



Exploring the influence of collaborative reflection in a flipped classroom environment on preservice teachers' academic resilience and self-regulated learning

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Abstract

This study investigates the effects of structured collaborative reflection within flipped classrooms on preservice teachers' academic resilience and self-regulated learning (SRL). A mixed-method explanatory sequential design was employed, involving 120 preservice teachers from three Indonesian universities. Participants were assigned to four groups based on instructional model (flipped vs. traditional learning) and reflection type (structured vs. no reflection). Quantitative data were analyzed using two-way ANOVA, followed by qualitative analysis through thematic coding of interviews and reflective journals. Results indicated that the group receiving flipped learning with structured reflection (G1) outperformed others in both academic resilience and SRL. Three qualitative themes emerged: improved metacognitive awareness, emotional support from peers, and application of reflective practices beyond the classroom. Structured collaborative reflection enhances the benefits of flipped learning by fostering cognitive, emotional, and adaptive growth in preservice teachers. Integrating structured peer reflection into teacher education can improve long-term learning strategies and professional resilience. Future research should explore sustained effects and consider using AI-based tools to optimize reflective practices in technology-enhanced learning environments.

Keywords: Academic resilience, Flipped learning, Self-regulated learning, Structured collaborative reflection, Teacher education.

Citation | Meriyati, M., Romlah, R., Hadiati, E., Jatmiko, A., & Erwanto, E. (2026). Exploring the influence of collaborative reflection in a flipped classroom environment on preservice teachers' academic resilience and self-regulated learning. *Journal of Education and e-Learning Research*, 13(1), 86–99. 10.20448/jeelr.v13i1.8222

History:

Received: 28 March 2025

Revised: 18 December 2025

Accepted: 29 January 2026

Published: 23 February 2026

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Publisher: Asian Online Journal Publishing Group

Funding: This research received no specific financial support.

Institutional Review Board Statement: The Ethical Committee of Universitas Islam Negeri Raden Intan Lampung, Indonesia, has granted approval for this study on 6 February 2023 (Ref. No. B-027/Un.16/L2/TL.01/02/2023).

Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: M.M. led the research design, coordinated data collection, and drafted the initial manuscript. R.R. contributed to the literature synthesis and qualitative data analysis. E.H. conducted the quantitative analysis and helped with data interpretation. A.J. provided academic supervision and manuscript validation. E.E. oversaw ethical compliance and contributed to critical manuscript revision. All authors reviewed and approved the final version of the manuscript.

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Contribution of this paper to the literature

This study contributes to the literature by providing empirical evidence on how structured collaborative reflection enhances preservice teachers' academic resilience and self-regulated learning within flipped classrooms. It also highlights the pedagogical value of integrating peer-based reflective practices into technology-enhanced teacher education programs.

1. Introduction

In the ever-changing world of teacher education, equipping prospective teachers with academic resilience and self-learning skills (SRL) is increasingly important to support their future success. Being a teacher is not just about mastering teaching materials or techniques but also requires adapting to complex classroom dynamics, understanding the needs of diverse students, and facing various challenges that arise throughout the profession. Academic resilience, namely the ability to persist and achieve success despite facing academic and professional difficulties, is an important factor that helps prospective teachers manage emotions, overcome obstacles, and maintain enthusiasm amidst the pressures of the teaching environment (Martin & Marsh, 2006; Rudd, Meissel, & Meyer, 2021; Wang, King, Fu, Chai, & Leung, 2024). This ability is closely related to self-regulated learning skills, or SRL, which involve a process that includes metacognitive strategies, motivation, and behaviors. These skills help prospective teachers set learning goals, monitor their progress independently, and adjust learning strategies effectively (Imhof, Worthington, Burger, & Bellhäuser, 2024; Suud, Agilkaya-Sahin, Na'Imah, Azhar, & Kibtiyah, 2024). Although academic resilience and self-regulated learning (SRL) are recognized as important competencies in teacher readiness, pedagogical strategies specifically aimed at developing these competencies, particularly through technology-based collaborative learning, remain largely unexplored.

The flipped classroom model is a promising instructional approach that aligns with student-centered learning and self-regulated learning principles. Unlike traditional lecture-based instruction, flipped learning shifts foundational content acquisition to pre-class activities (e.g., video lectures, assigned readings) and reserves in-class time for active learning, problem-solving, and discussion-based activities (Gerges, 2025; Zainuddin, Chu, & Perera, 2024). This structure requires students to take responsibility for their learning before class, fostering autonomy and self-regulation (Yorganci, 2025). While flipped learning has been widely studied in terms of cognitive gains (Reinoso-Tapia, Galindo, Delgado-Iglesias, & Bobo-Pinilla, 2024), engagement (Karaoglan-Yilmaz, Zhang, Ustun, & Yilmaz, 2024), and student performance (Yan, Liu, Armwood-Gordon, & Li, 2024), its impact on non-cognitive outcomes such as academic resilience and emotional regulation remains underexplored. Furthermore, not all students naturally develop self-regulated learning skills in flipped environments, as some struggle with time management (Yan et al., 2024), self-discipline (Wang, Gao, Wang, & Zhang, 2024), and cognitive overload (Xin & Zhang, 2024) when required to take control of their learning.

Collaborative reflection is a powerful yet underexplored mechanism in flipped learning, and it can be utilized for peer discussion to analyze learning experiences more deeply. Unlike individual reflection, which can be lengthy and descriptive, collaborative reflection encourages critical discourse, peer commentary, and the construction of knowledge in a manner consistent with sociocultural approaches to learning (Kozulin, 2002) and reflective practice models (Osterman, 1990). Clarà, Mauri, Colomina, and Onrubia (2019) emphasize that structured facilitation is key for going deeper than merely scratching the surface, in which preservice teachers are supported to gradually move from problem-pointing toward deeper synthesis and development of adaptive competence. This process of socially mediated reflection facilitates self-regulated learning, emotional regulation, and professional adaptiveness and is, as such, of potential relevance for pre-service teacher education. Although recognized in professional development, evidence of its systematic application in flipped learning remains sparse, signifying the importance of placing deliberate efforts for scaffolding to harness it effectively.

Although the theoretical relationships among flipped learning, collaborative reflection, resilience, and SRL are well established, these variables are scarcely studied. It was reported from previous research that active learning promotes the involvement of students and motivation in learning (Afzali & Izadpanah, 2021), and collaborative reflection can promote deeper learning and professional development (Thomas, Bleasdale, Clifton, & Glover, 2024). However, the method of structured peer reflection in flipped classrooms specifically strengthens resilience and self-regulation in preservice teachers and is not well established.

In addition, previous research has not addressed how collaborative reflection affects adaptive learning behaviors and emotional regulation in difficult learning situations. Filling this void is of critical importance, as gaining insight into these mechanisms would assist teacher educators in crafting more effective models of instruction that foster both cognitive and non-cognitive growth.

To explore these relationships, this study investigates the influence of collaborative reflection in a flipped classroom environment on preservice teachers' academic resilience and self-regulated learning, using a mixed-methods approach with an explanatory sequential design. The study quantifies the impact of collaborative reflection on resilience and self-regulated learning (SRL), and then examines preservice teachers' experiences and perceptions to provide deeper insights into the mechanisms driving these effects. Specifically, this study aims to answer the following research questions.

1. To what extent does implementing collaborative reflection in a flipped classroom environment influence preservice teachers' academic resilience and self-regulated learning?
2. How does engagement in collaborative reflection predict improvements in academic resilience and self-regulated learning strategies?
3. How do preservice teachers perceive the impact of collaborative reflection on their resilience and self-regulated learning?
4. How do qualitative insights explain the observed quantitative effects of collaborative reflection in flipped learning?

2. Literature Review

2.1. Academic Resilience in Preservice Teacher Education

Academic resilience is widely recognized as an important trait that enables preservice teachers to persevere, adapt, and succeed when facing academic and professional challenges (Martin & Marsh, 2006). It is related to long-term teaching effectiveness, job satisfaction, and professional commitment (Wang et al., 2024). Early studies of resilience viewed it as an inherent characteristic of individuals, but more recent research has also indicated that resilience can be dynamic and situational, developing within a supportive learning environment (Hiver & Solarte, 2021). However, there is still a lack of knowledge about instructional strategies that help preservice teachers develop resilient reactions.

Studies on resilience in teacher education primarily focus on mentorship and field-based experiences, which are believed to contribute to the development of resilience (Krisdianata & Mbato, 2022; Squires, Walker, & Spurr, 2022). Although these findings underscore the significance of social support and experiential learning, they neglect the contribution of formal pedagogical interventions, such as technology-enhanced learning models, to the construct of resilience. However, despite some evidence that structured reflection may support the development of resilience by helping preservice teachers to process better and cope with challenges, the role of these interventions warrants further exploration (Crane, Searle, Kangas, & Nwiran, 2019; Finley, 2018; Hughes, Cologer, Swoboda, & Rushton, 2021) there is limited empirical evidence of how collaborative reflection in structured learning environments contributes to resilience.

As the role of technology and technology-enhanced learning in teacher education continues to grow (Choi, 2025; Shankar, Pothancheri, Sasi, & Mishra, 2025), there is a demand for exploring how digital and collaborative learning environments support the development of resilience. The current study addresses this gap by examining whether structured collaborative reflection implemented in flipped classrooms can enhance preservice teachers' emotion regulation, self-regulated learning behaviors, and academic persistence.

2.2. Self-Regulated Learning (SRL) in Flipped Learning Environments

Self-regulated learning (SRL) is a widely accepted theoretical framework that explains how students consciously control their cognitive, metacognitive, and motivational strategies to maximize learning outcomes (Garcia & Pintrich, 2023; Zimmerman, 2002). In teacher education, self-regulated learning (SRL) is extremely important as pre-service teachers are expected to cultivate independent learning, reflective knowledge, and flexibility to progress successfully into their future teaching profession (Dorsah, 2021; Matsumoto-Royo, Ramírez-Montoya, & Conget, 2021; Naykki, Kontturi, Seppanen, Impio, & Jarvela, 2021).

Flipped classrooms, requiring students to prepare for a class in advance and engage in learning activities during class time (Park & Kim, 2022; Yoon, Hill, & Kim, 2021), have been suggested as an effective learning environment for promoting self-regulated learning. Flipped instruction has been associated with doing better on several measures of metacognitive awareness (Khodaei, Hasanvand, Gholami, Mokhayeri, & Amini, 2022), better time management (Thai, De Wever, & Valcke, 2024), and higher levels of motivation (Yarım, Ada, Morkoç, & Doğan Kurt, 2024) in lectures than traditional lecture-based instruction. Flipped learning can also enhance students' self-efficacy outcomes (Samaila, Tsong, Masood, & Bervell, 2024), goal-setting behavior (Hwang, 2025), and persistence in learning tasks (Mitsiou, 2019).

Nevertheless, flipped classrooms do not necessarily lead all students to successful self-regulated learning. While some students excel in self-directed learning, others struggle with self-regulation, procrastination, and cognitive overload, and therefore may not always maximize the benefits of flipped learning (Silverajah et al., 2022). For example, Nielsen (2023) points out that students who are intrinsically not very motivated to study or have a low level of metacognitive skills might find flipped learning to be an overload, which results in inappropriate learning strategies and inattentiveness. Similarly, Yoon et al. (2021) note that students in flipped classrooms are usually not equipped with a structured support system, making it challenging to establish self-regulatory routines without specific instructions.

These results indicate that more instructional scaffolding is needed for students to develop self-regulated learning as learners in flipped classrooms. Reflection is embedded as part of self-regulation (Mertens, Deković, Van Londen, & Reitz, 2022; Zarestky, Bigler, Brazile, Lopes, & Bangerth, 2022). Therefore, this study investigates whether structured cooperative reflection can provide the necessary scaffolding to promote self-regulated learning in flipped classrooms.

2.3. Collaborative Reflection as a Pedagogical Strategy

For years, reflection has been a fundamental component of teacher education because it encourages prospective educators to think critically, adapt, and continue to grow (Korthagen & Nuijten, 2022). The usual practice is personal reflection, reflecting on learning experiences alone. However, a much livelier form has recently emerged: collaborative reflection. Here, prospective teachers gather in focused discussions, share difficulties, respond to ideas from their peers, and then formulate solutions together (Kelley & Curtis, 2023). This kind of dialogic process not only sharpens metacognitive awareness but also trains participants to manage their learning in a more focused way (Clarà et al., 2019; Kelley & Curtis, 2023).

When viewed from the perspective of sociocultural theory (Kozulin, 2002), collaborative reflection views the meaning of learning as something that is formed through social interaction rather than the result of separate individual reflections. This aligns with the concept of "distributed cognition," which emphasizes that knowledge and problem-solving strategies develop more rapidly when built collaboratively rather than individually (Clarà et al., 2019). Recent research indicates that when preservice teachers engage in reflective dialogue, they become more aware of their thinking patterns, improve their emotional regulation skills, and develop greater resilience to classroom challenge factors that are critical for managing dynamic learning environments (Bergmark, 2023; Esfandiari & Arefian, 2024).

Unfortunately, collaborative reflection practices in technology-rich classrooms such as flipped classrooms have not been widely studied. Most studies still focus on individual reflection (Beauchamp, 2015; Körkkö, Kyrö-Ämmälä,

& Turunen, 2016; Mortari, 2012). The flipped classroom model already requires students to be more independent; incorporating structured collaborative reflection can further enhance their self-regulation, problem-solving skills, and emotional resilience. Therefore, research that thoroughly investigates the contribution of guided peer reflection within the flipped classroom context remains urgently needed. Our study aims to address this gap. Specifically, we emphasize how reflective discussions among preservice teachers can promote learning independence and academic resilience two essential competencies they will need when leading real classrooms.

2.4. Conceptual Framework

This study is based on the intersection of the flipped classroom model, collaborative reflection, self-regulated learning (SRL), and academic resilience. These four concepts form an important foundation for an in-depth understanding of how prospective teachers can optimally develop both cognitive and non-cognitive skills. A flipped classroom is a fundamental approach that shifts the activity of understanding the material to the pre-class stage, allowing class time to be more focused on active learning activities and problem-solving (Park & Kim, 2022; Yoon et al., 2021). Although this model supports student autonomy, implementing flipped classroom learning does not automatically guarantee that students can manage themselves. Some students still experience obstacles such as poor time management, low motivation, and excessive cognitive load (Nielsen, 2023; Silverajah et al., 2022). Therefore, additional support is needed, one of which can be realized through structured collaborative reflection.

Collaborative reflection is a social and metacognitive learning process. In this process, prospective teachers openly reflect on their learning experiences, share their challenges, and receive input and support from their peers. Unlike personal reflection, which is internal and introspective, collaborative reflection emphasizes social interaction as a central element in formulating solutions and developing adaptive strategies together (Clarà et al., 2019; Kelley & Curtis, 2023). This aligns with sociocultural learning theory (Kozulin, 2002) and distributed cognition theory, emphasizing that knowledge is created through dialogue and interaction, not simply through individual reasoning separate from their social environment (Clarà et al., 2019). Through structured shared reflection, prospective teachers can become more aware of their thinking processes, improve self-management strategies, and build the emotional resilience that is essential for facing challenging learning environments (Bergmark, 2023; Esfandiari & Arefian, 2024; Mertens et al., 2022).

This study begins with the assumption that collaborative reflection serves as a bridge that enhances the benefits of flipped learning in two significant areas for prospective teachers: self-regulation skills (SRS) and academic resilience. Self-regulation skills can be developed through simple yet consistent habits setting concrete goals, regularly monitoring progress, and adjusting learning strategies as circumstances change (Garcia & Pintrich, 2023; Zimmerman, 2002). Resilience, on the other hand, grows when someone is persistent, able to regulate emotions, and knows how to choose the right tactics when faced with adversity (Martin & Marsh, 2006). So far, research has tended to evaluate flipped classrooms and collaborative reflection separately. The results have been positive, but little has been examined regarding what happens when these approaches are combined. Logically, reflective discussions after independent learning at home can help students reorganize their understanding and define the next steps. This study aims to address this gap by examining how combining the two approaches, initial independent learning followed by structured dialogue can lead to a greater increase in self-management skills and academic resilience.

3. Methodology

This research adopted a mixed-methods approach with a "numbers first, stories later" pattern known in the literature as an explanatory sequential design (Creswell & Creswell, 2023). The process was divided into two main stages. The research was structured into two primary phases. In the first phase, a quantitative study was conducted to assess the strength of relationships between key variables. The main objective was straightforward: to determine the extent to which structured reflective discussions conducted after students independently engaged with the material in a flipped classroom setting could enhance prospective teachers' academic resilience and independent learning skills. The data collected offered an initial overview of the intervention's effects magnitude.

Once the statistical patterns emerged, the research moved to the second qualitative stage. This is where we "brought the numbers to life" with stories. Through in-depth interviews and a review of participants' reflective journals, we explored how the collaborative reflection process worked: what triggered the changes, what obstacles emerged, and why some students improved more rapidly. This combination of two stages was chosen to enrich the report with tables and to link the numerical data with the real context in the field. The results allow us to understand how significant the influence of collaborative reflection is and how the mechanisms behind that influence operate.

3.1. Research Design

This research was conducted during the even semester of the 2023 academic year, spanning approximately 16 weeks. Intervention activities took place across three campuses: the University of Lampung (UNILA), the State Islamic University (UIN) Raden Intan Lampung, and Muhammadiyah University (UM) Metro, during regularly scheduled lectures. The quantitative phase lasted the first 10 weeks. During this period, prospective teachers participated in the intervention according to predetermined experimental conditions. Assessments were conducted through pre-tests at the beginning and post-tests at the end of this phase to measure changes. Subsequently, the qualitative phase lasted for the following six weeks. During this stage, data were collected through semi-structured interviews and analysis of participants' reflective journals to gain deeper insights into their experiences with collaborative reflection in vertical classes.

This study employs a quasi-experimental design using a 2×2 factorial structure, where preservice teachers are assigned to one of four groups based on two independent variables: instructional model (Flipped Learning vs. Traditional Learning) and collaborative reflection (With vs. Without Structured Reflection). The factorial design enables the use of Two-Way ANOVA to examine the main effects of these factors on academic resilience and self-regulated learning (SRL). The design of the experiment is outlined in Table 1, which presents the four groups based on the combination of instructional model and collaborative reflection conditions.

Table 1. Quasi-experimental design using a 2 × 2 factorial structure.

| Group | Instructional model | Collaborative reflection | Description |
|-------|----------------------|---|---|
| G1 | Flipped learning | With structured collaborative reflection | Students engage with content before class and participate in structured peer discussions and guided reflection exercises. |
| G2 | Flipped learning | Without structured collaborative reflection | Students engage with content before class but do not participate in structured reflection or peer discussions. |
| G3 | Traditional learning | With structured collaborative reflection | Students receive direct instruction in class and engage in structured peer discussions and guided reflection exercises. |
| G4 | Traditional learning | Without structured collaborative reflection | Students receive direct instruction in class and do not engage in structured reflection or peer discussions. |

The factorial structure allows for examining both independent effects (Flipped vs. Traditional Learning and Reflection vs. No Reflection), which reveal whether the impact of collaborative reflection differs between flipped and traditional learning environments.

3.2. Intervention and Experimental Manipulation

In the intervention phase, we embedded collaborative reflection activities directly into the rhythm of the flipped classroom. After each session, the preservice teachers in the treatment group sat together again, openly dissecting their learning experiences. The conversations were guided using Korthagen (2017)'s incisive but straightforward reflection framework starting with "What just happened?", moving on to "Why did that happen?", and then "What steps might be worth trying next time?". The discussions did not stop there. Afterwards, they provided feedback to each other, highlighting strengths, noting gaps, and offering practical ideas that could be implemented immediately. To ingrain the reflection process, each participant kept a short journal periodically, recording obstacles that arose, flashes of new insights, and adaptive strategies they discovered along the way. With this sequence, reflection was no longer just a personal activity but a collective exercise that sharpened the learning strategies of the entire group.

In contrast, prospective teachers in the control group underwent a similar flipped learning experience but without engaging in structured collaborative reflection. They were only asked to reflect independently, with no guiding questions, group discussions, or directed feedback sessions. While they were still given space to think reflectively, their experience was not framed within a formal structure as it was in the experimental group. To ensure consistent implementation of the intervention, the instructor facilitated reflection sessions in the experimental group using a standard protocol that ensured discussions remained focused, in-depth, and productive. The quality of participants' reflections was assessed based on several aspects, namely the depth of analysis, the level of engagement in group discussions, and the extent to which they could apply the feedback received to their learning strategies. By designing collaborative reflection explicitly and systematically, the intervention ensured that reflection was not just an additional activity but an integral part of the pedagogical strategy to strengthen self-regulated learning and build academic resilience in a flipped learning setting.

3.3. Participants and Sampling

Participants in this study were prospective teachers from three universities in Lampung, Indonesia, namely the University of Lampung (UNILA), the State Islamic University (UIN) Raden Intan Lampung, and Muhammadiyah University (UM) Metro. These three institutions were selected intentionally to create a diverse sample regarding educational background and teaching experience. UNILA, as a state university, is known for its research-based approach to teacher education, providing a strong foundation in evidence-based pedagogical practices. UIN Raden Intan Lampung offers uniqueness by integrating Islamic values into its teacher education program, thus opening opportunities for exploring pedagogical innovation within a values-based educational context. Meanwhile, as a private university, UM Metro emphasizes a student-centered learning approach, making it a relevant setting to examine adaptive learning strategies and reflective practices in teacher education.

A total of 120 prospective teachers participated in this study, and they were divided proportionally into four experimental conditions, each containing approximately 30 participants. This sample size was determined based on an a priori analysis to ensure sufficient statistical power ($\alpha = 0.05$, power = 0.80) to detect medium to significant main effects in the Two-Way ANOVA analysis. Although the number of participants was considered adequate for comparative analysis, potential limitations in detecting minor effects will be discussed further in the discussion section. To maintain the validity of the study results and minimize potential confounding factors, the researchers considered participants' previous exposure to the flipped learning model, as measured through a pre-study questionnaire. Additionally, initial differences in academic resilience and self-regulated learning ability (SRL) were statistically controlled using Analysis of Covariance (ANCOVA).

In the qualitative phase, a subgroup of 10 participants was purposively selected based on variations in their pre-test and post-test results. These participants were then invited to participate in semi-structured interviews and reflective journal analyses. The qualitative data collected provided a deeper understanding of how pre-service teachers experienced collaborative reflection in a flipped learning setting and how the process contributed to strengthening their academic resilience and developing their self-regulated learning.

3.4. Data Collection Instruments

This research integrates quantitative data collection with narrative analysis. In the initial phase, we gathered data through pre-tests and post-tests. Two validated scales were employed: the Academic Resilience Scale-30 (Cassidy, 2016), which assesses persistence, emotional regulation, and problem-solving skills, and the Self-Regulated Learning Questionnaire (Oz & Sen, 2018), which evaluates goal-setting habits, progress monitoring, and thought management. Both scales utilize a five-point Likert scale, enabling clear measurement of score changes before and after the intervention.

After the numbers were collected, we listened to the participants' voices. Through semi-structured interviews, they discussed the challenges that arose, how to persevere when motivation dropped, and what they learned most

from reflective discussions with friends. Their notes and the reflective journals they write weekly are important complements. They contain snapshots of emotions, strategies tried, and sometimes failures that spark new ideas.

To make their engagement in collaborative reflection measurable, this research adapted surveys by Clarà et al. (2019) and Korthagen (2017). The items asked participants to rate how actively they discussed, exchanged feedback, and importantly tried to apply their peers' input to their learning strategies. The survey serves as a bridge connecting the statistical findings with the story behind the numbers.

Combining the two data types provides a more comprehensive understanding of how much the resilience and self-regulation scores improved and the reasons behind these improvements. It appears that collaborative reflection in a flipped classroom serves as an additional activity and a safe space for prospective teachers to practice critical thinking, manage emotions, and consciously design learning steps skills they will carry into real classrooms.

3.5. Data Analysis Procedures

The analysis in this research follows a "numbers first, stories later" pattern. We first collected quantitative data and then explored the story behind the numbers through a qualitative approach, linking the two together to obtain a comprehensive understanding. This sequence, often called an explanatory sequential design, helps us understand how collaborative reflection in a flipped classroom affects teacher candidates' academic resilience and self-learning skills.

In the quantitative stage, pre-test and post-test scores were analyzed using descriptive statistics to examine means, distributions, and basic patterns across the four treatment groups. The two-way ANOVA test was employed to evaluate the main effects of the learning model and the presence of structured reflection. Additionally, ANCOVA was used to control for baseline differences between participants, ensuring that the observed changes were genuinely attributable to the intervention rather than pre-existing disparities in resilience among the groups.

Once the numerical results were obtained, we proceeded to analyze the participants' responses through semi-structured interviews and reflective notes. This qualitative process adhered to the thematic analysis steps outlined by Clarke and Braun (2017). We engaged in repeated readings, applied preliminary codes, and identified common patterns that were subsequently refined into themes. Two researchers independently coded the data; when discrepancies in interpretation arose, they discussed until reaching a consensus. Cohen's Kappa coefficients were calculated to assess inter-coder reliability, ensuring consistency in coding. The entire process was managed using NVivo software to systematically track and organize the coding process.

The final stage was to weave the findings into a narrative. Qualitative themes are mapped to quantitative patterns so that we understand "how much influence" and "why and how" that influence works. In this way, the research presents statistical tables and real stories about prospective teachers developing academic resilience and managing their learning process effectively.

3.6. Ethical Considerations

The entire study was conducted with strict adherence to the principles of research ethics. Before any data was collected, we explained in detail the purpose of the study, the steps involved, and the participants' rights to withdraw at any time without consequences. Once this was understood, all participants signed an informed consent form. The privacy of the participants was carefully protected. Every questionnaire, interview excerpt, and reflective note was specially coded; no real names appeared in the report or publication. This approach fully safeguards personal identities. The university's ethics committee (Institutional Review Board) reviewed and approved all procedures. This ensures that the research design, conduct, and reporting comply with national and international ethical standards, prioritizing the welfare of the participants.

3.7. Research Validity and Reliability

Maintaining the quality of the findings was a significant concern throughout the project. From the design stage, we chose tried-and-tested instruments such as the ARS-30 academic resilience scale and the SRLQ self-study questionnaire because they have been used repeatedly and proven to measure what they are supposed to measure. Consistent Cronbach's alpha values above 0.86 gave us confidence that the items related to each other reliably. Before the main research began, we also conducted a small pilot test; some confusing statements were adjusted in language. When the quantitative data was collected, we did not analyze it immediately. The first step was to check the statistical prerequisites that the distribution was normal, the variance was homogeneous, and each score was truly independent and then run a Two-Way ANOVA.

The qualitative part required a different kind of care. After the interviews, we returned the transcripts to the participants so that they could verify the accuracy of the content, a process commonly referred to as member checking. The thematic analysis was not conducted alone; a second researcher also coded the data to ensure our interpretations were accurate. If disagreements arose, we discussed them until we reached a consensus. Additionally, we compared the interview findings, reflective journal entries, and numerical results this triangulation helped us determine whether the participants' stories aligned with the quantitative patterns.

In the closing stage, we "match" the two worlds numbers and narratives with a convergence approach. The themes from the interviews and journals were juxtaposed with the statistical patterns that emerged in the pre-test and post-test. As a result, the graphs were no longer dry because they had a story background, while the participants' stories were supported by empirical evidence. This layered combination makes us confident in stating that collaborative reflection in the flipped classroom strengthens the academic resilience and the independent learning skills of prospective teachers.

4. Results

In this results section, we examine the data and then explore the underlying factors to provide a comprehensive understanding of the impact of collaborative reflection in flipped classrooms on pre-service teachers' academic resilience and independent learning abilities. First, we assess the "health" of the data checking whether the distribution is normal and whether the variances across groups are balanced. Once these basic assumptions are

satisfied, a Two-Way ANOVA is conducted to determine the influence of each variable and to identify any interaction effects between the two factors.

Once the statistical pattern is identified, the focus shifts to the qualitative aspects. Interviews and reflective journals are analyzed thematically: snippets of participants' experiences are collected, coded, and then woven into key themes. These narrative findings are subsequently juxtaposed with quantitative trends, allowing the numbers to gain a meaningful context while participants' stories are grounded in empirical evidence. Through this layered approach, the impact of collaborative reflection within the flipped classroom scheme can be understood more comprehensively.

4.1. Quantitative Analysis

4.1.1. Assumption Testing and Descriptive Statistics

Before conducting a Two-Way ANOVA, the Shapiro-Wilk test was performed to verify that the data distribution met the assumption of normality. Additionally, the Levene's test was used to assess the equality of variances across groups. The results of these assumption tests, along with descriptive statistics for each experimental group, are presented in Table 2.

Table 2. Summary of normality, homogeneity, and descriptive statistics for academic resilience and self-regulated learning across experimental groups.

| Group | Instructional Model | Collaborative reflection | Academic resilience (M ± SD) | Self-regulated learning (M ± SD) | The Shapiro-Wilk test (p-value) | Levene's test (p-value) |
|-------|----------------------|-------------------------------|------------------------------|----------------------------------|---------------------------------|-------------------------|
| G1 | Flipped learning | With structured reflection | 78.42 ± 8.31 | 82.75 ± 7.94 | 0.366 | 0.499 |
| G2 | Flipped learning | Without structured reflection | 72.81 ± 7.92 | 76.38 ± 7.52 | 0.415 | 0.512 |
| G3 | Traditional learning | With structured reflection | 74.15 ± 7.85 | 78.94 ± 8.10 | 0.586 | 0.809 |
| G4 | Traditional learning | Without structured reflection | 69.47 ± 8.21 | 73.61 ± 7.89 | 0.472 | 0.623 |

The Shapiro–Wilk test indicates that the data distribution for academic resilience and independent learning skills is relatively normal across all four groups, as all p-values are above 0.05. Additionally, the Levene test yields a p-value exceeding 0.05, suggesting that the variances between groups are approximately equal. In summary, the fundamental assumptions for conducting further statistical analyses are satisfied.

Judging from the summary statistics, the combination of flipped learning with structured reflection (G1) is at the top, recording the highest average for both variables. In contrast, the traditional learning scenario without reflection (G4) is at the lowest point. This initial picture suggests that adding a directed collaborative reflection session to the flipped classroom scheme has the potential to increase academic resilience as well as the self-regulation skills of prospective teachers. The descriptive findings were then tested in more depth through inferential statistical analysis to determine the strong and significant relationship between the variables.

4.1.2. Two-Way ANOVA Results

To assess the impact of the two factors class type and the presence of structured reflection, we conducted a Two-Way ANOVA. The first factor compared the flipped classroom with the traditional classroom, while the second factor distinguished between groups that engaged in structured reflection and those that did not. The summary results are presented in Table 3 (academic resilience) and Table 4 (self-regulated learning).

Table 3. Summary of two-way ANOVA results on the effects of instructional model and structured reflection on academic resilience.

| Source | SS | df | MS | F | p | Partial η ² |
|---|---------|-----|---------|-------|---------|------------------------|
| Instructional Model (Flipped vs. Traditional) | 1124.25 | 1 | 1124.25 | 14.82 | 0.001 | 0.12 |
| Collaborative reflection (With vs. Without) | 1563.74 | 1 | 1563.74 | 20.64 | < 0.001 | 0.16 |
| Error | 8734.12 | 116 | 75.29 | | | |

Table 4. Summary of two-way ANOVA results on the effects of instructional model and structured reflection on self-regulated learning.

| Source | SS | df | MS | F | p | Partial η ² |
|---|---------|-----|---------|-------|---------|------------------------|
| Instructional Model (Flipped vs. Traditional) | 1348.52 | 1 | 1348.52 | 18.74 | < 0.001 | 0.14 |
| Collaborative reflection (With vs. Without) | 1745.39 | 1 | 1745.39 | 22.89 | < 0.001 | 0.17 |
| Error | 9012.67 | 116 | 77.69 | | | |

The data clearly demonstrate the effectiveness of the educational interventions. Both the classroom scheme and reflective practices significantly influenced the academic resilience and self-directed learning abilities of preservice teachers, with all results showing p-values less than 0.001. Analyzing the magnitude of these effects through partial η² provides a practical understanding: the learning model explained approximately 12% of the variation in resilience scores, while structured reflection contributed to 16%. Similarly, for self-regulated learning (SRL), the flipped classroom accounted for 14%, and structured reflection explained 17% of the variance.

4.2. Qualitative Analysis (Thematic Analysis)

A thematic analysis of data obtained from semi-structured interviews and reflective journals was conducted following the framework established by Clarke and Braun (2017) to enhance the quantitative findings. This inductive approach enabled themes to emerge directly from the data, providing a deeper understanding of how structured collaborative reflection contributes to prospective teachers' academic resilience and self-regulated learning (SRL).

The analysis process involved several stages: familiarization with the data, initial coding, identification of themes, and refinement of thematic categories to ensure coherence and consistency of meaning. The analysis revealed three primary themes: increasing metacognitive awareness, strengthening emotional resilience, and the transferability of reflective practice beyond the classroom context. The frequency of these themes, derived from qualitative data coding, is presented in Table 5 to offer empirical evidence of their prominence in participants' reflective experiences.

4.2.1. Theme 1: Increased Metacognitive Awareness

Participants who engaged in collaborative reflection reported a significant increase in their awareness of their learning processes. They noted becoming more conscious of their cognitive strategies, such as identifying learning challenges, setting more targeted academic goals, and adjusting their learning approaches to enhance understanding and retention. Many participants also emphasized that reflective discussions with peers helped them recognize previously unnoticed misconceptions and improve their learning techniques through constructive feedback and collective problem-solving. Active participation in this reflective process strengthened the self-regulated learning cycle, encouraging a transition from passive to more active, independent learning. Additionally, participants indicated that the structured reflective journaling activity prompted them to analyze their thinking patterns, evaluate which learning strategies were effective or less effective, and systematically synthesize their learning progress. Many described this shift from reactive to proactive learning as one of the most valuable outcomes of engaging in collaborative reflection.

Table 5 presents authentic quotes from participants that illustrate how structured collaborative reflection was key in fostering metacognitive awareness while enriching understanding of how strategic and intentional learning behaviors develop through this process.

4.2.2. Theme 2: Peer Support as an Emotional Buffer

The peer discussions were more than just academic venting sessions; for many preservice teachers, the moments were emotional turning points. Sitting in a circle and reviewing their classroom experiences in a structured way, they felt like they had "comrades in arms." This sense of connection eased the pressure, removed the feeling of fighting alone, and ultimately strengthened their resilience in the face of demanding coursework.

Several participants said they initially felt as though they were experiencing failure alone. After hearing similar stories from their peers, they realized that ups and downs are a natural part of the learning process. The guided dialogue, with prompting questions and targeted feedback, prevented conversations from spiraling into complaints. Instead, the conversations focused on exchanging strategies, encouraging each other, and fostering a "we can get back up together" mindset.

The effects were palpable: the stronger their social support network, the less psychological burden they felt. Many said that realizing that "my classmates were grappling with similar challenges" gave them the courage to keep going. The excerpts from the statements in Table 5 show how collaborative reflection served as both an emotional cushion and a cognitive learning vehicle two functions that supported each other in fostering academic resilience and persistence.

4.2.3. Theme 3: Transferability of Reflective Practices

Participants admitted that the habit of sitting together and dissecting learning experiences initially just a routine part of the flipped classroom turned out to "stick" to other areas of their lives. After the lecture, they used the reflective journal-style question-and-answer technique again when working on individual assignments, solving problems at part-time jobs, and even when faced with personal decisions: "What is the best next step?" The process that previously felt like an academic obligation slowly shifted to become a daily compass. One participant said that she is now used to writing down flashes of thoughts before going to bed matching goals with progress and then preparing a plan for the next day. This simple habit, she said, made her more disciplined and fully aware that progress is not just the lecturer's business but her responsibility.

This repetitive pattern demonstrates the effects of reflection that extend beyond the classroom. When asking "what, why, how" is consistently practiced, prospective teachers develop the habit of assessing their strengths and weaknesses and formulating steps for improvement without waiting for guidance from their superiors. As a result, professional resilience is also strengthened: they feel more prepared to face future changes in the curriculum, school demands, or student dynamics. The testimonial excerpts listed in Table 5 shed light on this story from students who are now more at ease responding to criticism to those who feel empowered to take on new projects because they are accustomed to strategizing through structured reflection.

Table 5. Thematic illustrations: direct participant quotes supporting identified themes from interviews and reflective journals.

| Theme | Participant code | Summary of key idea | Direct participant quote |
|-------------------------------------|------------------|---|---|
| Increased metacognitive awareness | P01 | Recognizing passive learning habits and shifting to active learning | "Before engaging in structured reflection, I had not realized how much I relied on passive learning. Through peer discussions, I became more aware of my learning gaps and adjusted my strategies accordingly." |
| | P07 | Identifying effective and ineffective learning strategies | "Writing reflective journals has compelled me to think critically about my learning habits. It has helped me identify strategies that are effective and those that are not." |
| | P12 | Developing structured study habits and goal-setting | "I used to study without a clear plan, but now I actively set goals and monitor my progress. This shift has made me more confident in my learning." |
| Peer support as an emotional buffer | P03 | Feeling reassured through shared academic struggles | "Knowing that my peers face similar struggles helped me stay motivated. Sharing strategies and |

| Theme | Participant code | Summary of key idea | Direct participant quote |
|---|------------------|---|---|
| | | | experiences made learning less stressful and more manageable." |
| | P09 | Reducing stress and normalizing setbacks through peer discussions | "Talking about academic challenges with my group made me feel less alone. It reassured me that setbacks are a normal part of the learning process." |
| | P20 | Receiving motivation and perseverance through peer encouragement. | "When I was feeling overwhelmed, my peers' encouragement gave me the push I needed to keep going. It strengthened my ability to persist through difficult tasks." |
| Transferability of reflective practices | P05 | Applying Reflective Techniques Beyond the Classroom | "Reflecting on my learning process has changed how I approach new challenges. Now, I apply the same reflective techniques even outside of class." |
| | P11 | Expanding reflection from academics to personal development | "At first, I thought reflection was just an academic exercise, but I now use it to evaluate my strengths and weaknesses in different areas of life." |
| | P16 | Becoming more self-disciplined and taking ownership of learning | "Since using structured reflection, I've become more self-disciplined in my studies. I take ownership of my learning rather than just relying on instructions." |

4.2.4. Visual Representation of Thematic Analysis

To strengthen the validity of the qualitative findings, a frequency analysis of the coded themes was also conducted. Figure 1 presents the distribution of themes in the form of a bar chart, illustrating how often each theme appeared in the participants' data. This visualization helps highlight the aspects of structured reflection that were most dominantly discussed by participants during the reflection process.

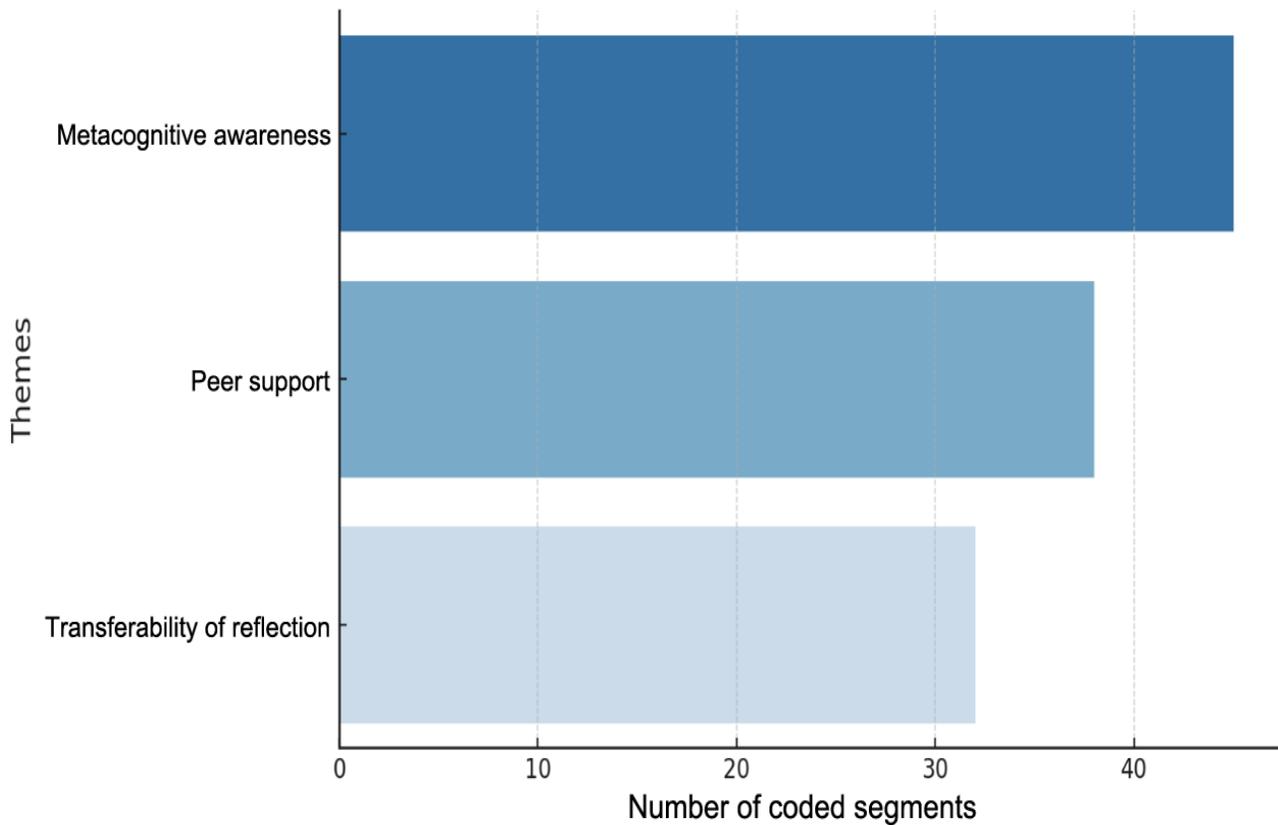


Figure 1. Frequency distribution of emergent themes from qualitative thematic analysis.

Figure 1 illustrates how frequently three major ideas emerged in participants' reflections. The most frequently mentioned was the desire to "look inside your mind" 45 times, where students noted that collaborative reflection increased their awareness of their mental processes. This was followed by 38 accounts of how talking with peers served as an emotional "buffer" when facing a backlog of assignments. In third place were 32 references to applying the reflective techniques outside the classroom for example, when creating personal study plans or making decisions at work. These figures highlight that structured reflection sessions primarily enhance self-control and bolster academic resilience, rather than merely serving as numerical data.

To make the themes easier to read, we also created a Word Cloud (Figure 2). The words in larger print "self-regulated learning," "goal setting," "peer discussion," "reflective cycle" immediately catch the eye. The large font is not merely decorative; it indicates how frequently these terms appear in journals and interviews. In this way, the Word Cloud provides visual evidence that students are genuinely centering their conversations around self-regulation, collegial encouragement, and iterative reflection. In summary, both bar charts and word clouds complement each other: one presents quantitative data, and the other highlights visual emphasis, but both reinforce the argument that structured collaborative reflection is a key driver behind the growth of metacognitive awareness, emotional resilience, and transferable learning strategies.

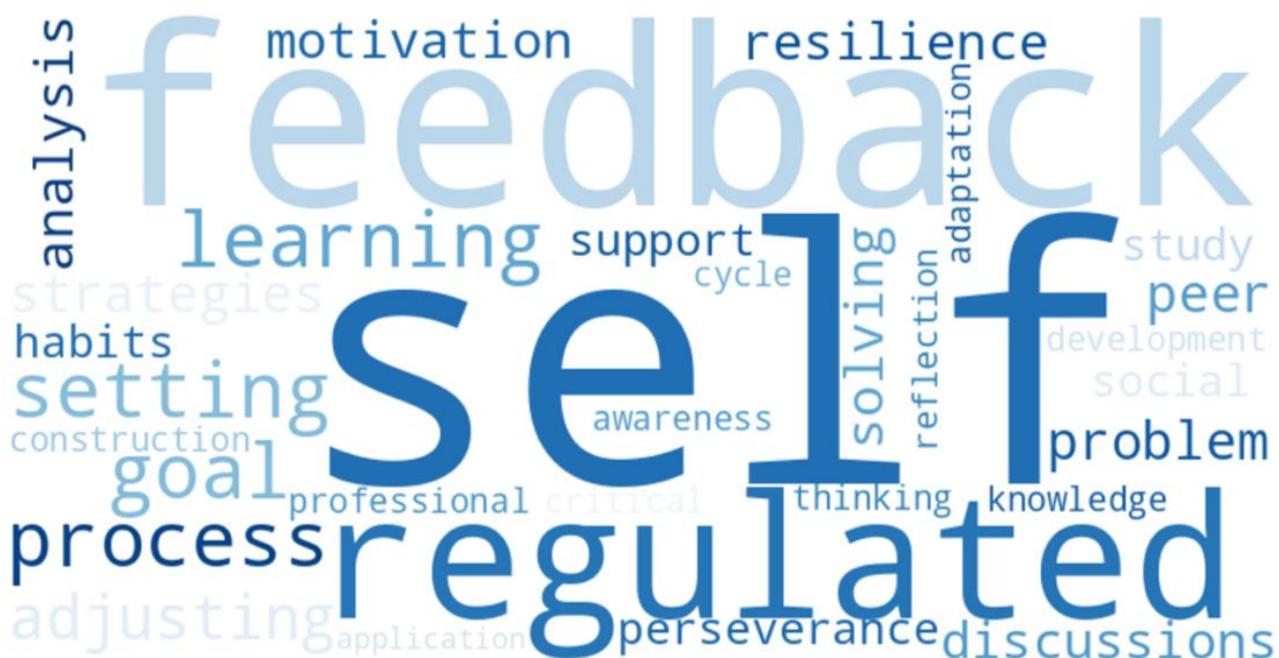


Figure 2. Word cloud depicting dominant concepts from participant reflections and interviews.

4.2.5. Integration of Quantitative and Qualitative Findings

Numbers alone do not tell the whole story, and that is where qualitative data comes into play. It is clear from interviews and participant diaries that guided reflection discussions made them more aware of their thinking. They began to recognize when they lost focus, what caused it, and what strategies they could use to bounce back. This story aligns with quantitative findings: the group that took the flipped classroom plus structured reflection (G1) scored higher on SRL.

Another strong thread ran through the equation: a sense of peer support. When someone complained about a complex topic, the peer next to them would chime in with tips or say, “Do not worry, I have been overwhelmed too.” This kind of emotional support which did not occur in the group without guided reflection was directly correlated with a spike in academic resilience. Interestingly, the practice of collaborative reflection did not stop in the classroom. Some students said they now use it to assess their internship performance and make everyday life decisions. In short, the benefits of collaborative reflection go beyond helping them pass their courses; it lays the foundation for growth and adaptability in a changing professional world.

5. Discussion

The results of this study confirm, through measurable data, that embedding collaborative reflection sessions into flipped classrooms strengthens prospective teachers' academic resilience and learning independence. In the discussion section, we will compare these findings with similar studies: are there any that align, differ, or challenge previous conclusions? From there, we will explore their pedagogical significance what they mean practically for lecturers and students. Another focus is to examine how structured collaborative reflection works in practice: first, it enhances metacognitive awareness as students learn to map their thought processes; second, it fosters resilience through peer support networks formed during discussions; and third, the habit of reflection extends beyond the classroom, for example, when students assess their internship performance or develop self-improvement plans. By combining critical analysis and practical implications, this discussion aims not only to address the research problem but also to provide concrete guidance for educators who wish to incorporate collaborative reflection into the flipped classroom model or other learning schemes in the future.

5.1. The Role of Structured Collaborative Reflection in Enhancing Self-Regulated Learning

The results of this study indicate that preservice teachers in the Flipped Learning + Structured Reflection (G1) condition consistently achieved the highest scores in academic resilience and self-regulated learning ability (SRL) compared to the other groups. This finding suggests that structured integration in flipped learning can encourage deeper engagement with the material while strengthening participants' ability to manage their learning processes independently. This observation aligns with previous research emphasizing the significant role of metacognition in supporting self-regulated learning (Hoffman & Schaefer, 2024; Kim, 2024). However, this study also extends the understanding in the literature by showing that collaborative reflection rather than just individual reflection provides significant added value in strengthening preservice teachers' SRL.

The qualitative analysis further substantiates this claim. Participants in the structured reflection groups reported heightened metacognitive awareness, actively identifying learning gaps, setting personal goals, and adjusting their study strategies in response to peer feedback. This aligns with Theme 1: Increased Metacognitive Awareness, where participants described a shift from passive to active learning. The fact that participants actively modified their learning approaches based on structured reflection sessions suggests that collaborative reflection reinforces self-regulation by making students more intentional about their learning behaviors. These results corroborate previous studies on reflective learning, highlighting its role in fostering autonomous, goal-driven learners (Chang & Sun, 2024; Ye, 2025).

A key implication of this finding is that flipped learning alone is insufficient to develop self-regulated learners. While flipped learning exposes students to self-directed study practices, structured reflection guides them through refining their learning strategies. Without structured reflection, as seen in the Flipped Learning + No Reflection group (G2), students may still struggle with self-discipline and time management, which are common challenges in

self-directed learning environments (Khodaei et al., 2022; Wang et al., 2024). Thus, integrating structured collaborative reflection within flipped learning appears to be a necessary intervention to maximize its effectiveness in promoting self-regulation.

5.2. Collaborative Reflection as a Mechanism for Building Academic Resilience

The significant main effect of structured reflection on academic resilience supports the notion that reflection is not merely a cognitive exercise but also an emotional and motivational process. The results demonstrated that Group 1 (Flipped Learning + Structured Reflection) had the highest resilience scores, whereas Group 4 (Traditional Learning + No Reflection) had the lowest. This suggests that structured reflection is crucial in helping students cope with academic challenges, particularly when embedded within an active learning environment.

The qualitative findings in this study further support this claim. Theme 2: Peer Support as an Emotional Buffer highlights how structured collaborative reflection fosters a sense of social belonging and shared accountability, thereby reducing stress and enhancing learning persistence. Many participants explicitly stated that sharing challenges with peers made them feel less isolated, a finding that aligns with previous research on the role of social learning in building resilience (Avakyan & Taylor, 2024).

By providing a structured platform for emotional support and collaborative problem-solving, collaborative reflection helps preservice teachers develop important coping mechanisms to persist amidst academic and professional demands. This finding also aligns with the social healing perspective on learning, which suggests that strong social relationships contribute to psychological resilience and academic success (Bottomley, Wild, Miles, Mavor, & Kohnle, 2024). Unlike individual reflection, which can sometimes exacerbate internal frustration, collaborative reflection allows challenges to be externalized, making them easier to overcome through shared discussion and peer support. This also explains why students in group G3 (Traditional Learning + Structured Reflection) exhibited higher levels of resilience than students in group G2 (Flipped Learning + No Reflection). Even without the flipped learning approach, the presence of structured reflection still contributed positively to strengthening participants' resilience.

The pedagogical implication of this finding is that structured collaborative reflection should be actively incorporated into teacher education programs as a resilience-building strategy. Given that teacher attrition is often linked to emotional burnout and a lack of coping mechanisms (Clara et al., 2024; Pöysä, Kiuru, Sorkkila, Lerkkanen, & Pakarinen, 2025), fostering resilience through structured reflection can equip preservice teachers with the emotional and cognitive skills necessary to navigate their professional careers successfully.

5.3. The Transferability of Reflective Practices Beyond the Classroom

A key contribution of this study is the evidence that structured reflection fosters long-term, transferable learning strategies. The qualitative findings from Theme 3: Transferability of Reflective Practices suggest that students who engaged in structured reflection did not confine their reflective thinking to the flipped learning context but applied it to broader academic and professional settings. Many participants described how reflection became an integral part of their self-improvement process, influencing independent study habits, problem-solving approaches, and professional decision-making. This finding supports research on lifelong learning and self-regulated education (Mejeh, Sarbach, & Hascher, 2024; Nguyen, Lämsä, Dwiarie, & Järvelä, 2024), demonstrating that structured reflection cultivates immediate academic benefits and long-term adaptive learning behaviors.

These findings also reinforce the theoretical connection between reflection and professional identity development. Previous research has suggested that reflective practice is a cornerstone of professional growth in teacher education (Karim, Kabilan, Sultana, Amin, & Rahman, 2024; Reissner & Armitage-Chan, 2024). This study provides empirical evidence that structured reflection fosters metacognition, resilience, and professional adaptability as preservice teachers learn to engage in critical self-assessment and continuous improvement.

Given these findings, teacher training programs should not treat reflection as an isolated academic exercise but as a fundamental component of professional development. Embedding structured reflection within flipped learning environments can encourage lifelong reflective habits, equipping future educators with the skills to adapt to complex and evolving educational challenges.

5.4. Limitations and Future Directions

While the findings of this study provide strong evidence for the benefits of structured collaborative reflection, several limitations should be acknowledged. First, the study was conducted in three universities within a single regional context (Lampung, Indonesia), which may limit the generalizability of the results to different educational and cultural settings. Future research should explore how these findings apply to different countries, diverse institutional structures, and varying student experience levels with flipped learning.

Second, while the quantitative analysis confirmed significant effects of structured reflection, additional experimental designs, such as longitudinal studies, could further explore how reflection influences long-term changes in resilience and self-regulated learning (SRL). Future research should investigate whether the benefits of structured reflection persist over time and how they manifest in actual classroom teaching practices.

Finally, although the qualitative phase provided rich insights into participants' experiences, future studies could expand data collection through video analysis of reflection sessions or learning analytics tracking of reflection logs, offering a more nuanced understanding of how reflection evolves across different instructional conditions.

6. Conclusion and Recommendation

This study provides strong empirical evidence that integrating structured collaborative reflection into flipped classroom learning significantly improves preservice teachers' academic resilience and self-regulated learning (SRL). Quantitative results show that students who engage in structured reflection consistently demonstrate higher achievement in resilience and SRL, with the most pronounced impact observed in the Flipped Learning + Structured Reflection Group (G1). These findings are reinforced by thematic analysis, which reveals that collaborative reflection plays a crucial role in fostering metacognitive awareness, providing emotional support through peer interaction, and

encouraging reflective activities outside the classroom. In other words, structured reflection enhances short-term performance and strengthens the foundation of long-term learning skills that can be transferred to various academic and professional contexts. The results of this study suggest that flipped learning alone is insufficient to develop independent or emotionally resilient learners. Structured collaborative reflection is a key component that enables students to actively gather, listen, and continuously adjust their learning processes. Based on these findings, it is recommended that teacher education programs systematically incorporate structured collaborative reflection into flipped learning designs. This approach is believed to optimize students' cognitive and affective abilities. Moving forward, pedagogical frameworks should emphasize the importance of guided reflection activities, directed peer discussions, and structured feedback systems so that prospective teachers can develop the core skills necessary for long-term academic and professional success.

7. Teaching and Learning Recommendations

If collaborative reflection is to truly "hit" in the flipped classroom, educators need to provide a clear path not just ask students to "think about it." One practical way to do this is to use the Korthagen (2017) as a constant guide. With this framework, students are encouraged to look back at what happened in class, why it happened, and then plan steps to improve it repeatedly.

The process should be conducted collaboratively rather than in isolation within individual rooms. For example, after independently preparing their materials at home, students gather in class to engage in small group discussions, exchange feedback, and document reflection points in a structured journal. This collaborative approach promotes accountability and fosters a network of emotional support elements that are crucial for maintaining resilience when faced with challenging material. To ensure effective reflection, instructors must train students in reflective thinking skills. This training includes providing examples of prompting questions, demonstrating how to assess their learning strategies, and guiding them in developing plans for improvement.

Since research shows that structured reflection works best in flipped classrooms, institutions can organize their courses accordingly: core content is learned online at students' own pace, followed by face-to-face sessions focused on guided reflective discussions. By making structured reflection a mandatory part of the curriculum rather than an optional "when-you-can" activity students will become accustomed to introspecting their thinking, adjusting their strategies, and ultimately building the academic resilience they need both on campus and in the workplace.

8. Future Research Consideration

While this study provides robust evidence of the impact of structured collaborative reflection on preservice teachers' resilience and self-regulated learning (SRL), several areas remain open for further investigation. First, future research should explore longitudinal effects, examining whether the benefits of structured reflection persist beyond the duration of a single course and whether these skills translate into long-term professional resilience and adaptive teaching practices. Comparative studies across diverse educational and cultural contexts are also necessary to determine whether the observed effects hold across different institutions, disciplines, and learning environments. Future studies should also employ learning analytics, eye-tracking technology, or AI-driven sentiment analysis to gain deeper insights into how students engage with structured reflection and how their cognitive and emotional responses evolve. Furthermore, while this study focused on structured peer reflection, future research should explore the roles of instructor-guided reflection, digital reflection tools, and AI-assisted feedback mechanisms in supporting self-regulated learning and resilience. Finally, experimental designs incorporating different levels of reflection scaffolding (e.g., minimal, moderate, and intensive reflection support) could provide further insights into how varying levels of reflection structure impact students' cognitive and affective learning outcomes. These future research directions will contribute to a more comprehensive understanding of how structured collaborative reflection can be optimized to support 21st-century learning and professional development.

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