teachers' professional competencies. *Aust. J. Teach. Educ.* 42:1. doi: 10.14221/ajte.2017v42n12.1

Vrieling, E., Stijnen, S., and Bastiaens, T. (2018). Successful learning: balancing self-regulation with instructional planning. *Teach. High. Educ.* 23, 685–700. doi: 10.1080/13562517.2017.1414784

Vázquez, S., Latorre, C., Liesa, M., and Rivera-Torres, P. (2021). El sistema de evaluación mutua en el trabajo en equipo: el valor de la calificación individual. *Eval. Práct. Invest. Eval.* 26:3. doi: 10.7275/wfkz-md55

World Economic Forum (2020). *The Future of Jobs Report 2020*. Cologny: World Economic Forum.

Yerdelen-Damar, S., Özdemir, O. F., and Ünal, C. (2015). Pre-service physics teachers' metacognitive knowledge about their instructional practices. *Eur. J. Math. Sci. Technol. Educ.* 11, 1009–1026. doi: 10.12973/eurasia.2015.1370a

Zeichner, K., and Peña-Sandoval, C. (2015). Venture philanthropy and teacher education policy in the U.S.: the role of the new schools venture fund. *Teach. Coll. Rec.* 117, 1–44.

Zohar, A., and Barzilai, S. (2013). A review of research on metacognition in science education: current and future directions. *Stud. Sci. Educ.* 49, 121–169. doi: 10.1080/03057267.2013.847261

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