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Enhancing Problem-Solving Skills through the Student Facilitator and Explaining Model: An Exploratory Study

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Abstract: Enhancing Problem-Solving Skills through the Student Facilitator and Explaining Model: An Exploratory Study. Objectives: This study investigates the potential of the Student Facilitator and Explaining (SFE) model to improve undergraduate students' problem-solving skills during microteaching practice. **Methods:** A quantitative, single-group pretest-posttest design was employed, involving 21 students enrolled in the Microteaching course of the Early Childhood Education (PG PAUD) program. The instrument consisted of six dimensions: persistence, divergent thinking, convergent thinking, motivation, environment, and general knowledge and skills, measured using a five-point Likert scale. Pretest and posttest data were analyzed using paired sample t tests to determine statistical significance. **Findings:** Results showed significant improvements across all dimensions of problem-solving skills. The most substantial gains were observed in divergent thinking (M_{diff} = 18.57, t = 13.54, $p < 0.001$), general knowledge and skills (M_{diff} = 18.05, t = 13.90, $p < 0.001$), and motivation (Mdiff = 17.81, t = 14.12, $p < 0.001$). All dimensions demonstrated statistically significant enhancement ($p < 0.001$), indicating that the SFE model effectively fosters students' cognitive flexibility, persistence, and self-motivation in addressing instructional problems. **Conclusion:** The SFE model enhances students' problem-solving abilities by promoting active engagement, collaborative reasoning, and reflective learning within Microteaching courses. These findings highlight the potential of student-centered instructional models to develop both cognitive and professional competencies in teacher education. Future research using control groups and larger samples is recommended to strengthen the validity and generalizability of these results.

Keywords: problem-solving skills, SFE model, microteaching, pedagogical strategy.

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INTRODUCTION

Problem-solving skills are perhaps the most critical set of skills students must possess to cope with the ever-increasing complexities and dynamism of the 21st century. In the wake of globalization, technological advancement, and accelerated social and economic developments, not only must students possess mastery in theory or declarative knowledge but must rather be equipped with the capabilities of being able to make sound judgments on the problems, scope several options of solutions, select the appropriate solution, and assess outcomes thus gained (Suparatulatorn et al., 2023; Tsai et al., 2023). These abilities are invaluable not only for maintaining academic excellence but also for managing real-world cases in professional and everyday life (Omar, 2022). The ability to solve problems also counts among the key indicators of ideal quality university graduates. These individuals can think systemically, logically, adaptively, and retrospectively in response to a wide range of predicaments. Graduates from high-quality universities should be proficient in both theoretical and practical skills, such as problem-solving. (Low et al., 2024; Ravenswaaij et al., 2022). The development of these skills is essential and becomes the main focus of the learning process, either through innovative pedagogical approaches, problem-based assignments, or active learning models that involve students directly in exploration and problem-solving, both independently and collaboratively.

The current state of learning in higher education indicates that most students still have difficulty solving problems in a structured, logical manner. This is because teacher-centered learning methods are so prevalent, in which lecturers are the only source of information, and students are passive recipients. Students' ability to engage in active, critical, and exploratory thinking is constrained by this method. According to a study by the National Survey of Student Engagement (NSSE) in 2023, only about 30-40% of students in developing countries are reported to be actively engaged in collaborative problem-based learning (Ferguson, 2023). In Indonesia, Kristiana et al. (2023) found that approximately 94.45% of students reported low engagement, primarily due to instructors' continued reliance on traditional, one-directional teaching methods. Such findings highlight that learning practices in many universities remain inadequate in facilitating higher-order thinking processes, including analytical reasoning and problem-solving skills (Abdellatif & Zaki, 2020; Özdayi, 2019).

This condition is further strengthened by the Ministry of Education, Culture, Research, and Technology's 2021 survey results, which show that students have difficulty solving analysis-based and complex problems. This suggests that the learning process in higher education still focuses on low-level cognitive skills, such as memorization and basic understanding, without placing sufficient emphasis on the application, analysis, and synthesis of knowledge. In addition, curricula that have not fully integrated skills-based approaches also exacerbate this situation (Afacan & Kaya, 2022; Mirzoeva, 2023). Given that the professional world increasingly demands graduates with the capacity to think critically, collaborate effectively, and adapt creatively, a pedagogical transformation toward more student-centered, skills-based approaches is urgently needed.

Microteaching is one of the core courses in teacher education programs, designed to train students' practical teaching skills through simulations in controlled situations (Sithole, 2020; Yafie et al., 2024). Through this activity, prospective teachers have the opportunity to practice various technical aspects of teaching, such as lesson planning, mastery of content, media use, and classroom management on a small scale. Even when the central emphasis is on learning to teach, micro-teaching has immense potential for the acquisition of soft skills such as problem-solving, collaboration, communication, and self-reflection (Haneda & Ito, 2018; Park, 2022; Zhang et al., 2024). Unfortunately, in practice, the approach to microteaching learning still tends to be procedural and oriented towards technical achievement, without providing sufficient space for students to systematically develop high-level thinking skills. In fact, to produce professional educators who are adaptive and innovative, learning models that not only train in the methodological aspects of teaching but also encourage students to actively participate in designing, evaluating, and solving problems that arise in the learning process reflectively and creatively (Casal et al., 2024).

There should be innovation in learning; i.e., the Explaining and Student Facilitator is one method of active learning that involves positioning students not only as recipients of information but also as facilitators, explaining material to their peers (Mathisen et al., 2022). In this model, students are encouraged to master the material, re-present it in structured explanations, and actively facilitate discussions with their peers. This process fosters two-way interactive communication, promotes reciprocal talk, and ensures accountability for the learning process at the individual and group levels. Through this group engagement, the SFE model can develop the essential characteristics of students, including effective communication skills, the ability to work together, critical thinking, and the ability to constructively deal with problems (Noge et al., 2022). SFE characteristics that emphasize active participation and collaboration are very relevant to be applied in practice-based learning, such as microteaching, because they can strengthen pedagogical skills as well as soft skills needed by aspiring educators in handling the intricacy of real-world instructing and learning procedures (Aris et al., 2025; Donnelly et al., 2023).

What is distinctive about this work is the deployment of the SFE model to the higher education environment, especially in microteaching courses that often lack space for the improvement of higher-order cognitive abilities. Most studies still focus on the application of the SFE model at the primary and secondary education levels, with results showing an increase in communication skills, collaboration, and understanding of the material (Oskarita & Arasy, 2024; Witarsa, 2017). Research by Yuniarti & NguyÅn (2024) shows that SFE is effective in improving collaboration skills and material comprehension among secondary school students. By contrast, limited attention has been devoted to understanding the potential of SFE in fostering university students' problem-solving skills particularly within the practical, hands-on learning contexts of teacher education programs. Thus, the current study aims to add to the expanding body of knowledge by exploring the initial potential of the SFE model to enhance students' problem-solving competence and engagement during microteaching activities (Jamil & Bhuiyan, 2021).

This study does not claim to establish the causal effectiveness of the Student Facilitator and Explaining (SFE) model, as it employs a single-group pretest–posttest design without a control group. Instead, it explores the model's potential to foster students' active engagement, reflective reasoning, and collaborative problem-solving within simulated teaching contexts. The findings suggest that the SFE model not only enhances technical teaching competenciesbut also strengthens soft skills, particularly in complex problem-solving and higher-order thinking (Ritter et al., 2018; Widad & Abdellah, 2022). Consistent with Almulla & Al-Rahmi (2023), the results indicate that cooperative learning approaches, such as SFE, can promote critical thinking and extend their application from school to higher education settings.

The study emphasizes the importance of cultivating student agency in higher education. Preparing students to meet complex global challenges requires developing 21st-century skills, including adaptive problem-solving, teamwork, and critical thinking. Thus, the current research positions itself as an exploratory investigation into how the SFE model may serve as an instructional framework that nurtures these competencies within microteaching contexts, offering valuable implications for future pedagogical innovation in higher education.

■ METHOD

Participants

Students enrolled in the Early Childhood Teacher Education Study Program (PG-PAUD) at the Faculty of Psychology and Education Science, Universitas Muhammadiyah Sidoarjo (UMSIDA), Indonesia, participated in this study.

The total sample consisted of 21 students enrolled in the Microteaching course during the 2024 academic year.

Purposive sampling was employed, and participants were selected according to predetermined criteria set by the researcher. The inclusion criteria were: (1) students currently taking the Microteaching course, (2) those who had completed all prerequisite courses, and (3) students who freely consented to take part in the research. This selection ensured that the data obtained were representative and relevant to the study's objectives.

Research Design and Procedures

This study examined how students' problem-solving abilities changed after engaging in SFE-based learning using a quantitative pre-experimental design and a single-group pretest-posttest methodology. Due to the absence of a control group, the results are interpreted as indicative evidence of potential improvement. The research follows these steps:

$$O_1 \quad x \quad O_2$$

Figure 1. One group pre-test post-test design

Description:
O1 : Pretest (before treatment)
X : The treatment given (application of the SFE model)
O2 : Posttest (after treatment)

The data collection spanned eight weeks, beginning with a pretest, followed by a six-week implementation of the SFE model intervention, and concluding with a posttest at the end of the period. To clarify how this research design was operationalized across the eight weeks, the detailed schedule of the intervention activities is presented in Table 1 below.

Table 1. Schedule of SFE model implementation

Week	Research Stage	Types of Activities	Description of Activities	Mode / Meeting Format
Week 1	Pretest (O1)	Problem-solving pretest	Students completed a structured problem-solving test measuring baseline abilities before SFE learning.	Face-to-face briefing; submission via Google Form
Week 2	Introduction to SFE	Orientation to SFE phases	The lecturer introduced the purpose, sequence, and expectations of the SFE model (Preparation–Facilitator–Explaining–Feedback–Evaluation).	Face-to-face lecture and modeling
Week 3	SFE Intervention	Preparation Phase	Students analyzed pedagogical problems and prepared microteaching lesson plans using the SFE steps.	Face-to-face workshop
Week 4	SFE Intervention	Facilitator Phase	Students acted as facilitators, guiding peers in identifying, clarifying, and organizing the problem's elements.	Microteaching session (face-to-face)
Week 5	SFE Intervention	Explaining Phase	Students delivered structured explanations of problem-solving steps, supported by visual aids and reasoning strategies.	Microteaching session

Week 6	SFE Intervention	Feedback Phase	Peer observers completed an observation rubric evaluating clarity, logic, and interaction quality; the lecturer provided corrective guidance.	Face-to-face observation; documentation via Google Form
Week 7	SFE Intervention	Evaluation & Reflection Phase	Students conducted self-assessment, discussed challenges, and reflected on the application of problem-solving strategies.	Reflection meeting (face-to-face)
Week 8	Posttest (O2)	Problem-solving posttest	Students completed the same assessment instrument to measure changes after the SFE intervention.	Online submission via Google Form

Instruments

A closed-ended questionnaire was developed based on indicators of problem-solving abilities as the primary research variable and used to gather data. A five-point Likert scale, with 1 denoting "strongly disagree" and 5 denoting "strongly agree," was utilized for each questionnaire item. Eighteen items made up the questionnaire, which was divided into six categories: environment, motivation, persistence, divergent and convergent thinking, and general skills and knowledge.

Table 2. Instrument grid of research variables

Dimensions	Indicator	Scale	Source
Persistence	1. Demonstrate perseverance when solving difficult problems. 2. Maintain effort despite repeated failures. 3. Continue seeking solutions until the problem is resolved.	Likert 1-5	Jonassen (2000)
Divergent Thinking	1. Generate many alternative solutions. 2. Consider multiple perspectives. 3. Creative thinking in problem solving.	Likert 1-5	Paf & Dinçer (2021)
Convergent Thinking	1. Choose the best solution from the alternatives. 2. Filter out relevant solutions. 3. Develop a focused and practical solution.	Likert 1-5	
Motivation	1. Have a drive to solve problems. 2. Demonstrate resilience in the face of adversity. 3. Take responsibility for the results of problem-solving.	Likert 1-5	
Environment	1. Adapt solutions to environmental conditions. 2. Understand the influence of external factors. 3. Leverage the environment to support solutions.	Likert 1-5	
General knowledge and Skills	1. Apply relevant knowledge. 2. Using practical skills for solutions. 3. Choose the right tools or resources.	Likert 1-5	
Persistence	4. Demonstrate perseverance when solving	Likert 1-5	

difficult problems.
5. Maintain effort despite repeated failures.
6. Continue seeking solutions until the problem is resolved.

Several example items were included to demonstrate the instrument's content validity. For instance, items such as "*I continue working on a problem even when it becomes difficult*" represented the persistence dimension; "*I generate multiple alternative solutions when facing a classroom challenge*" reflected divergent thinking; "*I select the most effective solution from several available options"* aligned with convergent thinking; "*I feel motivated to complete problem-solving tasks even when they are demanding*" captured the motivation dimension; "*I adapt my problem-solving strategies based on environmental or situational demands*" represented the environment dimension; and "*I apply relevant knowledge and skills when responding to teaching-related problems*" reflected general knowledge and skills. These examples demonstrate that the questionnaire items were clearly aligned with the targeted theoretical constructs and were appropriate for measuring students' problem-solving abilities in the context of SFE-based microteaching.

Data Analysis

There were multiple phases to the data analysis. To support the subsequent visual representation of students' performance, score categorization was applied to group pretest and posttest results into five descriptive categories. The classification ranges used in this study are presented in Table 3.

Table 3. Score categorization for visualization

Score Range	Category
0–20	Very Low
21–40	Low
41–60	Medium
61–80	High
81–100	Very High

There were multiple phases to the data analysis:
1. To guarantee data quality, test the validity and reliability of the device.
2. To ascertain whether the data distribution satisfied the normalcy assumption, use a normality test.
3. To compare pretest and posttest data and ascertain the impact of the SFE model on students' problem-solving skills, hypothesis testing was carried out using the paired sample t-test.

The factors for decision-making are:
1. The null hypothesis (Ho) is accepted, and the alternative hypothesis (Ha) is rejected if the t count is less than the t table.
2. The alternative hypothesis (Ha) is accepted, and the null hypothesis (Ho) is rejected if the t count is greater than the t table.

RESULT AND DISCUSSION

Validity Test

Table 4 below shows the validity test results.

Table 4. Validity test results

Dimensions	Item	r-table	r-count	Description
Persistence	Y1	0.444	0.526	Valid
	Y2	0.444	0.494	Valid
	Y3	0.444	0.651	Valid

Divergent Thinking	Y4	0.444	0.611	Valid
	Y5	0.444	0.588	Valid
	Y6	0.444	0.723	Valid
Convergent Thinking	Y7	0.444	0.509	Valid
	Y8	0.444	0.565	Valid
	Y9	0.444	0.672	Valid
Motivation	Y10	0.444	0.761	Valid
	Y11	0.444	0.450	Valid
	Y12	0.444	0.506	Valid
Environment	Y13	0.444	0.533	Valid
	Y14	0.444	0.565	Valid
	Y15	0.444	0.546	Valid
General knowledge and Skills	Y16	0.444	0.567	Valid
	Y17	0.444	0.696	Valid
	Y18	0.444	0.651	Valid

The validity test findings shown in Table 3 show that r-count values are higher than r-table values for every item in each dimension. This would imply that every element of the dimensions of persistence, motivation, environment, divergent and convergent thinking, general knowledge, and talents is still relevant. Consequently, the measures employed in this study are deemed legitimate and suitable for assessing students' problem-solving abilities.

Reliability Test

Table 5. Reliability test results

Variables	Standard	Cronbach's alpha	Description
Problem-Solving Skill	0.7	0.878	Reliable

The reliability test findings in Table 5 indicate that the Cronbach's alpha for the Problem Solving Skill variable is 0.878, exceeding the minimum criterion of 0.7. This indicates that the instrument used to assess problem-solving skills is highly reliable and can be considered trustworthy for research purposes.

Normality Test

Table 6 indicates that the pre-test data are normally distributed, as the Shapiro-Wilk and Kolmogorov-Smirnov p-values are both greater than 0.05 (0.265 and 0.084, respectively). The post-test results indicate that the data are likewise normally distributed, with p-values of 0.051 for the Kolmogorov-Smirnov test and 0.189 for the Shapiro-Wilk test. Thus, it is possible to say that the pre-test and post-test data are regularly distributed.

Table 6. Normality test results

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRE-TEST	.213	21	.084	.906	21	.265
POST-TEST	.188	21	.051	.937	21	.189

Paired Sample t-Test

All six characteristics of students' problem-solving abilities show significant differences between pretest and posttest scores ($p < 0.05$),

Table 7. Paired sample t-test results

Dimension	Mean (Pre)	Mean (Post)	Mean Difference	t	df	Sig. (2-tailed)	Interpretation
Persistence	70.10	85.14	-15.04	-11.210	20	0.000	Significant
Divergent Thinking	69.81	88.38	-18.57	-13.542	20	0.000	Significant
Convergent Thinking	71.33	87.05	-15.72	-12.214	20	0.000	Significant
Motivation	72.52	90.33	-17.81	-14.115	20	0.000	Significant
Environment	68.19	83.14	-14.95	-10.672	20	0.000	Significant
General Knowledge and Skills	70.95	89.00	-18.05	-13.899	20	0.000	Significant

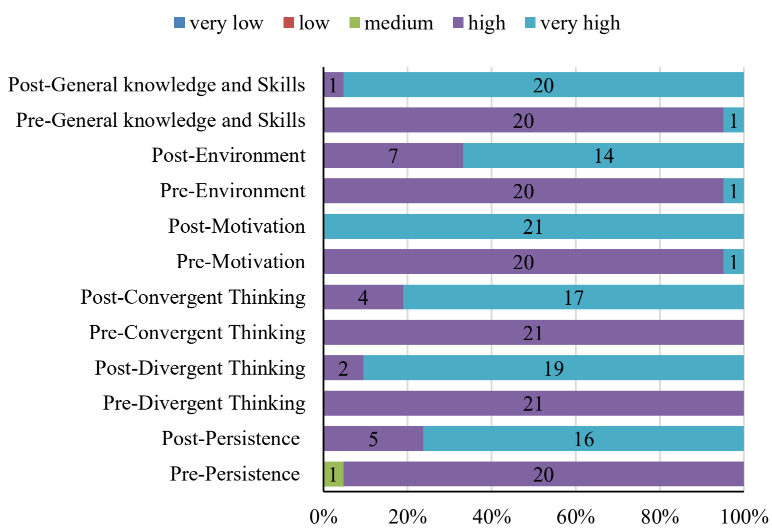

Figure 2. Distribution of pretest and posttest scores

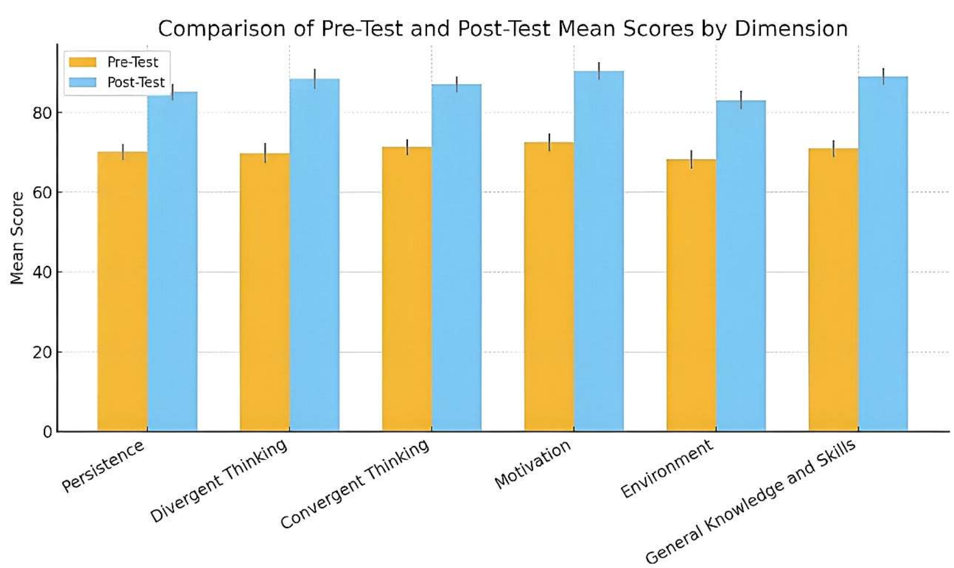

Figure 3. Comparison of average pretest and posttest scores

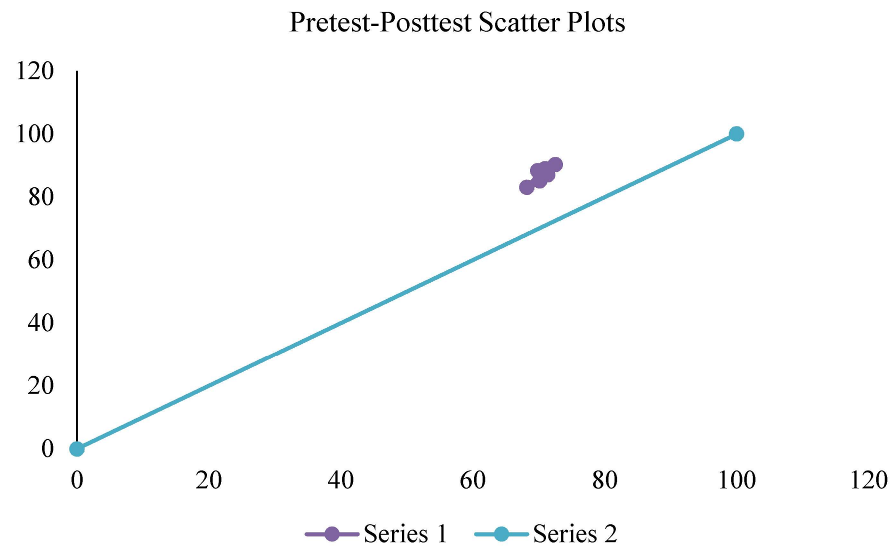

Figure 4. Pretest–posttest scatter plots

as indicated by the paired-samples t-test results shown in Table 6. After the SFE model was implemented, each dimension improved. The greatest increase was observed in Divergent Thinking (M_{diff} = -18.57, t = -13.542) and Motivation (M_{diff} = -17.81, t = -14.115), indicating that the SFE model effectively encouraged students to think creatively and sustain motivation during microteaching tasks. Similarly, notable gains were found in Persistence, Convergent Thinking, and General Knowledge and Skills, suggesting enhanced perseverance, decision-making, and application of pedagogical knowledge. Improvement in the Environment dimension also highlights students' better adaptability and awareness of contextual factors during teaching practice. All things considered, these findings offer preliminary proof that the SFE approach can improve several aspects of students' problem-solving skills in microteaching environments.

Although the main analysis of this study relied on quantitative pretest–posttest data, classroom documentation collected during the implementation of the SFE model provided supporting evidence that strengthened the statistical findings. Observations showed that during the Explaining Phase, students began to demonstrate more structured reasoning, using diagrams or brief explanatory frameworks to visualize problem-solving steps. At the same time, in the Facilitator Phase, peer interactions became more active through clarification questions and collaborative organization of problem elements. Written reflections at the end of Week 7 indicated that students felt more confident in identifying alternative solutions and in justifying their chosen strategies, and the lecturer's notes recorded that students' explanations became increasingly clear and systematic from session to session. These observational insights complement the quantitative results by illustrating the development of student engagement, interaction, and reasoning throughout the SFE learning cycle. Several documents related to the implementation of the SFE model are shown in Figure 5.

The Role of the SFE Model in Enhancing Problem-Solving Skills

The findings of this study are associative in nature, as the pre-experimental design does not allow for a definitive causal conclusion. The Student Facilitator and Explaining (SFE) model plays a vital role in developing students' problem-

(a) (b) (c)

Figure 5. Documentation for the Implementation of the SFE Model

solving skills, especially in Microteaching courses. Since the research tool was created specifically to evaluate aspects of problem-solving, such as persistence, divergent and convergent thinking, motivation, environment, and general knowledge and skills, this study focuses solely on problem-solving abilities rather than critical thinking. In this model, students not only act as recipients of information but also as facilitators who are responsible for explaining the material to their peers. This dual role may contribute to improved problem-solving skills by stimulating deeper engagement with the content and encouraging analytical thinking, although causality cannot be definitively claimed (Ssemugenyi, 2023; Tuxtayevich et al., 2024).

The use of the SFE model in Microteaching allows for analyzing the theory of teaching and practicing it more pragmatically (Santoveña-Casal et al., 2024b; Yafie et al., 2024). In microteaching, students simulate real classroom scenarios in small groups. Within the SFE model, students are not only expected to teach but also to lead discussions and clarify complex content, which enhances their ability to identify problems, generate explanations, and collaboratively construct solutions (Nagaraj et al., 2023; Singh-Pillay, 2023). This process reflects cognitive elaboration and social interaction mechanisms, where explaining to peers reinforces one's own understanding, aligns with Vygotsky's theory of social constructivism, and promotes higher-order thinking (Alam & Mohanty, 2023; Green, 2021).

The study's findings are consistent with other research that emphasized the advantages of SFE for motivation and cognition. Qu (2023) and Loyens et al. (2023) demonstrated that the SFE approach enhances students' problem-solving and reasoning through active peer collaboration, while Grant & Ferguson (2021) found that it strengthens self-regulation, persistence, and reflective thinking in higher education. Consistent with these studies, the present research observed the greatest improvements in motivation and divergent thinking, suggesting that the SFE model effectively fosters engagement and creative exploration of multiple solutions to instructional challenges.

From a psychological perspective, the effectiveness of the SFE model can be explained through two main mechanisms: social-cognitive interaction and cognitive elaboration. Through peer explanation, students externalize their thought processes, receive constructive feedback, and refine reasoning strategies that build flexible problem-solving abilities (Damaðevièius &

Sidekerskienë, 2024; Okolie et al., 2022; Xu et al., 2023). In addition, the collaborative and participatory nature of SFE enhances students' persistence and confidence, resonating with Bandura's (1997) self-efficacy theory, which posits that mastery experiences and social learning strengthen perseverance in addressing complex problems (Bandura, 2023).

In conclusion, the SFE model enhances students' problem-solving competence across cognitive, motivational, and social dimensions within Microteaching practice. Reflection, peer discussion, and facilitation activities allow students to integrate theory into practice and co-construct knowledge collaboratively. The improvements observed across all problem-solving dimensions indicate that SFE supports not only pedagogical proficiency but also adaptive, creative, and collaborative problem-solving skills relevant to professional teaching contexts (Almazroui, 2023; Yafie et al., 2024). However, these results should be interpreted with caution due to the small sample size and one-group pretest-posttest methodology. It is advised that future studies corroborate these mechanisms and investigate the sustainability of problem-solving abilities outside the Microteaching course, using mixed-method or longitudinal designs with larger, more varied samples.

CONCLUSION

This study provides exploratory evidence that the Student Facilitator and Explaining (SFE) model has the potential to enhance students' problem-solving competence within Microteaching contexts. The findings showed significant improvements across multiple dimensions particularly motivation and divergent thinking indicating that the SFE approach fosters students' engagement, creativity, and persistence in addressing instructional challenges. Through facilitation, peer explanation, and collaborative reflection, students were able to connect pedagogical theory with practice, develop adaptive reasoning strategies, and cultivate social interaction skills essential to teaching and professional environments.

While these results highlight the potential benefits of the SFE model, they must be interpreted with caution. The one-group pretest–posttest design and the relatively small sample size ($n = 21$) limit generalizability and preclude definitive causal claims about the model's effectiveness. Nevertheless, the observed patterns provide valuable insights into how peer interaction and cognitive elaboration, as conceptualized in Vygotsky's social constructivist theory, can contribute to students' higher-order thinking and problem-solving abilities.

From a practical perspective, integrating the SFE model into Microteaching courses can serve as an effective strategy to promote active learning, reflective dialogue, and collaborative problem-solving among pre-service teachers. Such practices not only strengthen pedagogical competence but also prepare students to face the complex, adaptive demands of real-world teaching. Future studies are recommended to employ more rigorous methodologies, such as quasi-experimental or mixed-method designs with larger and more diverse samples, to further validate these findings. Longitudinal research could also explore the sustainability of problem-solving gains and examine the model's broader impact on related variables, including communication, teamwork, and motivation. Continued investigation into the cognitive and social mechanisms underlying the SFE model will deepen understanding of its role in developing reflective, innovative teaching professionals.

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