

RESEARCH ARTICLE

Impact of Teaching Practicum Experiences Through Teaching Portfolios on the Agency of Pre-service Science Teachers

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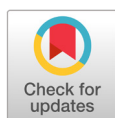
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ABSTRACT

This study aims to examine the impact of engaging in reflective experiences on one's own teaching through teaching portfolios during a teaching practicum on the agency of pre-service science teachers. To achieve this, we instructed 20 pre-service science teachers who participated in the teaching practicum in May 2024 to create teaching portfolios. These portfolios contained classroom discourse analyses and self-evaluations of lessons from the early, middle, and final stages of the practicum. We assessed agency at both the onset and conclusion of the practicum, and subsequently carried out in-depth interviews to help interpret the findings. The findings of the study are as follows. First, even short-term reflective activities based on teaching portfolios led to significant changes in teacher agency. Second, the pre-service teachers who critically reflected on their lessons developed a stronger awareness of themselves as agents of their teaching. These teachers were able to enhance their ability to make creative decisions when selecting and reorganizing instructional materials.

Keywords: Teaching portfolio, reflection, pre-service science teacher



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Introduction

Teachers play a pivotal role in shaping educational settings and are recognized as key agents of change (Um, 2020). Their ability to demonstrate agency depends on environments that support exploration and innovation (Kim, 2019). In an evolving educational landscape, teachers must respond swiftly and effectively to diverse pedagogical demands. This capacity extends beyond implementation skills and is defined as teacher agency—the ability to make intentional decisions and take action within educational contexts (Biesta et al., 2015). Teacher agency is not an innate characteristic; rather, it is a complex construct that emerges through specific situational contexts. It empowers educators to critically engage with and reshape instructional structures and cultural norms in alignment with their professional values. This capacity extends beyond professional competence; it involves applying critical reflection and self-awareness in decision-making (Kim,

2019). Because teacher agency does not develop easily in short periods, it must be cultivated intentionally from the pre-service stage before individuals enter the profession (Priestley et al., 2012).

Reflective teaching experiences allow educators to assess and refine their instructional practices while fostering a sense of accomplishment (Cho & Kim, 2018). Reflecting on teaching enables teachers to reassess instructional goals and strategies, making it a key component in developing teacher agency (Jeong et al., 2023). The ability to critically examine formal schooling and teacher identity is essential for future educators and is emphasized in teacher education programs (Biesta et al., 2015). Through the practical experience of a teaching practicum, pre-service teachers design lessons, interact with students, and establish their identity as educators (Cobb et al., 2018).

A teaching portfolio functions as an organized framework that facilitates reflective practice. It enables pre-service teachers to revisit their teaching practices, assess instructional methods, interpret student feedback and classroom interactions, and reflect on their underlying educational beliefs. Constructing a portfolio helps teachers identify their role as active agents in lesson implementation, providing opportunities for structured self-reflection and continuous improvement (Cobb et al., 2018). A teaching portfolio is also utilized as a tool to encourage pre-service teachers to reflect on and analyze their instructional practices. It typically contains various materials such as lesson plans and records of implementation, observations of other teachers' classes, and individual research documents (Snyder et al., 1998). Teaching portfolios serve as powerful tools that help pre-service teachers integrate their instructional beliefs with actual teaching experiences, thereby promoting long-term professional development. Yang and Kim (2023) utilized teaching portfolios to analyze how pre-service chemistry teachers anticipated and experienced stress during their teaching practicum. Over the course of four weeks, the pre-service teachers documented their lesson preparation and implementation through reflective entries in their teaching portfolios. Similarly, Corrigan and Loughran (1994) guided pre-service science teachers in Australia to reflect on their identity as science teachers over the span of one year. These teachers were encouraged to articulate what they had learned through various classroom experiences, what those experiences meant to them, and how such learning might influence their future teaching practices. As a result, teaching portfolios were found to function as effective instruments for helping pre-service science teachers meaningfully integrate their pedagogical beliefs and learning experiences, and to support their sustained professional growth. Teaching portfolios promote self-motivation and autonomy in teaching, moving the emphasis away from external evaluation and toward personal growth, which lies at the heart of teacher agency.

Several studies have explored the relationship between teaching portfolios and teacher agency among pre-service science teachers. Fairbanks and LaGrone (2006) analyzed how teachers in a learning community engaged in reflective practice and reconstructed their lessons. They found that teachers who focused on problematic classroom situations used diverse forms of discourse to share experiences and engage in reflective conversations that fostered agency. Kim et al. (2010) investigated the teaching performance of pre-service teachers during their practicum, using lesson evaluations and reflective journals. Their results showed that most pre-service science teachers improved various instructional components throughout the practicum. Many also perceived reflective journal writing as an effective tool for analyzing their lessons objectively and identifying areas for improvement. Lee and Kim (2021) explored the manifestation of science teacher agency during the second year of remote instruction amid the COVID-19 pandemic. Using

semistructured interviews and lesson materials from three secondary science teachers, they found that although teachers gradually adapted to remote instruction, they continued to experience challenges. Some strengthened their agency by reconstructing lessons through reflection or shifting toward student-centered teaching. An and Kim (2021) investigated the development of science teacher identity among pre-service teachers through a semester-long cycle of biology inquiry lessons and reflection. By analyzing discourse from pre- and post-lesson reflections, written assignments, and interviews, the study found that pre-service teachers shaped their professional identity through reflective practice. They came to perceive reflection not merely as an evaluative task but as an essential process for professional growth.

Although teacher agency has garnered growing attention, few studies have investigated how reflective teaching experiences through teaching portfolios influence changes in teacher agency during the practicum. Focusing on reflective practices supported by teaching portfolios, this study investigates how such experiences contribute to the development of agency in pre-service science teachers. To explore this issue, the study focuses on several central questions:

1. What is the level of agency among pre-service science teachers at the beginning of the teaching practicum?
2. How does engaging in reflective teaching experiences using teaching portfolios during the practicum influence the agency of pre-service science teachers?

Research Methods

Participants

This study examined twenty pre-service science teachers who participated in a teaching practicum in May 2024. The participants were third-year students from K University in the Chungnam region. The study's goals were outlined to participants before data gathering commenced, and informed consent was secured. Table 1 provides details about the participants.

Table 1. Information of the participant group

Practicum School Level	Gender	Number of participants
Middle School	Male	3
	Female	1
High School	Male	6
	Female	10

Research Design

Conducted between April and June 2024, this study explores the impact of reflective teaching experiences through teaching portfolios on the agency of pre-service science teachers. In April, based on previous research (Ahn & Kim, 2024; Lee & Kim, 2021; Mortimer & Scott, 2003), we established a structured portfolio format to facilitate reflective practice. In the third week of April, the course instructor provided an orientation on portfolio development during a practicum-linked class. Pre-service teachers were required to submit online portfolios at three stages of their practicum: early, middle, and final. The teaching portfolio consisted of two main components: classroom discourse analysis and self-evaluation. Its structure was as follows. For the classroom discourse analysis, each pre-service teacher recorded

and transcribed their teaching sessions, then examined the classroom interactions. This analysis focused on identifying teaching patterns such as the frequency of teacher questions, instances of teacher evaluation and feedback, and other relevant indicators. Following this analysis, participants completed a self-evaluation using eight open-ended questions adapted from Lee and Kim (2021) interview protocol on science teacher agency. These questions were modified to suit the practicum context and the characteristics of pre-service teachers. One example question was: ‘What were the shortcomings of your pre-practicum teaching demonstration, and how did you attempt to improve them in this lesson?’

To assess changes in teacher agency, a pretest was conducted in the second week of May (early practicum), followed by a post-test in the fourth week of May (late practicum). After completing the practicum, in-depth interviews with all 20 participants were held in the first week of June. Each interview lasted approximately 2 hours and focused on their experiences with teaching portfolios and reflective practice.

Measurement Instruments

To examine changes in the agency of pre-service science teachers engaged in teaching portfolio activities, this study adopted the agency assessment instrument developed by Hull and Uematsu (2020). The original instrument, comprising 31 items designed for physics teachers, was reviewed to ensure relevance for pre-service science educators. We modified item wording as needed, and an expert panel (including two science education professors, two in-service science teachers, and one graduate student) evaluated the revised items. Following a pilot test with pre-service teachers, further revisions were made, resulting in a final set of 18 items used in this study. Responses to all items were recorded using a five-point Likert scale. The overall mean Cronbach’s α values were 0.815 for the pretest and 0.800 for the post-test, indicating acceptable internal consistency. Table 2 lists the assessment items used in this study.

Table 2. Items measuring the teacher agency

Items
1. If my chemistry students struggle to understand the material, I will allocate more time to support their learning, even if certain planned topics are omitted.
2. Once I select a chemistry textbook, I will just use it, at most, as a guide. I will not hesitate to skip sections or addressing poorly worded, confusing, or inaccurate.
3*. Teaching is just a job that provides a paycheck. I gain no benefit from it beyond financial compensation.
4. Outdated classroom equipment does not justify poor instruction. I will just have to rely more on creativity!
5. I feel that I have control over both what I teach and the way I teach it.
6*. The content covered in my class offers minimal benefit to students in other courses and/or in everyday life.
7. I will provide quality education to my students, even if it requires more preparation time than my colleagues invest.
8. I believe I have a direct impact on my students’ progress.
9. Curricular resources are, at most, a guide for teachers to use or modify creatively, based on the situation.
10*. My students will have taken many classes before taking my class, and they will likely already have a sense of how a class “should go.” I need to teach in that style too, otherwise my students might find it too unconventional.
11. In my chemistry class, I will combine textbooks with supplementary materials, selecting the best content from multiple sources.
12. I find personal fulfillment from teaching.
13. I feel responsible for supporting my students’ learning.
14*. I will not dedicate more preparation time than my colleagues, even if it compromises lesson quality.
15. I think what my students learn in my class will be useful for students in other courses and in their daily lives.
16*. I think my students’ progress is independent of my instructional efforts as a teacher.
17*. In some schools, teaching may be less effective because of outdated equipment in the chemistry classroom. That’s something I can’t directly address in my role as a teacher.
18. I think the general skills students develop in my class will improve their chances of future success.

*This item is negatively worded and was reverse-coded for analysis.

Data Collection and Analysis

We collected teaching portfolios online from pre-service science teachers at three intervals: in the second, third, and fourth weeks of May. Pre- and post-agency assessments were also submitted via an online form in the second and fourth weeks of May, respectively. Responses to self-evaluation items were gathered simultaneously and used as supplementary data for interpreting the results. Considering the limited number of participants ($N = 20$), the Shapiro-Wilk test was chosen as an appropriate method for testing the normality of the data distribution. The test yielded a significance value of 0.741, confirming that the assumption of normality was met. Accordingly, parametric statistical methods were employed. This study employed a one-group pretest-posttest design to examine the impact of teaching portfolio-based practicum experiences on the agency of pre-service science teachers. Drawing on prior studies (Choi et al., 2015; Jeong, 2016; Lee et al., 2021; Sim & Byun, 2025), a paired-sample t-test was conducted to determine whether there were statistically significant differences between pre- and post-intervention scores. To assess the magnitude of the observed effect, Cohen's d was calculated. According to Cohen (1992), a d value of 0.2 or less is considered small, 0.5 indicates a moderate effect, and 0.8 or above reflects a large effect.

We transcribed and meticulously reviewed the teaching portfolios and in-depth interview recordings. Relevant statements reflecting participants' reflections and observed changes were annotated and categorized. To strengthen the study's validity and reliability, an expert panel (including two science education professors, two in-service science teachers, and one graduate student) provided ongoing consultation and review throughout the research process, from study design to result interpretation.

Results

Agency of Pre-service Science Teachers Before the Teaching Practicum

Table 3 presents the agency assessment results for pre-service science teachers at the outset of the teaching practicum.

Table 3. Agency of pre-service science teachers before the teaching practicum (continued)

Items	Mean SD)
1. If my chemistry students struggle to understand the material, I will allocate more time to support their learning, even if certain planned topics are omitted.	3.95 (0.89)
2. Once I select a chemistry textbook, I will just use it, at most, as a guide. I will not hesitate to skip sections or addressing poorly worded, confusing, or inaccurate.	3.85 (1.18)
3. Teaching is just a job that provides a paycheck. I gain no benefit from it beyond financial compensation.	4.65 (0.49)
4. Outdated classroom equipment does not justify poor instruction. I will just have to rely more on creativity!	3.60 (1.23)
5. I feel that I have control over both what I teach and the way I teach it.	3.35 (1.18)
6. The content covered in my class offers minimal benefit to students in other courses and/or in everyday life.	4.35 (0.67)
7. I will provide quality education to my students, even if it requires more preparation time than my colleagues invest.	4.70 (0.47)
8. I believe I have a direct impact on my students' progress.	4.70 (0.47)
9. Curricular resources are, at most, a guide for teachers to use or modify creatively, based on the situation.	3.35 (1.27)
10. My students will have taken many classes before taking my class, and they will likely already have a sense of how a class "should go." I need to teach in that style too, otherwise my students might find it too unconventional.	4.45 (0.89)
11. In my chemistry class, I will combine textbooks with supplementary materials, selecting the best content from multiple sources.	4.15 (0.88)
12. I find personal fulfillment from teaching.	4.25 (1.02)
13. I feel responsible for supporting my students' learning.	4.85 (0.47)

Table 3. Agency of pre-service science teachers before the teaching practicum

Items	Mean SD)
14. I will not dedicate more preparation time than my colleagues, even if it compromises lesson quality.	4.90 (0.31)
15. I think what my students learn in my class will be useful for students in other courses and in their daily lives.	4.25 (0.72)
16. I think my students' progress is independent of my instructional efforts as a teacher.	4.10 (0.72)
17. In some schools, teaching may be less effective because of outdated equipment in the chemistry classroom. That's something I can't directly address in my role as a teacher.	4.35 (0.81)
18. I think the general skills students develop in my class will improve their chances of future success.	4.25 (0.72)
Total	4.23 (0.42)

The average agency score was 4.23, indicating a relatively high level of perceived agency. Among the survey items, Items 13 and 14 received the highest scores. Item 13 (I feel responsible for supporting my students' learning.) had a pretest mean of 4.85. Item 14 (I will not dedicate more preparation time than my colleagues, even if it compromises lesson quality.) had a pretest mean of 4.90. These results reflect participants' strong sense of responsibility for student learning and their attitudes toward lesson preparation compared to peers. The findings suggest that even before the practicum, pre-service science teachers demonstrated a relatively strong sense of agency and ownership over their role in education.

In contrast, Items 5 and 9 showed the lowest average scores. Item 5 (I feel that I have control over both what I teach and the way I teach it.) had a pretest mean of 3.35. Item 9 (Curricular resources are, at most, a guide for teachers to use or modify creatively, based on the situation.) also had a pretest mean of 3.35. These results indicate that pre-service teachers felt less confident in their autonomy over instructional content and methods and in their ability to creatively adapt educational materials. This trend was also observed in Week 1 self-evaluation responses. Pre-service teachers reported difficulties in managing lesson structure and flow, as well as in adjusting materials based on student reactions. They acknowledged a lack of confidence in decision-making related to time management, monitoring student engagement, and presenting content clearly. This reveals that they were still developing the capacity to function as autonomous instructors.

Pre-service teacher A's week 1 self-evaluation responses: Because the pre-practicum teaching demonstration was conducted in a simulated environment, directly assessing student participation, such as completing Padlet entries or answering questions was difficult. As a result, my 15-minute microteaching goal was not met, and I only taught for 11 minutes. In the real classroom, I could gauge how much time students needed for activities, which helped me practice adjusting the lesson pacing.

Pre-service teacher B's week 1 self-evaluation responses: I realized I should have given students more time to process the graphs and formulas. The lesson felt rushed. Moreover, instead of repeatedly writing and erasing on the board, I should have simplified the content to make it clearer for students. I noticed their understanding progressed more slowly than I expected, so I resolved to explain concepts more carefully and at a slower pace.

Agency of Pre-service Science Teachers Before and After the Teaching Practicum

To assess the impact of reflective experiences gained through teaching portfolios during the practicum, agency assessments were conducted before and after the teaching experience. Table 4 presents the results.

Table 4. Agency of pre-service science teachers before and after the teaching practicum

Items	Mean (SD)		t	p
	Pre-	Post-		
1	3.95 (0.89)	4.10 (1.07)	-0.679	0.505
2	3.85 (1.18)	3.95 (1.05)	-0.462	0.649
3	4.65 (0.49)	4.75 (0.44)	-1.453	0.163
4	3.60 (1.23)	3.90 (1.25)	-1.241	0.230
5	3.35 (1.18)	3.95 (1.15)	-2.179	0.042*
6	4.35 (0.67)	4.55 (0.69)	-1.710	0.104
7	4.70 (0.47)	4.85 (0.37)	-1.371	0.186
8	4.70 (0.47)	4.65 (0.75)	0.271	0.789
9	3.35 (1.27)	3.90 (1.17)	-3.240	0.004**
10	4.45 (0.89)	4.30 (0.86)	1.371	0.186
11	4.15 (0.88)	4.55 (0.60)	-1.902	0.072
12	4.25 (1.02)	4.60 (0.60)	-2.101	0.049*
13	4.85 (0.47)	4.95 (0.22)	-1.453	0.163
14	4.90 (0.31)	4.90 (0.31)	-	-
15	4.25 (0.72)	4.40 (0.68)	-1.831	0.083
16	4.10 (0.72)	4.35 (0.67)	-1.422	0.171
17	4.35 (0.81)	4.30 (0.92)	0.567	0.577
18	4.25 (0.72)	4.30 (0.66)	-0.438	0.666
Total	4.23 (0.42)	4.40 (0.38)	-3.203	0.005**

* $p < .05$, ** $p < .01$

A statistically significant improvement was observed, with the mean agency score rising from 4.23 before the intervention to 4.40 afterward ($p < 0.01$). The effect size, represented by a Cohen's d of 0.72, demonstrates that engaging in teaching portfolios significantly contributed to the development of agency among pre-service science teachers. A similar pattern emerged in participants' self-evaluations from the third week of the practicum. As the practicum advanced, they increasingly took ownership of their roles as lesson planners and instructional decision-makers. Participants showed the capacity to adapt lesson objectives in response to classroom dynamics, adjust their questioning strategies to promote student engagement, and implement real-time instructional changes based on students' levels of understanding and classroom interactions.

Pre-service teacher C's week 3 self-evaluation responses: While previous lessons had been largely theory-oriented, this particular session emphasized inquiry-based learning, leading me to revise the instructional objective. I began by introducing the concept of density, after which students were encouraged to generate their own methods for layering various materials to construct a density tower. The aim was for each group to collaboratively engage in the process and deepen their understanding of density through discussion. To facilitate the activity effectively, I circulated around the classroom, using preplanned, group-specific questions to promote independent thinking based on each group's progress.

Pre-service teacher D's week 3 self-evaluation responses: In my earlier lesson demonstrations, I struggled with handling student responses. When students gave incorrect answers to my questions, I got flustered and responded inappropriately. Therefore, in both last week's and this week's lesson, I tried to provide feedback that would not

make students feel embarrassed but would help them think in a different direction. For instance, during a lesson on dynamic equilibrium, I asked what would happen if yellow sugar were added to a saturated solution of white sugar. A student responded, "Nothing would change." I said, "Yes, it's reasonable to think that yellow sugar might just settle at the bottom without causing any visible change. But if we apply today's concept of solution equilibrium, could something else happen? Let's reconsider." In the first week, I simply panicked and failed to provide such feedback. However, now that I've taught more lessons, I feel more satisfied with how I can offer better responses to my students.

Because this study involved the development and application of a teaching portfolio, we conducted an item-level analysis to identify specific aspects of agency influenced by portfolio writing. Three items showed statistically significant effects ($p < 0.05$).

Item 5 (I feel that I have control over both what I teach and the way I teach it). reflects teachers' perceived instructional autonomy. In in-depth interviews, pre-service science teachers demonstrated increased awareness and actively sought to enhance their control over instruction as the practicum progressed.

Pre-service teacher E's in-depth interviews: Microteaching in university classes led me to assume I could simply walk around and monitor students. But in real classrooms, it was quite confusing. Before conducting experiments, I had to consider what I would do first, which videos I would use, and how long I would use them. During the class, I also had to maintain eye contact to check if students were paying attention. I realized that instructional strategies must be adjusted based on each school's unique characteristics.

Pre-service teacher F's in-depth interviews: In my first lesson, I lacked spontaneity. When a student gave an incorrect answer, I immediately provided the correct one instead of guiding them toward self-reflection. Later in the practicum, I realized my questioning strategies had improved significantly.

Item 9 (Curricular resources are, at most, a guide for teachers to use or modify creatively, based on the situation.) assesses a teacher's ability to adapt instructional materials. Interview responses indicated that pre-service teachers attempted to modify existing resources or implement new strategies to suit their classroom contexts.

Pre-service teacher G's in-depth interviews: At first, I thought that returning to my alma mater as a student teacher would naturally help me connect with students. But I was shocked to find many were not interested in chemistry and focused solely on college entrance exams. I had to make lessons more engaging. In my second lesson, I developed a game based on Hess's law, and in the third, I designed an experiment related to the topic. I invested considerable effort in making the material interesting.

Pre-service teacher H's in-depth interviews: While preparing for a lesson on evaporation and diffusion, I found an experiment using ammonia in the textbook. However, as its odor was too strong for a middle school lab, I decided to replace it with acetone. Students were fascinated by how acetone evaporated from their hands, and their feedback was overwhelmingly positive. After the lesson, the mentor teacher complimented me on my adaptation and creativity.

Item 12 (I find personal fulfillment from teaching.) reflects the intrinsic motivation and personal fulfillment associated

with the teaching profession. In-depth interviews revealed that the practicum experience and the process of creating portfolios allowed pre-service science teachers to reexamine their initial motivations and rediscover meaning in their teaching roles.

Pre-service teacher I's in-depth interviews: I started preparing for the national teaching exam this year, and it was really stressful. I often questioned the necessity of this practicum. However, when reviewing a recording of my lesson for the portfolio, I observed myself gesturing, smiling, and engaging with students. This reflection reminded me why I had chosen to become a teacher. Despite entering the practicum with a negative mindset, the experience of teaching and portfolio writing helped me reconnect with my original motivation.

Pre-service teacher J's in-depth interviews: While reflecting on feedback from my lessons, I realized that despite thorough preparation, I had often neglected effective questioning techniques in class. So I focused my lesson planning on structuring meaningful questions. I can confidently say I put in substantial effort to improve. As a result, students found the class engaging and enjoyable. Another student teacher even told me they learned a lot from me, and that feedback really stayed with me.

Discussions

The results of this study suggest that engaging in reflective teaching through the use of teaching portfolios had a positive impact on the agency of pre-service science teachers. This finding aligns with the results of Price and Valli (2005), who reported that pre-service teachers demonstrated a sense of agency by reflecting on classroom events, interactions, and instructional outcomes in their weekly reflective journals during the practicum, expressing the belief that “I can bring about change in this aspect.” Engaging in discourse practice through classroom discourse analysis within the teaching portfolio is considered to have contributed to the development of pre-service science teachers’ agency (Biesta et al., 2017). Pre-service teachers develop both professional competence and identity by recognizing themselves as educators within the practicum setting. This realization strengthens their perception of agency in lesson design and implementation of instruction (Cobb et al., 2018). To facilitate change requires teachers to not only identify challenges but also take deliberate actions to improve them (Thorgeirsdottir, 2019). When used effectively, portfolios empower teachers to reflect on their practice while fostering agency and professional growth (Wolf & Dietz, 1998). This teaching portfolio aims to help pre-service teachers reassess their conceptual understanding of teaching and articulate their professional knowledge (Corrigan & Loughran, 1994). The findings indicate that participants strengthened their sense of agency by engaging in critical reflection on their teaching practices and identifying areas for growth through portfolio use. This reflective process played a key role in fostering their development as autonomous instructional decision-makers.

The shift in perception regarding creativity in instructional material use suggests that teachers began to see these resources not as rigid content but as adaptable tools suited to instructional contexts (Biesta et al., 2015). Through practicum experiences and reflective practices, pre-service science teachers transitioned from passively relying on textbook materials to actively adapting and reorganizing content. In response to student engagement and classroom context, they modified instructional activities, thereby reinforcing their identities as instructional designers and facilitators.

Pre-service science teachers’ heightened awareness of their core educational values resonates with the findings of

Fairbanks and LaGrone (2006), who reported that participation in teacher inquiry communities enabled educators to adapt and reinterpret lessons through collaborative dialogue. Such experiences supported a shift from passive implementation to autonomous instructional practice. In a similar vein, participants in this study critically examined student responses during portfolio development and refined their questioning and feedback approaches, thereby actively shaping the trajectory of their instruction. Reflection fosters awareness and helps individuals recognize the significance of their experiences (Lyons, 1998). Teacher reflection should extend beyond recalling past lessons, leading to improved instructional practices and deliberate efforts to address challenges encountered in teaching (Seah & Yore, 2017). Pre-service teachers involved in programs promoting reflective thinking exhibited advanced reflection beyond technical analysis. They provided in-depth critiques and suggestions for improvement across all instructional phases, refining material selection, pedagogical strategies, and student engagement approaches (Kim et al., 2013). Teaching portfolios have been shown to support independent learning and encourage reflective teaching practices (Roecker et al., 2007). These tools are widely endorsed in teacher education for their ability to systematize instructional performance while fostering both personal reflection and professional growth (Sung et al., 2009). In the context of this study, pre-service science teachers exhibited agency by adapting their communication strategies and revising instructional materials to prioritize student-centered approaches. Through reflective practice, they developed greater instructional competence and reinforced their identities as self-directed, autonomous educators. The process by which teachers critically evaluate and select educational values to shape a good lesson is essential (Oh, 2013). In this study, pre-service science teachers modified instructional activities based on student engagement, indicating that their pedagogical choices were guided by reflections rooted in educational values. Their deliberate adjustments to teaching materials, questioning strategies, and feedback practices reflect an effort to translate those values into meaningful classroom actions. These findings highlight that teacher reflection extends beyond retrospective analysis; it functions as a proactive mechanism for shaping instructional decisions. Nevertheless, for reflective practice to be effective, it must be supported by structured opportunities and consistent feedback within the practicum setting. To position reflection as a foundational component of teacher professionalism, teacher education programs should integrate reflective thinking and classroom enactment as mutually reinforcing processes.

Conclusions

This study explored how engaging in reflective teaching through portfolio use influenced the development of agency among pre-service science teachers. Throughout the practicum, participants completed teaching portfolios at three distinct points, and shifts in agency were examined using pre- and post-assessments alongside in-depth interviews. The findings revealed two key insights.

First, reflective portfolio activities led to notable improvements in participants' sense of agency. Although the practicum lasted only one month, structured opportunities for deep reflection brought about meaningful changes in how participants perceived and approached their teaching. During the planning and delivery of lessons, pre-service teachers increasingly saw themselves as central instructional agents, deliberately organizing lesson flow and content. This suggests that teaching portfolios served not only as tools for looking back on teaching experiences, but also as

catalysts for critically analyzing and reshaping classroom interactions and instructional strategies. Through this process, participants internalized a greater sense of autonomy and accountability, enabling them to evaluate their practices critically and take ownership of future instructional decisions.

Second, participation in reflective portfolio activities deepened pre-service teachers' understanding of their roles as active instructional decision-makers. They demonstrated the ability to thoughtfully select, adapt, and restructure educational content, reinforcing their identity as educators capable of making informed and creative pedagogical choices. As teacher identity and practice develop through interaction (Cobb et al., 2018), teaching portfolios can serve as structured tools that connect reflection with instructional practice. Furthermore, agency is not formed solely by an individual's competencies but emerges through interactions within lesson contexts, the reflective medium of portfolios, and school culture (Biesta et al., 2015). These findings highlight the importance of teacher education programs moving beyond mere knowledge delivery and skill development, emphasizing the incorporation of structured frameworks that support reflective practice. From a constructivist perspective, reflection functions as a mechanism for internalizing and adapting teaching practices to diverse educational settings (Suh, 2007), ultimately enhancing agency.

Third, the teaching practicum experience using teaching portfolios holds educational significance in refining the agency of pre-service science teachers. Participants in this study demonstrated a high level of agency at the beginning of the practicum, with an average score of 4.23, indicating that they already possessed a strong sense of ownership over their teaching practices prior to the practicum. Nevertheless, the goal-oriented reflective activities conducted during the practicum contributed to the further development of more practical and challenging dimensions of agency, such as instructional autonomy and the creative adaptation of teaching materials. These experiences not only reinforced their professional identity as teachers who actively design and lead instruction, but also illustrated the value of teaching portfolios as an effective tool for enhancing the sophistication of pre-service teachers' instructional practice.

Finally, this study examined the impact of one-month portfolio-based reflective teaching experiences on the development of agency among twenty pre-service science teachers. While the findings offer valuable insights, the limited scope and sample size may constrain the generalizability of the results. To deepen understanding of reflective teaching practices, future research should include a more diverse participant pool and explore a wider range of instructional settings. In addition, this study was conducted over a relatively short period of one month, which presents a limitation in that the observed improvement in teacher agency may be the result of a short-term intervention. Since teacher agency is typically developed and reinforced gradually through sustained and authentic professional experiences, longitudinal research is needed to examine whether such changes are maintained as pre-service teachers transition into actual teaching positions.

Conflicts of Interest

The author(s) declare no conflicts of interest.

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