

Identifying Pedagogical Gaps and Reformulating Microteaching for 21st-Century Teacher Preparation

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Received: December 28, 2025

Accepted: June 11, 2026

Online Published: September 21, 2026

doi:10.11114/jets.v15i1.8326

URL: <https://doi.org/10.11114/jets.v15i1.8326>

Abstract

The development of 21st-century education demands that prospective elementary school teachers possess pedagogical competencies that are not only technical but also encompass critical thinking, creativity, communication, and collaboration (4C) as the foundation for innovative learning in the digital era. However, various studies and microteaching practices in the field indicate that prospective teachers still experience difficulties in integrating these skills into learning planning and practice. This study aims to examine the urgency of improving the pedagogical competencies of prospective elementary school teachers through a microteaching methodology that emphasizes the development of 21st-century skills. The study used a cross-sectional survey design with a mixed methods approach and involved 173 participants consisting of teachers, students, and lecturers in the Greater Madiun area through purposive sampling. Data were collected through questionnaires, interviews, and observations, then analyzed using descriptive statistics and thematic analysis integrated through triangulation. The results showed that creativity, critical thinking, and pedagogical readiness were the aspects with the lowest category, while communication and collaboration competencies were relatively better but not yet consistently integrated into microteaching practices. Qualitative analysis revealed that microteaching guidelines at several universities still focus on administrative procedures and do not include 4C-based learning outcomes, causing students to tend to use conventional methods and practice less innovative strategies.

Keywords: elementary, microteaching, teacher, development, pedagogic, competence

1. Introduction

The 21st century is characterized by rapid technological and social change, requiring education systems to develop human resources equipped with the competencies needed to thrive in increasingly complex environments (Yoel et al., 2023; Arican & Mutlu, 2023). Beyond knowledge acquisition, education is expected to foster critical thinking, adaptability, and active participation in social transformation (Brahmadevara, 2023; Supandee & Yachulawetkunakorn, 2023). The growing emphasis on 21st-century skills reflects concerns that traditional education remains largely focused on individual achievement and competition, often providing limited opportunities for collaboration and problem-solving. In contrast, contemporary society requires individuals who can effectively communicate, collaborate, think critically, and solve complex problems. Consequently, these competencies have become essential foundations for success in the digital era (Y. Wang et al., 2023; Rojas et al., 2023).

The reality of global education, which has not yet accounted adequately for the educational output needs of the digital era, is another factor contributing to the emergence of 21st-century skills in particular (Brahmadevara, 2023; Rojas et al., 2023). Typically, the learning paradigm that develops focuses on competitiveness. Teachers who, without realizing it, instill a competitive mindset in their students while neglecting cooperation (Iqbal et al., 2023; Coşkun & Filiz, 2023). For instance, academic rankings remain relevant, classes with accelerated learning, and the emergence of preferred schools. Students become more cognitively sophisticated only when they develop competing thought processes. Hence, this approach disregards the importance of a collaborative and cooperative culture (Teresa & Fields, 2023; Rojas et al., 2023).

This perspective contrasts with the perception of the 21st century, which holds that people live in a technologically advanced world with easy access to a wealth of knowledge as well as novel forms of cooperation and communication. Thus, having a solid foundation in digital skills such as problem-solving, communication, collaboration, and critical thinking is essential for success in the digital age.

In order to adequately educate students for the realities of the twenty-first century, educators must offer collaborative learning materials, as indicated by the aforementioned fact (Zhang & Zhou, 2023; Karuna et al., 2022). 4C stands for communication, collaboration, critical thinking and problem-solving, and creativity and innovation. These terms have emerged to describe the content of 21st-century learning (Shwartz-Asher et al., 2022). Teachers are, conceptually, professionals with both the amount and quality of work experience who can address any demands or obstacles in education (Aizenkot & Ben David, 2023). Instead of expecting teachers to know it all and be experts in every field, 21st-century educators must be able to learn alongside their students and set an example of perseverance, openness, and trust that will help them face the challenges of a rapidly evolving digital world.

21st-century skills become a narrative to change the minds of educators. The reality is that today's educators are very different from those in the past. In the past, many teachers were found to be sincere figures who dedicated their lives to their students so that they become human beings who are not afraid to face life's problems (Coşkun & Filiz, 2023; Şendağ et al., 2023). Meanwhile, today's teachers are often stigmatized for abandoning their professional obligations, coming to school to fulfill their duties, and teaching that is limited to transferring knowledge (Ulfert-Blank & Schmidt, 2022; Yong & Saad, 2023). It is a loss for an experienced teacher when he only presents information that is irrelevant to life safety, lacks emotional power, and provides no deep meaning.

Educators need to understand that the professionalism of educators in the 21st century is not merely expertise in a particular topic (Contreras-Espinosa & Eguia-Gomez, 2022). Rather, they must be experts in collaborating with their students to find new discoveries in every learning process (Hoon et al., 2022). 21st-century skills are not just an educational product concept that students must have (Benrahal et al., 2023). However, to prepare their pupils for the reality of 21st-century digital life, educators are encouraged to continually present themselves as role models for trust, openness, perseverance, and dedication. This is concept known as 21st-century skills (Sylva et al., 2020). The challenges facing education in the twenty-first century include creating a workforce capable of competing in the market by implementing or providing students with 4C competencies through excellent programs offered by the institution (Bijjahalli, 2020). However, many educational institutions are still unable to produce graduates who are prepared to compete in the 21st century (Isa et al., 2020). This is caused by the implementation of education in Indonesia, which still does not refer to the 4C provision, but is still oriented towards mastering the material only. The ability of students to retain information and respond to inquiries is still the ultimate measure of education. However, it is not enough to face this IT-centric world of work just by providing learning materials. Thus, providing soft skills (4C) in this era is very urgent (Rinekso, 2021).

In every education, there is a learning process where students interact with each other or are closely related to the duties and roles of a teacher (Benbow et al., 2021). In the 21st-century school standards, or what can be called the digital century, where all life activities are always related to digital technology, it is necessary to apply technology in teaching and learning activities (Merl, 2022). In this digital era, whether a teacher likes it or not, they will face students who were born and developed in this digital age, so they must have extensive and high levels of technological knowledge or literacy (Drajati et al., 2021).

Since teaching is a teacher's primary responsibility, a teacher needs to possess, master, and internalize competencies such as skills and behavior. There are several competencies that a student must have, one of which is pedagogical competency. This competency is very important because it helps students understand psychological development (Mitra & Aziatul Niza, 2021; Yılmaz, 2021). Meanwhile, learning that educates students encompasses three key components: carrying out learning, designing learning, and assessing learning outcomes. Teachers face a challenge in the twenty-first century to become more proficient in the development of communication and information (Perdanasari & Sangka, 2021; Sadeck et al., 2021). In the twenty-first century, educators who meet high requirements of proficiency are considered professionals.

A teacher needs to be competent in terms of ability and knowledge, which is also known as professional competence. The ability to solve academic difficulties that are intimately related to the process of teaching and learning activities is the goal of professional competence for teachers (Pamungkas et al., 2020; Perdue, 2020). Teachers must become more professional to keep up with the advancement of science and technology. To fulfill his responsibilities as an educator, a teacher must be completely competent (Jansen & Söbke, 2022; Haryani et al., 2021). On the other hand, ignorance of the skills and responsibilities of teaching will hinder the smooth progression of the teaching and learning process, preventing the achievement of desired educational goals. A teacher must employ special learning methods to adapt to the industrial revolution 4.0, such as utilizing technological advancements in the classroom; until recently, elementary school education

primarily involved watching and observing these advancements, and whether students liked it or not, they were compelled to use technology in the classroom (Gupta & Sharma, 2019; Teresa & Fields, 2023). The ability to control learning is known as pedagogical competency in education. Regulation Number 16 of 2007 covering Academic Qualification Standards and Pedagogical Competencies, issued by the Minister of National Education, contains the competencies that are essential for a teacher to possess.

When the teachers stand in front of the class carrying out learning activities, it is not enough just to have mastered the learning material that must be conveyed to students (Sithole, 2023). However, the teacher still has several other requirements to meet, including controlling all the learning components that were previously discussed and interacting with students in a way that facilitates the achievement of the desired learning objectives. This situation is where learning is a complex process (Marhaban et al., 2023).

Considering the complexity of the learning process for every student teacher candidate or for those who have occupied a professional teaching position, teaching abilities must always be trained and developed so that maximum and professional abilities can be obtained (Sithole, 2023). One effort to prepare prospective teachers or improve the abilities of current teachers in handling complex learning tasks is to implement a training or learning process that uses a simplified learning model, commonly known as microteaching.

Microteaching is one of the teaching training courses in a small form (micro) designed to develop the teaching skills of prospective teachers. This learning is deliberately carried out in micro form so that the behavior and teaching skills of prospective teachers can be carefully guided and controlled by the team of lecturers who teach the course (Murphy Odo, 2023). Microteaching is carried out in a micro teaching laboratory where mirrors are installed on each side of the wall, so that student teachers and lecturers can pay close attention to the teaching behavior of prospective teachers. Subramaniam, (2023) in their research entitled "Pre-Service Teachers' Approaches to the Effectiveness of Micro-Teaching in Teaching Practice Programs" also states that the microteaching method provides an opportunity for pre-service teachers to conduct an evaluation of their strengths and weaknesses in the teaching process (Thangaraju & Medhi, 2023; Woods, 2023). 80% of research participants reported difficulties in implementing the teaching process, particularly in the field they had mastered before conducting microteaching exercises in an ideal classroom. Twenty percent of interviewees said they had no problems at all. Ninety percent of students said that it was simpler for them to weigh the benefits and drawbacks of microteaching methods after observing peers use them. From all the research results regarding the implementation of microteaching that have been carried out, it can be concluded that the implementation of microteaching is quite effective in developing teaching skills for prospective teachers before carrying out teaching and learning activities directly in the classroom (Sithole, 2023; Hama & Osam, 2021).

Prospective teachers must possess fundamental abilities in microteaching, and to become instructors, they must master pedagogical topic knowledge after completing the course (Woods, 2023). These competencies include the ability to initiate and conclude lessons, class management, reinforcement, small group discussion facilitation, questioning, lesson description, and variation. Then, in addition to receiving training in basic skills, prospective teacher students are prepared to teach by being trained in learning process abilities such as managing the learning process, planning lessons, and conducting assessments (Zhu & Wang, 2022; J. Wang & Wang, 2023). From this case, it appeared that the students were not ready to enter the field. Apart from not being able to master the skills that a teacher must have, students also have not used the 4Cs, which nowadays teachers are required to have 21st century competencies. This reality must be addressed immediately.

Although microteaching is recognised as an effective approach for improving the pedagogical competencies of prospective educators, recent research indicates that microteaching practices primarily focus on basic technical training, including classroom management, instructional variation, and reinforcement, while neglecting the explicit integration of 21st-century skills vital for the teaching profession in the digital age (Haryanto et al., 2021; Wu et al., 2023). Furthermore, previous research has primarily focused on the effectiveness of microteaching in general, without exploring the relationship between deficiencies in the 4C competencies and the microteaching guidelines, which tend to be administrative and misaligned with 21st-century learning goals. The identified research gaps suggest that microteaching has not evolved into a competency-based pedagogical framework adequate for preparing teachers to address the challenges of 21st-century education.

The originality of this research is in its extensive assessment of the pedagogical requirements of future educators through a convergent mixed-methods methodology, aimed at precisely identifying shortcomings in the 4C skills and discrepancies in the associated microteaching guidelines. Therefore, this research seeks to evaluate the need for improving the pedagogical skills of prospective elementary school teachers and to formulate strategies for creating a microteaching model centred on 21st-century competencies in response to contemporary educational challenges.

2. Method

2.1 Research Design

This study employed a convergent mixed-methods design (Abdullah, 2015), in which quantitative survey data and qualitative data (interviews and observations) were collected concurrently, analyzed separately, and integrated during interpretation (Cresswell et al., 2003; Åkerblad et al., 2021). This design was chosen to obtain a comprehensive understanding of the pedagogical needs and 21st-century skill readiness of future primary school educators in the Greater Madiun region (Madiun, Magetan, Ngawi, Ponorogo, and Pacitan). The convergent approach complemented the cross-sectional nature of the quantitative survey by allowing qualitative insights to validate, elaborate, and contextualize the numerical patterns found in the data. Research participants consisted of primary school teachers, elementary education students, and university instructors, selected purposively to represent diverse perspectives on microteaching implementation and 21st-century skill development.

2.2 Participant

The research participants consisted of primary school teachers, elementary education students, and university instructors from the Greater Madiun region. Quantitative data were collected from 54 teachers, 95 students, and 9 instructors, yielding a total of 158 participants, while qualitative data were obtained from 5 teachers, 7 students, and 3 instructors, resulting in 15 participants. In total, the study involved 173 participants. Participants were selected through purposive sampling to capture perspectives from key stakeholders directly involved in teacher preparation and microteaching practices. Teachers were included because of their experience implementing classroom instruction, students because they were prospective teachers who had completed or were enrolled in microteaching courses, and instructors because they were responsible for supervising and assessing microteaching activities. Eligibility criteria included active involvement in teacher education, microteaching, or classroom teaching during the study period. Participants who had no direct experience with microteaching activities or were not actively engaged in teacher education programs were excluded from the study. This sampling strategy ensured diverse and contextually relevant perspectives on the pedagogical needs of future primary educators (Tambak et al., 2023).

Appropriate identification of research participants is critical to the science and practice of psychology, particularly for generalizing the findings, making comparisons across replications, and using the evidence in research syntheses and secondary data analyses. If humans participated in the study, report the eligibility and exclusion criteria, including any restrictions based on demographic characteristics.

2.3 Research Collecting Technique and Instruments

Questionnaires, interviews, and classroom observations were used to obtain complementary quantitative and qualitative insights into participants' pedagogical needs and their readiness for 21st-century skill development. The questionnaire comprised Likert-scale items designed to measure four key dimensions—critical thinking, creativity, communication, and collaboration (4C)—along with items assessing pedagogical preparedness and challenges in microteaching implementation. The interview guide explored participants' experiences, perceived obstacles, and expectations regarding microteaching practices, while observations focused on real-time teaching behaviours, interaction patterns, and manifestations of the 4C competencies during instructional activities.

Table 1. Instrument Grid

Dimensions	Aspects	Indicators
Critical Thinking	Problem Identification	Ability to identify learning problems
	Information Analysis	Ability to evaluate information
Creativity	Idea Development	Ability to generate alternative learning strategies
	Media Innovation	Ability to design new learning media
Communications	Oral Communication	Clarity in delivering material
	Classroom Interaction	Responsiveness to student questions
Collaboration	Group Work	Ability to collaborate on microteaching assignments
	Coordination	Role in shared decision-making
Pedagogical Readiness	Learning Planning	Readiness to prepare lesson plans
	Learning Implementation	Mastery of basic teaching skills

Adaptation from Supandee & Yachulawetkunakorn (2023), Inayah et al. (2023) and Haryani et al. (2021)

2.4 Instrument Validity and Reliability

To ensure the validity and reliability of the research instruments, the questionnaire, interview guide, and observation sheet were reviewed by three experts in teacher education and educational technology. The experts evaluated the relevance,

clarity, and representativeness of each item with respect to the study constructs, resulting in several revisions to improve content accuracy and readability. Following expert validation, the questionnaire was pilot-tested prior to the main study. Reliability analysis using Cronbach's alpha indicated satisfactory internal consistency across all dimensions, with coefficients ranging from 0.78 to 0.91, exceeding the recommended threshold of 0.70. These procedures ensured that the instruments were appropriate for assessing participants' 21st-century competencies and pedagogical readiness.

2.5 Data Analysis Technique

To ensure conceptual clarity, the questionnaire was developed using a specification matrix consisting of dimensions, aspects, indicators, and item allocation (Cresswell et al., 2003). The qualitative instruments were validated through expert review, whereas the quantitative instrument underwent content validation and reliability testing prior to use. Quantitative data were analysed using descriptive statistics, while qualitative data were processed through thematic analysis (Patel & Patel, 2019). To strengthen the validity of findings, results from the quantitative and qualitative strands were integrated through methodological triangulation, enabling cross-verification of patterns and ensuring comprehensive insights into the pedagogical requirements of future primary school educators. This integrated analytical approach supported the development of a contextually grounded microteaching model aligned with 21st-century competencies (Cresswell et al., 2003).

3. Results

The descriptive analysis of the survey data revealed substantial variation in the mastery of 21st-century skills among teachers, lecturers, and elementary education students in Greater Madiun. The results indicate that critical thinking and creativity dimensions exhibit the highest proportion of participants in the low category, suggesting limited readiness to engage in teaching practices that require analytical reasoning or innovative lesson planning.

In contrast, communication and collaboration skills show relatively higher adequate and high percentages, indicating that participants tend to be more capable of interacting, delivering content, and working in teams than generating creative solutions or designing innovative media. Pedagogical readiness which includes planning and executing instruction, still shows notable weaknesses, with a considerable proportion of respondents scoring in the low category as can be seen in table 2.

Table 2. Descriptive Results of 21st-Century Skill Dimensions

Dimension	Aspect	Indicator	% Low	% Adequate	% High	N
Critical Thinking	Identifying problems	Recognizing classroom learning problems	38%	47%	15%	158
	Analyzing information	Evaluating information and alternatives	41%	45%	14%	158
Creativity	Idea generation	Generating alternative instructional strategies	52%	39%	9%	158
	Media innovation	Designing innovative learning media	58%	33%	9%	158
Communication	Oral communication	Delivering content clearly	29%	51%	20%	158
	Classroom interaction	Responding to student questions	33%	48%	19%	158
Collaboration	Teamwork	Working collaboratively in microteaching tasks	27%	55%	18%	158
	Coordination	Making shared teaching decisions	30%	52%	18%	158
Pedagogical Readiness	Lesson planning	Preparing structured lesson plans	44%	43%	13%	158
	Teaching execution	Mastery of basic teaching skills	47%	41%	12%	158

The results in Table 2 indicate several critical issues relevant to microteaching improvement. First, creativity emerges as the weakest dimension, with more than half of participants scoring in the low category for both idea generation (52%) and media innovation (58%). This finding aligns with qualitative insights indicating that participants often rely on conventional and repetitive instructional strategies, lacking confidence and competence in developing innovative learning media.

Second, critical thinking skills are also limited, particularly in analyzing information (41% low), which suggests that participants may struggle to evaluate instructional challenges or adapt teaching strategies based on student needs. Third, communication and collaboration competencies appear relatively stronger, with most participants falling into the adequate category. These patterns indicate that participants can generally articulate content and work in teams, yet they still lack higher-order cognitive and creative abilities that are essential for 21st-century pedagogy. Finally, pedagogical readiness remains a challenge, with 44–47% of participants scoring low, highlighting the need for structured interventions particularly microteaching modules that explicitly embed 4C competencies.

To complement the indicator-level findings, a summary of each main competency domain was generated based on mean scores and standard deviations. The results reinforce the descriptive patterns in Table 3, showing that creativity has the lowest mean score among all measured variables, followed by pedagogical readiness. In contrast, communication and collaboration achieve higher average scores, indicating more stable performance across participants.

Table 3. Summary Statistics of 21st-Century Competency Levels

Variable	Mean	SD	% Below Standard	% Meeting Standard	N
Critical Thinking	68.4	9.7	39%	61%	158
Creativity	62.1	8.9	55%	45%	158
Communication	72.3	10.2	31%	69%	158
Collaboration	73.8	9.1	29%	71%	158
Pedagogical Readiness	66.7	8.5	46%	54%	158

Table 3's summary data indicate that creativity competency was the least robust area, evidenced by the lowest mean score (62.1) and the biggest proportion of participants falling below the criterion (55%). This discovery affirms that creativity is the domain most requiring intervention, especially through the reconfiguration of microteaching lessons to better foster innovation and creative problem-solving. Alongside creativity, pedagogical preparation is also deficient, with 46% of participants not meeting the criteria. This indicates the participants' challenges in properly planning and executing learning, highlighting the need for focused enhancement of fundamental teaching abilities. In contrast, communication competency (72.3) and collaboration (73.8) exhibited the highest average scores, suggesting that participants possess superior interaction and collaboration skills compared to higher-order cognitive abilities. Nonetheless, these two competences necessitate additional enhancement for optimum integration into educational procedures. This pattern of findings suggests that higher-order thinking skills, including critical thinking and creativity, along with pedagogical competence, are still inferior to interpersonal competence, resulting in a discrepancy between current microteaching practices and the requirements of optimal 21st-century skills.

Qualitative data analysis from interviews and observations identified three primary themes that illustrate the difficulty of adopting microteaching in elementary school teacher preparation programs in the Greater Madiun region. The primary theme is the inadequate incorporation of 21st-century abilities inside microteaching methodologies. Observations indicate that the majority of students continue to utilize conventional teaching methods, marked by a predominance of lectures, a deficiency in new learning methodologies, and minimal engagement with digital media. Microteaching approaches have yet to incorporate structured learning activities aimed at fostering creativity, problem-solving, or teamwork. Students seem to encounter difficulties in creating educational resources that promote higher-order thinking skills and frequently depend on traditional lesson plan structures that do not expressly assist them in employing the 4Cs.

The second topic pertains to the disparity between the substance of microteaching guidelines and the requirements for cultivating 4C competencies. Analysis of documents reveals that microteaching guidelines at various universities predominantly emphasize administrative components, including implementation procedures, regulations, reporting mechanisms, and evaluation formats. No specific elements were identified that assist students in incorporating critical thinking, creativity, communication, or cooperation abilities into their pedagogical methods. The lack of 4C-based learning achievement indicators deprives students and lecturers of a definitive benchmark for the competencies required in the microteaching process.

The third theme concerns variations in the quality and emphasis of microteaching guidelines across universities. Although some institutions provide more comprehensive guidelines, they remain limited in explicitly promoting the development of 4C competencies. Likewise, several universities have adopted the Merdeka Belajar curriculum, yet their microteaching practices continue to emphasize procedural compliance and reporting requirements rather than competency development. These differences contribute to variations in students' pedagogical readiness and skill acquisition. Students from some universities demonstrate stronger administrative and lesson-planning abilities but lack creativity and instructional media design skills, whereas others show adequate classroom management skills but limited critical thinking and problem-solving capabilities.

These findings were reflected in participants' experiences. One instructor stated, "*The microteaching handbook mainly focuses on procedures, reporting formats, and assessment requirements. There are no explicit indicators that guide students to develop critical thinking, creativity, communication, or collaboration skills.*" (Instructor 2). Similarly, a student participant noted, "*Most of our microteaching activities focused on delivering lessons correctly. We were rarely challenged to design innovative learning activities or use collaborative approaches in teaching practice.*" (Student 5). A teacher participant further explained that "*students from different universities have different strengths, but many still struggle to design innovative learning activities and encourage active student participation.*" (Teacher 3).

These statements suggest that the limitations observed in prospective teachers' creativity, critical thinking, and

pedagogical readiness are not solely individual factors but are also influenced by institutional and curricular conditions. The absence of explicit 4C-oriented learning outcomes within microteaching guidelines appears to restrict opportunities for students to practice higher-order thinking, collaborative learning design, and innovative pedagogical strategies. Consequently, microteaching tends to function as a procedural training activity rather than a transformative learning environment that prepares future teachers for the demands of 21st-century education. This finding reinforces the central argument of the study that reformulating microteaching through the integration of 4C competencies is essential for strengthening pedagogical readiness and ensuring that teacher preparation programs remain aligned with contemporary educational expectations.

These findings highlight the urgent need to develop microteaching guidelines that not only regulate implementation procedures but also explicitly incorporate 21st-century skills-based learning outcomes. The integration of interview and observation data suggests that these challenges are systemic, affecting both the implementation of microteaching and the design of teacher education curricula. Table 4 presents the thematic analysis derived from the interview and observation data.

Table 4. Results of Thematic Analysis of Qualitative Data

Main Themes	Category	Emerging Codes
Limitations in Integrating 21st-Century Skills in Microteaching	Conventional teaching methods	Lecture dominance; monologue pattern; minimal discussion; low student activity
	Low creativity	Difficulty creating media; minimal innovation; use of outdated templates
	Minimal use of 4C strategies	No problem-based learning; rare collaborative tasks; no project-based learning
	Limited use of technology	Repetitive use of PPT; no interactive media; limited digital tools
Misalignment of Microteaching Guidelines with the 4C Competencies	Focus on procedures	Dominant technical flow; Emphasis on rules and regulations; Focus on administration
	No 4C achievements	Absence of critical thinking indicators; No creativity rubric; Undefined collaboration
	Inappropriate guidelines	Examples of conventional tools; Does not support innovation; No 4C model
	Differences in content	Varying completeness of guidelines; Different systematics
Variations in Guideline Quality Across Universities	Inconsistent outcomes	Ununiform achievements; Not synchronized with the MBKM curriculum
	Different focuses across campuses	Campus A is strong in administration; Campus B is strong in the MBKM curriculum; Campus C is strong in report format

The thematic analysis results demonstrate that the implementation of microteaching in the Greater Madiun area has not adequately facilitated the development of 21st-century abilities in prospective primary school teachers. The restricted student competencies in creativity and critical thinking are directly associated with the absence of structured guidelines for achieving the 4Cs. The disparities in the quality and emphasis of guidelines among universities have exacerbated the gap in student capabilities, hence requiring a more standardized and targeted microteaching model tailored to the learning demands of the digital era.

The qualitative findings robustly corroborate the quantitative results, revealing that creativity (mean 62.1; 55% below standard) and critical thinking (mean 68.4) are the least proficient competencies across all dimensions of 21st-century skills. The participants' limited competencies were evident in interviews and observations, as they reported challenges in formulating creative strategies, utilizing new media, and implementing problem-solving learning methodologies. Moreover, the quantitative data revealed that pedagogical preparedness was deficient, falling 46% below the established requirement. This aligns with qualitative studies indicating that microteaching guidelines at numerous universities fail to offer pertinent learning outcomes, resulting in insufficient assistance for students in cultivating 4C-based teaching approaches. Simultaneously, the elevated communication and cooperation competences evident in the quantitative data were corroborated by observations, indicating that students exhibited greater confidence in classroom interactions and group activities, although continued to exhibit deficiencies in creative learning design and critical thinking skills. The amalgamation of both data sets reveals that the principal deficiency in microteaching is the absence of support from educational frameworks and institutional guidance for cultivating 4C competencies. Consequently, a more systematic and explicit enhancement of microteaching design focused on 21st-century abilities is required.

4. Discussion

As is well established, the study's findings reveal a distinct gap between the 21st-century skills competencies held by prospective elementary school instructors in Greater Madiun and the competencies necessary to fulfill the requirements

of 21st-century pedagogy. The integration of the two data sources in this study confirms that the existing structure and implementation of microteaching remain insufficient in preparing prospective teachers to meet the demands of modern pedagogy. Therefore, a more systematic revision of the microteaching model, aligned with the 4Cs, is necessary. The relatively low level of 4C competencies identified in this study may be explained not only by individual limitations among prospective teachers but also by broader institutional and pedagogical factors. The qualitative findings indicate that microteaching activities are frequently oriented toward procedural mastery and lesson delivery rather than the development of higher-order thinking, innovation, and collaborative problem-solving skills. As a result, students may have limited opportunities to experiment with creative instructional strategies or engage in authentic learning situations that foster critical reflection. While these findings are consistent with studies reporting persistent challenges in integrating 21st-century skills within teacher education programs (Haryani et al., 2021; Supandee & Yachulawetkunakorn, 2023), they differ from research conducted in more innovation-oriented learning environments where structured microteaching interventions have been shown to improve creativity, collaboration, and pedagogical readiness (Ghafar, 2020). This contrast suggests that the effectiveness of microteaching may depend not only on its implementation as a teaching practice but also on the extent to which its design explicitly incorporates opportunities for developing 4C competencies.

The limited proficiency in these two competencies aligns with the characteristics of microteaching guidelines, which are predominantly administrative and do not direct students toward 4C-based learning outcomes. Consequently, the microteaching process emphasizes procedural aspects rather than pedagogical innovations vital for 21st-century learning (Inayah et al., 2023; Ye & Xu, 2023). The inability to meet the creative and analytical requirements outlined in these guidelines leads to students having reduced exposure to problem-solving-oriented learning activities, innovative media design, and the application of collaborative and reflective approaches pertinent to the demands of the digital age, as highlighted in the 21st-century skills literature (Nuryanto et al., 2025; Aulia & Utami, 2021). The alignment between quantitative and qualitative findings suggests that the existing microteaching framework fails to offer sufficient opportunities for prospective teachers to engage in creative, collaborative, and student-centered learning. Although incorporating 21st-century competencies into microteaching has been demonstrated to enhance the pedagogical preparedness and effectiveness of prospective teachers across diverse educational settings (Ghafar, 2020). Therefore, it is imperative to reformulate the 4C-based microteaching model to enhance the pedagogical preparedness of future educators and to align learning practices with current educational requirements (Şen Akbulut & Hill, 2020; Barnett & Botes, 2022).

Qualitative findings suggest that microteaching practices across different universities remain predominantly traditional and have yet to serve as experimental environments for fostering innovative learning. This is evidenced by the limited integration of constructivist approaches, reflective activity-based instructional designs, and problem-solving strategies in the training processes for prospective teachers (Barnett & Botes, 2022; Tyan et al., 2020). This gap is intensified by microteaching guidelines that are primarily administrative and do not incorporate 4C-based learning outcomes, thereby serving as a structural obstacle to the integration of 21st-century skills into student teaching practices. This runs counter to the principles of developing learning outcomes, the 4C competency rubric, and the revised Bloom's taxonomy, which emphasize the cultivation of analytical, creative, and collaborative skills (Aulia & Utami, 2021; Inayah et al., 2023). Furthermore, disparities in the quality of guidelines among universities result in inconsistencies in competency outcomes and may contribute to disparities in graduate quality, thereby affecting the alignment of novice teachers' competencies with national standards and the Merdeka Belajar policy, which requires flexibility, creativity, and responsiveness to diverse learning environments (Supandee & Yachulawetkunakorn, 2023; Aini et al., 2020). These findings suggest that the limited development of 4C competencies may stem from interconnected institutional, curricular, and pedagogical factors. At the institutional level, microteaching is often positioned as a course for demonstrating teaching performance rather than as a space for experimentation and reflective practice. Curricular expectations frequently prioritize lesson planning accuracy, procedural compliance, and assessment documentation, which may inadvertently reduce opportunities for creativity and critical inquiry. In addition, prevailing learning cultures within teacher education programs tend to emphasize content delivery and classroom control, reinforcing conventional teaching approaches rather than collaborative and problem-based pedagogies. As a result, prospective teachers may have limited exposure to authentic learning experiences that cultivate innovation, reflection, and higher-order thinking, thereby contributing to the competency gaps identified in this study.

The integration of quantitative and qualitative data reveals a consistent pattern, wherein deficiencies in creativity, critical thinking, and pedagogical preparedness within statistical analysis are elucidated by qualitative insights into the paucity of innovative strategies, students' dependence on lecture-based approaches, and the lack of problem-based learning within microteaching practices. This collectively affirms the limitations inherent in the current learning framework (Hidayati et al., 2019; Haryani et al., 2021). The correlation between low quantitative scores and field narratives indicating the absence of 4C guidance in microteaching protocols illustrates that qualitative data offers explanatory insights into the underlying causes of insufficient competence among prospective teachers, particularly in the domains of creativity and information analysis (Inayah et al., 2023; Vilppola et al., 2022). The consistency of these two data points confirms that a microteaching system

centered solely on procedures and administration, without incorporating 21st-century skills, is no longer sufficient to prepare educators for the contemporary educational landscape. This underscores the growing urgency for reform based on the 4C framework, ensuring that pedagogical practices remain relevant to the demands of the digital era and Society 5.0.

These findings carry significant theoretical implications for the advancement of microteaching literature and 21st-century skills, especially in providing a conceptual basis for emerging models such as the 4C-Integrated Design Microteaching, which holistically integrates constructivist theory, instructional design, and the 4C competency framework (Tyan et al., 2020; Orak & Al-khresheh, 2021). Practically, this study underscores the importance of developing 4C-based microteaching guidelines, revising the microteaching curriculum through restructuring task designs, implementing authentic assessment rubrics, and enhancing lecturers' ability to create innovative and collaborative learning environments to meet the requirements of 21st-century education (Haryani et al., 2021; Ecevit & Kaptan, 2021). From a policy perspective, universities should revise microteaching guidelines by incorporating explicit 4C competencies, authentic assessment rubrics, and collaborative teaching tasks. Curriculum developers may further align microteaching outcomes with the Merdeka Belajar framework to strengthen prospective teachers' readiness for 21st-century learning environments. Future research should evaluate the effectiveness of these reforms across diverse teacher education contexts.

Although the study was conducted in the Greater Madiun region, the findings may have broader relevance for teacher education institutions in other Indonesian contexts that continue to implement conventional microteaching practices. Similar challenges related to the integration of 21st-century skills, competency-based assessment, and curriculum alignment have also been reported in developing educational systems across Southeast Asia and other emerging contexts. Therefore, the proposed emphasis on 4C-oriented microteaching may provide useful insights beyond the immediate research setting.

5. Limitation of the Study

Several limitations should be considered when interpreting the findings of this study. The research was conducted exclusively within the Greater Madiun region, which may influence the contextual applicability of the results to other teacher education settings with different institutional, cultural, and educational characteristics. In addition, the purposive sampling approach was selected to obtain information-rich perspectives from participants directly involved in microteaching and teacher preparation; however, this approach may limit the representativeness of the sample. The cross-sectional nature of the study also captures participants' perceptions at a single point in time and therefore does not provide insights into how pedagogical competencies and 21st-century skills develop throughout teacher education programs. Future research could strengthen the evidence base by involving participants from a wider range of regions, employing longitudinal designs, and examining the implementation and effectiveness of 4C-based microteaching models in diverse educational contexts.

6. Conclusion

The study concludes that the readiness of prospective and in-service primary school educators in Greater Madiun to meet 21st-century learning demands remains limited, particularly in creativity, critical thinking, and pedagogical readiness. Although communication and collaboration competencies appear relatively stronger, these skills are not yet integrated consistently within microteaching practices. The weaknesses identified are closely linked to the predominance of conventional teaching strategies and the absence of explicit 4C-oriented learning outcomes in existing microteaching guidelines across universities. These structural and pedagogical gaps hinder the development of higher-order thinking skills and limit opportunities for innovative instructional design, thereby contributing to the generally low performance of Primary School Teacher Education (PGSD) students, whose learning outcomes remain below the expected institutional standards.

Based on these findings, the study highlights the urgency of developing a microteaching model explicitly oriented toward 21st-century skills. Such a model should not only emphasize technological literacy but also integrate critical thinking, creativity, collaboration, and communication as core competencies to be achieved through structured and authentic learning activities. The design of microteaching media offers a feasible and contextually appropriate alternative for strengthening these competencies. Implementing a 4C-integrated microteaching framework can therefore serve as a strategic pathway for improving the pedagogical capacity of future educators and for aligning teacher preparation programs with the complex demands of contemporary primary education.

Acknowledgments

Not applicable.

Author contributions

Example: Dr. MKB and Dr. KK were responsible for the study design and revisions. Prof. S was responsible for data collection. Mr. AA and Mrs. IFW drafted the manuscript, and Dr. MKB revised it. All authors have read and approved the final manuscript.

Funding

This research has no funding.

Competing interests

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

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Redfame Publishing.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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