Research article

Metacognitive analysis of the *practicum* subject of the Master's in Secondary Teaching through a reflexive portfolio

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ARTICLE INFO

ABSTRACT

This study delves into the efficacy of the reflective portfolio in the metacognitive domain within the context of the Master's in Secondary Teaching. It places particular emphasis on the impact of prior academic training in different specialties (scientific vs. humanities) on metacognitive skills development. The research employs a mixed-methods approach, analyzing portfolios from various academic specialties, developed in practicum subject, to ascertain differences in meta-cognitive competencies of teaching competencies. The main findings reveal that while students generally demonstrate a basic level of success in describing learning situations, there is a notable deficiency in deeper analytical skills and self-improvement strategies, especially among science students compared to their humanities counterparts. This suggests that initial training and educational background significantly influence the development of these competencies. The study concludes that there is a pressing need for more focused and robust training in metacognitive skills across different educational disciplines. Furthermore, it highlights the necessity for educational strategies that effectively address these variations, aligning teaching and learning processes with the principles of quality and sustainable education as envisioned in Agenda 2030. The insights gained are crucial for the development of more effective and comprehensive teacher education programs.

1. Introduction

Spain's newly enacted educational laws, for regulating the mandatory Education and the University system, highlight the pivotal role of critical thinking as the bedrock of quality education (SDG4), essential for fostering a society of discerning, analytical, and independent citizens [1,2]. In the realm of higher education, this emphasis on critical thinking is particularly significant. It propels students beyond mere knowledge accumulation, urging them to engage in deep analysis, to question existing paradigms, and to conceptualize innovative alternatives.

The Organic Law of the University System [2] underscores the imperative of nurturing a deeper, more introspective learning experience within the Spanish university context. This approach advocates for a pedagogical shift from the simple acquisition and rote

memorization of theoretical concepts to a model that cultivates critical evaluative skills, the development of versatile competencies, learner autonomy, and a continual reassessment of the learning process by the students themselves. This educational stream repositions the learner at the center, envisioning them as self-regulating agents, with educators acting as intermediaries between the learners and the information.

Self-regulation, conceptualized as a dynamic process where thoughts, emotions, and actions are continually adjusted to achieve specific goals [3], spotlighting the importance of metacognition. This skill, pivotal for effective decision-making, is fundamental for authentic deep learning, requiring a robust and efficient introspection about one's own learning processes [4].

According to McCluskey et al. [5] metacognition involves becoming aware of one's learning process, interweaving strengths, and weaknesses in problem-solving or task completion, and supervising, evaluating, and regulating the processes that lead to successful task achievement. They emphasize the development of genuine metacognitive awareness, which is focused on forging an effective link between the potential or actual interplay of thoughts and emotions and their subsequent impact on behavior [6].

From this standpoint, metacognition, through metacognitive awareness, leads to the generation of new knowledge. This knowledge arises from the application of previously acquired insights to address recurring challenges and situations encountered by students in their daily academic endeavors. It guides them towards fresh understandings, enabling them to navigate novel and diverse scenarios.

Metacognition, understood as the ability to reflect upon and regulate one's own learning process, is a crucial component in teaching. This skill not only allows educators to better understand their own thought and teaching processes but also equips them to foster deeper and more meaningful learning in their students. It is emphasized that educators possessing well-honed metacognitive skills are more adept at implementing adaptive and effective teaching strategies [7], which leads to enhanced comprehension and knowledge retention among students.

Furthermore, research by Kramarski and Michalsky [8] underscores the positive influence of metacognition in teaching, where it is observed that teachers who apply metacognitive practices promote more collaborative and reflective learning environments. This is particularly relevant in today's educational context, where the ability to adapt and respond to diverse learning needs is crucial. As Zohar and Barzilai [9] indicate, metacognition not only enhances the quality of teaching but also prepares students to be autonomous and critical learners, essential skills in the 21st century. Therefore, fostering metacognitive competencies in teachers not only augments their professional practice but also contributes substantially to their continuous professional development, yielding a significant and enduring impact on student learning and development.

In the Practicum segment of the Master's in Teacher Training (MUFPES), metacognitive processes gain heightened importance. Students embark on their initial journey as future educators in secondary education settings. Existing research suggests that cognitive strategy training may yield more substantial benefits for younger students as opposed to their older counterparts [10–12].

The Practicum uniquely promotes reflection on pedagogical practices within the ever-evolving landscape of educational environments. Here, students, assuming the role of teachers, are thrust into the forefront of various pedagogical scenarios, entailing responsibilities like organizing, planning, programming, executing, and assessing their educational interventions. These tasks demand a high degree of engagement and rigorous analytical scrutiny. A metacognitive process that is conscious, well-regulated, and systematically structured through appropriate scaffolding strategies, therefore, becomes crucial in laying the groundwork for high-quality teaching practices based on effective methodologies. The literature, thus, advocates for framing these metacognitive processes within the context of formative assessment, as this approach is more likely to yield successful outcomes [10,11,13].

In general terms, formative assessment encompasses dialogic and evaluative dynamics, which are shared with students about their learning processes. This involves communication tailored to both individual and group needs and can take place in settings ranging from small groups to cooperative group environments. However, the implementation of formative assessment necessitates a nuanced approach that connects information at the object level with self-regulatory control processes at the meta-level. This approach should also embrace the concept of error as a fundamental building block in the learning process. When formative assessment integrates several key elements – such as students' pre-existing knowledge [14], their invested effort [15], adequate time allocation for reflective thinking [16], and consistent feedback – metacognitive processes become more effective [17,18].

Moreover, research indicates the necessity of specific strategies, grounded in targeted scaffolding, to aid in the construction of new knowledge through metacognition [12]. Scaffolding strategies, integral to the metacognitive process, require careful design and detailed explanation upon introduction. This is essential to ensure that students understand the framework and can engage with it repeatedly, thereby enhancing its effectiveness in practical application. This approach highlights a notable gap in research, particularly evident in higher education and university-level studies. Despite the recognized importance of scaffolding strategies in metacognitive development, there is a notable scarcity of research that comprehensively examines how these strategies effectively translate into learning outcomes in the context of higher and university education. Specifically, the research gap is evident in three main areas: the adaptation of these strategies according to academic disciplines, their long-term effectiveness in knowledge retention and transfer, and teaching practice, and the integration of educational technologies to enhance metacognitive scaffolding.

This study aims to address these gaps by investigating the design, implementation, and evaluation of metacognitive scaffolding strategies in the training of secondary education teachers. Through this approach, we aspire to offer valuable insights that contribute to filling these voids, providing a practical guide for educators and teacher trainers. Our goal is not only to improve the understanding of how scaffolding strategies can be optimized according to the disciplinary and technological context but also to assess their long-term impact on teacher professional development, thus contributing to the formation of more effective and reflective educators.

The student portfolio, as an educational tool, facilitates the transition from teacher-centric methodologies to learner-centric approaches [19]. It represents a comprehensive self-assessment process that nurtures the capacity to critically evaluate one's own performance and the strategies involved in the learning process.

This, in turn, bolsters autonomy and has a direct positive impact on intrinsic motivation [20]. Thus, the portfolio emerges as a

self-regulated and metacognitive strategy that enables the assessment of the professional growth of teacher trainees through various indicators, including the identification of specific evidence, description, analysis, implementation guidelines, the correlation of learned-acquired knowledge through exposure, and suggestions for enhancing personal learning [21]. The deployment of these interventions is critical, as training in cognitive strategies fosters a resilient set of self-regulatory skills. These skills are transferable to new and diverse settings by teachers in training, who, without such tools, might face a myriad of challenges in their learning journey [22].

However, due to the complexity of the reflective processes it involves, the portfolio requires continuous monitoring by educators. Without such oversight, the portfolio's application could not only prove ineffective but also detrimentally impact intrinsic motivation, leading to a repetitive and superficial analytical discourse.

Educator intervention in the portfolio through formative evaluation is critical. This intervention should be sequential and its continuous monitoring should be supported by scaffolding strategies specifically tailored for the tool. The comparison between metacognition in scientific and humanities specialties holds particular significance, especially when considering students enrolled in a Master's in Teaching Training, given the significant influence of prior academic training on the development of metacognitive skills. Scientific disciplines, with their emphasis on method and experimentation, may foster a type of analytical and data-driven thinking, while the humanities, focused on critical analysis and interpretation, could encourage deeper, contextual reflection. This divergence in pedagogical approaches suggests that students from these areas might develop different metacognitive capacities and strategies. More recent studies, such as the one by Zohar and Barzilai [9], reinforce this view by demonstrating the impact of disciplinary differences on students' cognitive and metacognitive processes. Additionally, the work of Bransford, Brown, and Cocking [23], highlights the significant role of the disciplinary context in shaping how students approach learning and problem-solving. Therefore, examining and comparing how scientific and humanities specialties shape metacognitive skills is crucial to understanding differences in learning and teaching, and to developing educational strategies that effectively address these variations.

It is evident that the path charted by the Spanish educational law [2] represents a shift towards a formative evaluation model that emphasizes self-regulation and metacognition in the teaching-learning process. This transition to a new paradigm requires a deep understanding of various strategies and tools to ensure their effectiveness, directly influencing the pursuit of evidence-based education, the only way to achieve the standard of quality education as envisioned in Agenda 2030.

In the context of enhancing educational outcomes, the reflective portfolio emerges as a pivotal tool within the metacognitive framework, facilitating deeper learning and self-regulation among students. This approach is grounded in the theory that metacognition—students' awareness and control over their own learning processes—plays a critical role in effective learning. The reflective portfolio, as an educational strategy, supports this by encouraging students to critically analyze their learning experiences, thus fostering a higher level of self-awareness and self-regulated learning. Particularly within the Master's in Teacher Education for Secondary Education, this strategy holds promise for bridging theoretical knowledge and practical application across various disciplines. This research seeks to explore the influence of the reflective portfolio on the metacognitive capacities of students, specifically examining whether disciplinary differences between the humanities and experimental sciences impact the effectiveness of these reflective practices. The investigation aims to address the question: "How does the use of the reflective portfolio influence the development of metacognitive capacity in students of the Master's in Teacher Education for Secondary Education, and are there significant differences in the reflective processes between students from the humanities and experimental sciences areas?". Therefore, the overall objective of this work is to explore and deeply understand these strategies and tools, assessing their impact and efficacy in the current educational context. The analysis will focus on how the successful implementation of this paradigm shift can significantly improve teaching and learning processes, aligning them with the principles of quality and sustainable education proposed in Agenda 2030. This study seeks not only to identify but also to optimize educational practices that promote self-regulation and metacognition, key elements for the development of an educational system that responds to contemporary and future challenges. This general objective can be broken down into two specific objectives:

Objective 1: To analyze the effectiveness of the reflective portfolio in the metacognitive domain of students in the Master of Secondary Teaching program overall.

Objective 2: To compare the reflective process between students in the humanities field and those in the experimental sciences field of the Master of Teaching program.

2. Materials and methods

2.1. Procedure of the practicum subject in the master's degree in teaching

The Master's in Teacher Training, situated within the context of Spanish higher education, is characterized by its enabling nature. It is a prerequisite for those aspiring to teach in both public and semi-private educational institutions. The University of León structures this master's program into distinct curricular modules. Among these, the Practicum module stands out due to its critical importance. According to the academic guide, this module awards 10 ECTS credits. It focuses on the development of competencies and foundational knowledge crucial for effective teaching.

During the practicum, students go to real high school classrooms with the general objective of make an immersion in a real-world learning and teaching environment. This immersion aims to facilitate the acquisition and application of knowledge, skills, and competencies. Given its comprehensive nature. Students are required to apply competencies gained from previously completed courses. These include both generic competencies and those specific to the Practicum. The latter encompasses skills related to planning, evaluation, proficiency in oral and written communication, classroom coexistence, and family counseling.

Throughout this period, the student, acting as a teacher-in-training, receives ongoing supervision from two mentors. An institutional tutor oversees the student's professional growth at the designated secondary education center. Concurrently, a university tutor ensures the student's performance and adherence to their rights and obligations. These responsibilities are outlined in the teaching guide provided to students.

To evaluate the acquisition of teaching competencies effectively, the program employs the reflective portfolio methodology. This evaluation strategy constitutes 40 % of the final grade. It encourages a metacognitive process, enabling students to critically assess their learning experiences. Through a structured and thorough approach, students gain insights into their development within the teaching role. They compile documents detailing weekly reflections on their experiences at educational centers. These reflections center on the integration of professional competencies.

The reflective portfolio is structured as follows: an index, an overview of the educational center's context, and 7 evidences covering 15 core competencies. These competencies are further divided into various sub-competencies, including but not limited to content knowledge, classroom management, and educational assessment. The portfolio concludes with a comprehensive assessment and evaluation section. Students are tasked with selecting seven main competencies and 14 sub-competencies. They then present evidence of learning for each, divided into four segments: selection of sub-competencies, description of the learning situation, critical analysis or the learning situation and personal improvement suggestions.

This evaluative process is augmented by formative assessments, featuring continuous feedback from the university tutor. An initial synchronous session introduces the module, outlining the evaluation schedule and portfolio objectives. Over eight weeks, encompassing 200 h of direct engagement in educational centers, students submit weekly evidence. They receive asynchronous support and supervision from the university tutor via the Moodle platform. The initial session is pivotal for establishing foundational portfolio elements and facilitating constructive feedback. This feedback, derived from both educators and peers, utilizes a dual evaluation system: self-assessment and peer assessment. Subsequent evidence submissions occur weekly on Moodle, with educators providing feedback within three days. This ensures a consistent and systematic formative assessment process throughout the course.

For this analysis, the evaluation of the evidences—a compulsory component of the portfolio—serves as the foundation. This ensures the comparative study between humanities and science disciplines is based on uniform observational criteria. An accompanying flowchart details the structure described above (Fig. 1).
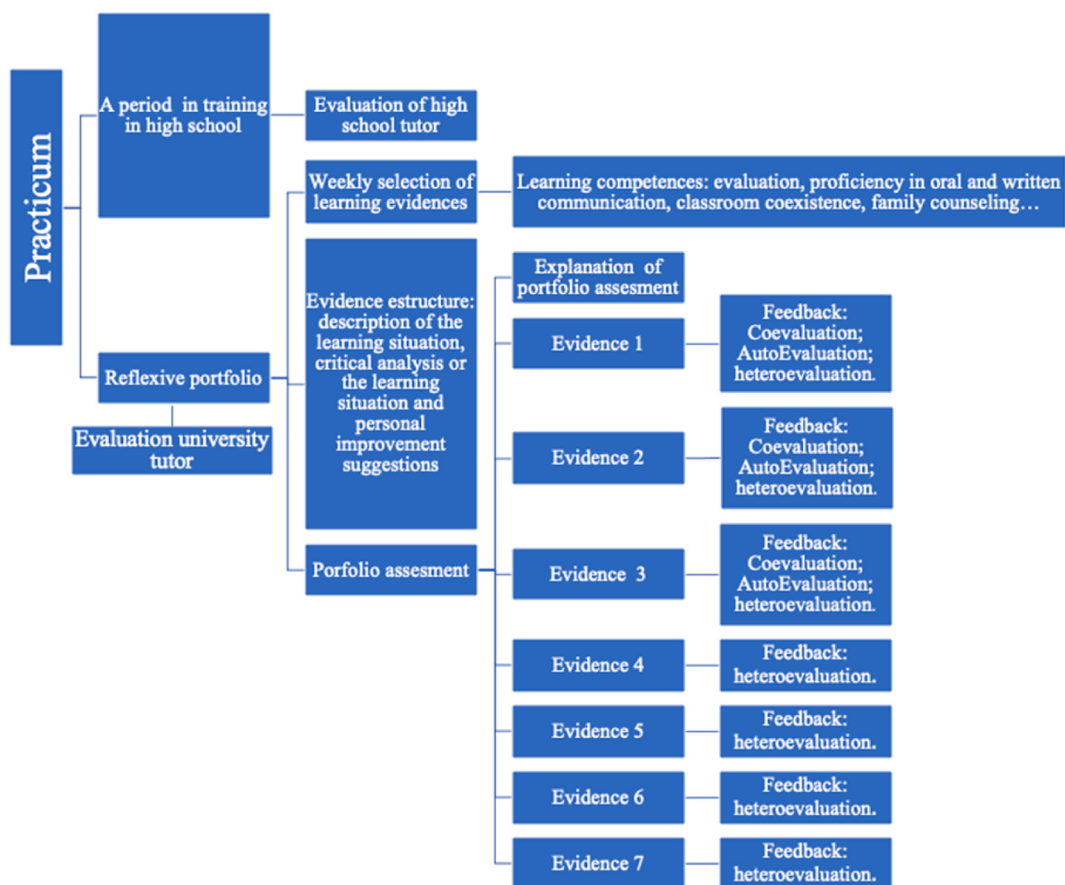
Fig. 1. Flowchart of Practicum.
This flowchart is representative of Practicum process (Highschool and University assesment).

2.2. Participants and sample

During the 2021/2022 academic year, within the Master's Degree in Teacher Training at the University of León, specifically for the Practicum course, a total of 19 students were enrolled in the Language and Literature module (belonging to the humanities branch), and 13 students were enrolled in the Physics and Chemistry module (pertaining to the experimental sciences branch).

To successfully complete the course, it was required for students to assemble a reflective portfolio containing 7 pieces of evidence as outlined previously. In developing their portfolios, each student produced a total of 7 pieces of evidence. Six of these were directly tied to the competencies and sub-competencies detailed in the course documents, with the seventh serving as a comprehensive summary.

For the purpose of analysis, one piece of evidence per student was selected for closer examination, specifically focusing on those evidences that dealt with evaluation sub-competencies. This selection criterion was applied because these sub-competencies were the only ones that were compulsory in choosing the content for the portfolio. This approach was taken to ensure that any differences observed in the subsequent metacognition analysis would stem not from the variability of the selected sub-competence but from the students' own reflective abilities.

2.3. Type of study and instrument

The study employs a mixed-method descriptive design, incorporating both documentary analysis (using selected evidences from the reflective portfolio) as the research methodology. This design facilitates the analysis of ideas presented in the documentary sources under review [24], enabling a comprehensive qualitative and quantitative examination of the data recorded. The research procedure is divided into two phases:

In Phase 1, a selection of documents was carried out. In this way, 32 learning evidences related to evaluation competencies were used, as it is mandatory for students to select both sub-competencies in this theme, which ensures more reliable comparisons.

Phase 2 employs the integrative review method [25] to both construct the analysis instrument and analyze the learning evidences. Through the integrative review, a consolidation of theoretical and/or methodological insights and research findings regarding the impact of portfolios on students' metacognitive development was achieved. This process aimed to construct a theoretical framework to inform the development of the study's analytical template. Relevant literature was surveyed across databases such as Eric, Scopus, Dialnet, and Web of Science to support this effort.

The analytical template's final structure is organized into three primary categories: description of the situation (comprising 4 items), analysis (9 items), and proposals for improving personal learning (8 items), totaling 21 indicators. These categories mirror the structure required of each piece of evidence submitted by students, ensuring a cohesive framework for the instrument, which encompasses 21 indicators in total. The instrument was developed by a panel of 5 experts in general and specific didactics related to the practicum subject. An initial set of 50 indicators was generated through a brainstorming session, which was then refined over two rounds of review: an initial screening followed by a subsequent refinement phase to enhance clarity and reduce ambiguity in evaluation.

To assess the effectiveness of the portfolios and mitigate potential biases [26], a retrospective and objective evaluation of the indicators' fulfillment (yes/no) was conducted by three experts: two professors specializing in the Master's program and one expert professor in university practicum, all affiliated with the University of León.2.4. Statistical analysis.

The data were refined through qualitative content analysis by coding the meaning of the different analysis categories present in each student's evidence of the reflective portfolios, and the final results were then established through quantitative analysis of achievement frequencies (yes/no) collectively. The analysis of each piece of evidence was developed, as previously mentioned, by an odd number of experts (3), so in the event of failing to reach a consensus, the majority option prevails (or in other words, the option chosen by 2 out of the 3 experts). Subsequently, to perform the comparison between the achievements of students in sciences versus humanities, the Mann-Whitney U test for non-parametric variables was conducted, in which a $p \leq 0.05$ was considered a significant difference between groups [27].

3. Results

In this section, an initial interpretation is provided, starting with a summary of the main trends observed, followed by a contextualization of these trends in relation to the expectations established by previous literature and the objectives of our research.

Table 1
Percentage of achievement of the indicators corresponding to the first category of the evidence: Description of the learning situation. * means significative differences ($p \leq 0.05$).

	All results (%)		Physics and Chemistry (%)		Language and Literature (%)		U de Mann-Whitney
	Yes	No	Yes	No	Yes	No	p value
1. Details the learning situation from an objective perspective.	78.1	21.9	69.2	30.8	84.2	15.8	0.50
2. Supports the description from the general to the particular.	62.5	37.5	46.2	53.8	73.7	26.3	0.20
3. Describes a real learning situation.	81.3	18.8	61.5	38.5	94.7	5.3	0.12
4. Provides the data necessary to support the following analysis	62.5	37.5	30.8	69.2	84.2	15.8	0.01*

Particularly, it highlights the influence of previous academic background in science versus humanities specialties. Subsequently, we present the specific results, divided into the three categories of each evidence of the portfolio: description of learning situation, analysis, and improvement proposals, which reflect the metacognitive competencies of students in teacher training.

3.1. Description of the learning situation

Table 1 presents the results detailing how students describe observed learning situations. It was found that a significant majority, 78.1 %, were able to make objective descriptions of these situations (item 1), focusing on facts without inserting personal judgments. However, there still remains 21.9 % who fail to maintain the necessary objectivity. When analyzing how students move from a general view to specific details in their descriptions (item 2), 62.5 % showed an ability to make this transition, while 18.8 % demonstrated difficulties. This skill is crucial for understanding and communicating the complexity of learning situations, highlighting particular details after establishing the general context.

Regarding the application of these skills during their practices, 81.3 % of the students described real-life situations they experienced, suggesting a strong connection between theory and practice (item 3). Equally important is the fact that 62.5 % provided concrete and relevant data that can be used for deeper analysis (item 4), indicating they can identify and record essential elements that are fundamental for reflection and subsequent learning. These results reflect the students' ability to observe, describe, and analyze educational situations efficiently.

Regarding the differences between specialties, significant differences were only observed in item 4, where humanities students achieved a higher level of accomplishment compared to the students in science. It is worth noting that even though the results did not reach statistical significance in the other items, numerically, students in language and literature obtained better achievement in all of them.

3.2. Analysis capability of the learning situation

In Table 2, we delve into the metacognitive analysis conducted by the practicum students of the Master's program. It reveals that a substantial portion of the students (40.6 %, item 5) utilized prior knowledge to analyze teaching-learning situations, indicating a positive tendency towards self-reflection and the application of past experiences to new educational contexts. Nonetheless, the linkage of this knowledge to new situations was achieved by only 50 % (item 6), pointing to an area ripe for enhancement in the capacity to integrate and apply theoretical knowledge practically. Furthermore, less than half of the students supported their findings with prior scientific knowledge (40.6 %, item 8), highlighting a shortfall in the ability to argue and provide theoretical underpinnings. While 65.6 % (item 9) were able to draw conclusions based on reflection, a mere 40.6 % (item 10) developed their discourse grounded in theory and practice, raising questions about the depth of critical thinking and the internalization of pedagogical competencies. More than half proposed general lines of action (59.4 %, item 12), yet the demonstration of metacognitive competence in their learning was evident in only 40.6 % (item 10) of the evidence.

When evaluating differences in portfolios between specialties, similar to the descriptive section, significant differences were observed in only one item. Students in language and literature were more efficient in developing their discourse based on theoretical and practical aspects, with 63.2 % achieving this, while in the case of students in physics and chemistry, only 7.7 % achieved it. As with the description, students in the sciences showed lower achievement values in all items, although significant differences were not observed.

3.3. Improvement proposals for own learning

Table 3 displays the results concerning improvement proposals for the students' own learning in their teaching role. It is evident that the overall achievement of the students was even lower than in the previous sections, with achievement ranging from 12.5 % to 62.5 %.

Table 2

Percentage of achievement of the indicators corresponding to the second category of the evidence: Analysis of the learning situation. * means significative differences ($p \leq 0.05$).

	All results (%)		Physics and Chemistry (%)		Language and Literature (%)		U de Mann-Whitney
	Yes	No	Yes	No	Yes	No	p value
5. Part of prior knowledge to analyze the situation	40.6	59.4	30.8	69.2	47.4	52.6	0.45
6. Connects prior knowledge with new situations	50.0	50.0	30.8	69.2	63.2	36.8	0.13
7. Describes the acquisition of new learning	53.1	46.9	46.2	53.8	57.9	42.1	0.60
8. Supports their findings with scientific knowledge	40.6	59.4	38.5	61.5	42.1	57.9	0.88
9. Draws general conclusions based on reflection	65.6	34.4	61.5	38.5	68.4	31.6	0.76
10. Develops their own discourse based on theory and practice	40.6	59.4	7.7	92.3	63.2	36.8	0.01*
11. Establishes action protocols based on reflection	50.0	50.0	30.8	69.2	63.2	36.8	0.13
12. Proposes generic guidelines for action	59.4	40.6	46.2	53.8	68.4	31.6	0.31
13. Demonstrates metacognitive competencies in their own learning	40.6	59.4	38.5	61.5	42.1	57.9	0.88

In a global perspective, it is observed that 40 % of the students identified specific deficiencies in their teaching competencies (item 14), and 56.3 % established mechanisms to address them (item 15). 62.5 % of the students used relevant bibliography to enhance the reflective process of their evidence (item 16), and 50 % included bibliographic references in line with the proposal (item 17). When it comes to excluding guidelines from the improvement process, only 12.5 % of the students were able to achieve this (item 18). Half of the students described the process without generating new points of analysis (item 19), while 53.1 % managed to present individual improvement proposals for their own learning (item 20). Finally, only 15.6 % of the students demonstrated metacognitive competencies in self-assessment of their teaching (item 21).

When examining differences between the experimental groups, greater variability in responses was observed. Science students displayed higher values in identifying deficiencies in their teaching competencies compared to the humanities students, with a tendency ($p < 0.10$, item 14). Nevertheless, they later implemented mechanisms to rectify these shortcomings, albeit to a lesser extent, with a noteworthy distinction ($p < 0.05$, item 15) favoring students in humanities disciplines. Substantial variances were similarly observed in the regularity of utilizing bibliographic resources to articulate an enhancement process, with humanities students demonstrating superior outcomes, mirroring the findings of the preceding item (item 16). In the other parameters, no significant differences were observed, although it is worth noting the low achievement in this category in both groups, especially in the exclusion of action guidelines as an improvement proposal (item 18) and in metacognitive competence for self-assessment of their own deficiencies, where the achievement percentage was below 30 % in both specialties, specifically, language and literature students showed an achievement percentage of 5.3 %, which was the lowest achievement among all the items in this study (item 21).

The study's findings suggest a foundational proficiency among students in describing and reflecting on learning situations. However, there is a marked discrepancy between students' ability to identify and analyze their pedagogical strengths and weaknesses and their capacity to formulate and apply effective strategies for improvement. Humanities students demonstrate a more robust capacity for critical reflection and application of pedagogical theory, as evidenced by their more effective use of corrective strategies and bibliographical resources. Across all students, the ability to critically assess their teaching practices and to discern relevant from non-relevant improvement strategies remains an area in need of significant development. These trends underscore the necessity for pedagogical programs to intensify focus on metacognitive skills training to bridge the gap between theoretical knowledge and practical teaching competencies.

4. Discussion

We acknowledge that, based on the findings, we cannot claim a significant impact of reflective portfolios without considering the methodological limitations and the scope of our research, aspects which are thoroughly addressed in the conclusions section.

Taken in account the first of our Objective, our data indicate that while students demonstrate an emerging awareness of their learning processes, they show considerable variability in their ability to apply this metacognitive insight to effectuate pedagogical improvements. This aligns with McCluskey et al. [5] and Valenzuela [6], who emphasize the importance of reflective practice in teacher education, and is further substantiated by the work of Kramarski and Michalsky [8] on the impact of metacognition on teaching effectiveness.

Related to the second Objective 2, we observe a notable distinction in metacognitive competency between students of humanities and sciences, resonating with Tobias and Everson's [14] assertion that disciplinary backgrounds shape cognitive processes. Humanities students appear more adept at integrating reflective practices into their teaching, an observation supported by McNamara and Magliano [12]. However, our findings suggest the need for pedagogical strategies that go beyond current practices, echoing Bransford, Brown, and Cocking's [23] advocacy for deeper learning through effective metacognitive strategies.

Additional references from the literature highlight the complexities of embedding metacognitive strategies within teacher training. Grimes [15] discusses the overconfidence in one's metacognitive abilities, a trend observed in the difficulty students displayed in evaluating the efficacy of their instructional strategies. Similarly, Thiede et al. [13] suggest that effective metacognitive practices are integral to understanding one's own learning, a point of struggle among our participants. Zohar and Barzilai [9] highlight the necessity of metacognitive knowledge for autonomous learning, a critical outcome for teacher preparation programs aiming to foster independence in future educators. Lastly, Barrientos and López-Pastor [17] discuss the transformative power of formative assessment in

Table 3
Percentage of achievement of the indicators corresponding to the third category of the evidence: Improvement proposals. * means significative differences ($p \leq 0.05$).

	All results (%)		Physics and Chemistry (%)		Language and Literature (%)		U de Mann-Whitney
	Yes	No	Yes	No	Yes	No	p value
14. Identifies deficiencies in their didactic competencies	40.6	59.4	61.5	38.5	26.3	73.7	0.09
15. Establishes mechanisms to address these deficiencies	56.3	43.8	30.8	69.2	73.7	26.3	0.04 *
16. Utilizes bibliography consistent with the improvement process	62.5	37.5	38.5	61.5	78.9	21.1	0.04*
17. Summarizes bibliographical sources in line with the proposal	50.0	50.0	46.2	53.8	52.6	47.4	0.76
18. Excludes action guidelines from the improvement proposals	12.5	87.5	7.7	92.3	15.8	84.2	0.71
19. Describes without generating new points of analysis	50.0	50.0	53.8	46.2	47.4	52.6	0.76
20. Presents improvement proposals individually	53.1	46.9	46.2	53.8	57.9	42.1	0.60
21. Demonstrates metacognitive competencies in self-assessment	15.6	84.4	30.8	69.2	5.3	94.7	0.24

teacher education, a concept mirrored in our findings where the need for a feedback-rich, reflective learning environment is clear.

Thus, our discussion weaves the empirical data with these theoretical perspectives, proposing a multifaceted approach to teacher education that prioritizes metacognitive skill development.

Finally, we have contemplated the crucial role of supervision and guidance in the students' reflective process about their practical experiences. Previous studies [28] have highlighted how students face difficulties in reflecting on their practical experiences without structured guidance and the support of supervisors. Our findings confirm this perspective, underscoring the importance of considering the role of feedback and how to effectively promote this process. We acknowledge that focusing solely on the students' metacognitive skills is not sufficient if supervision has not been organized in a way that enhances the development of metacognitive abilities and reflection.

5. Conclusions

This study has underscored the significant impact of reflective portfolios in enhancing metacognitive competencies among teacher trainees, a crucial aspect in the development of effective teaching practices. We found that while students generally demonstrated a basic level of success in describing learning situations, there was a notable deficiency in deeper analytical skills and the development of self-improvement strategies. These observations are critical as they highlight the need for more focused and robust training in metacognitive skills.

Furthermore, our analysis revealed substantial differences in metacognitive competencies between students from humanities and science backgrounds, suggesting that initial training and educational background play a pivotal role in the development of these competencies. The findings emphasize the importance of integrating comprehensive discursive and metacognitive training across all disciplines.

In conclusion, our study contributes valuable insights into the role of reflective portfolios in teacher training and highlights the need for enhanced metacognitive training across various educational disciplines. The proposed future research directions aim to build on these findings, contributing to the development of more effective and comprehensive teacher education programs.

In our study, several limitations were identified that are important for contextualizing the findings and their applicability. First, the size and diversity of the sample could limit the generalization of the results to broader populations or to different educational contexts, given its specific composition. On the other hand, the predominantly cross-sectional design of the study restricts our ability to infer causality or to trace the evolution of metacognitive competencies over time. We must also consider that the data collection methods used, including self-reports and document analysis, could introduce biases, such as social desirability bias, affecting the reliability of the participants' responses. Perhaps, from our perspective, the greatest limitation we note is related to the measurement of metacognitive competencies, as it faces inherent challenges in terms of objectivity and reliability, which may affect our interpretation of these competencies in the educational sphere. Finally, the specific context in which the study was conducted could limit the extrapolation of our findings to other contexts or educational levels, suggesting that the applicability of the results might be circumscribed to conditions similar to those of our study environment.

Looking ahead, our research opens avenues for further exploration and intervention. We propose to provide the student body with the analysis tool developed in this study, enabling a more profound re-evaluation of metacognitive abilities and reflective capacities. Such an intervention aims to address the identified gaps and enhance overall teaching competencies.

Additionally, to build on the insights gained, we plan to expand our research to include a more diverse and extensive sample covering all specializations within the Master's program. This expansion, coupled with an increased number of expert evaluators, will offer a more comprehensive understanding of the metacognitive competencies across different educational backgrounds and disciplines. This holistic approach is vital for developing effective and inclusive educational strategies that cater to diverse learning needs and preferences.

Data availability statement

The study data are available in the research data repository of the University of León (https://buleria.unileon.es/handle/10612/18754).

CRediT authorship contribution statement

Carolina Blanco Fontao: Writing – review & editing, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Miriam López Santos:** Writing – original draft, Validation, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Ana R. Arias-Gago:** Writing – review & editing, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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