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Integrating project-based learning and jigsaw to enhance teaching competence among pre-service non-formal educators for elementary learning contexts

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ABSTRACT

The objective of this study is to examine the effectiveness of integrating project-based learning (PJBL) and the Jigsaw cooperative strategy in improving the teaching competence of pre-service educators. Employing a quantitative experimental design, the research involved 80 undergraduate students enrolled in a Non-Formal Education Program, divided into 2 categories: an experimental group with PJBL-Jigsaw integration and a control group (conventional learning). Teaching competencies were assessed using a questionnaire validated through expert judgment and reliability testing (Cronbach's alpha > 0.80), covering lesson planning, classroom management, instructional strategies, reflection, and evaluation. Paired-sample and independent-sample t-tests were used to analyze the data, complemented by effect size analysis (Cohen's d). The results indicate a statistically substantial improvement in teaching competence in both groups; however, the experimental group demonstrated substantially greater mean score gains (increase of 32 points) compared to the control group (increase of 13 points). The effect size of the integrated PJBL-Jigsaw intervention was categorized as very large (d > 0.8). These findings confirm that integrating PJBL and Jigsaw strategies produces a strong and meaningful impact on the development of pedagogical competence among prospective educators. The study contributes empirical evidence supporting innovative, collaborative learning design in educator preparation.

INTRODUCTION

Non-formal education, as a flexible, contextual, and learner-centered pathway, plays a crucial role in human resource development. Its adaptive nature enables individuals to develop productive life skills and respond effectively to community needs (Abdul et al., 2022). However, the effectiveness of non-formal education initiatives is strongly influenced by the competencies possessed by educational personnel, particularly facilitators, who serve as key agents in designing and implementing meaningful learning experiences. Therefore, the preparation of competent prospective facilitators requires the use of effective and innovative pedagogical strategies.

Among the learner-centered approaches frequently applied in contemporary education, Project-based Learning (PJBL) has gained considerable attention due to its emphasis on inquiry, collaboration, and contextual problem solving. Through project-oriented activities, learners are

encouraged to connect theoretical understanding with authentic situations while simultaneously developing reflective and cooperative learning habits. Previous studies have reported that PJBL enhances critical thinking, motivation, and collaboration skills across various educational levels, such as identifying community needs, adapting to new situations, and developing effective, efficient, and relevant non-formal learning strategies (Guo et al., 2020). Meta-analytic evidence demonstrated that the impact of project-based learning in informal STEM varies according to learning duration and the size of the participant group, with effects generally falling within the moderate range (Santhosh et al., 2023; Widiawati et al., 2023). In addition, the implementation of PJBL has demonstrated positive effects on critical thinking, problem solving, and other 21st-century competencies across educational levels (Retnawati & Setiawan, 2025).

Within non-formal education settings, PJBL supports prospective facilitators in developing program planning, contextual problem-solving, and creative instructional design skills. The implementation of PJBL in non-formal education can enhance participants' program competencies and soft skills flexibly, tailored to their learning needs (Ishayati et al., 2025). This strategy has also been widely recognized for its effectiveness in improving teaching competence. This approach promotes knowledge sharing, peer interaction, and individual accountability within group learning processes. Empirical evidence suggests that the Jigsaw method significantly enhances academic motivation, perceived capability, and collaborative skills (Wang et al., 2023). These competencies are essential for facilitators working in diverse and participatory non-formal learning environments.

Beyond formal classroom settings, pedagogical preparation is also increasingly important within community-oriented educational environments that support school-age learners. Non-formal educator preparation increasingly intersects with elementary learning contexts, particularly in community-based educational programs, literacy initiatives, and after-school learning support, and supplementary education services for school-age children. Consequently, pre-service non-formal educators require pedagogical competencies that enable them to facilitate collaborative, student-centered, and developmentally appropriate learning experiences relevant to elementary-aged learners.

By integrating both PJBL and Jigsaw as a combination strategy in training prospective non-formal education facilitators, their abilities can be enhanced in the future (Orcos & Curto, 2020). Both are oriented toward collaborative and meaningful processes. Although both PJBL and Jigsaw have been extensively studied independently, research examining their integration remains limited. Existing studies tend to focus primarily on formal education contexts and student learning outcomes, with relatively little attention given to their combined effects on the pedagogical competence of prospective non-formal education facilitators. This highlights an important research gap, especially regarding how integrated learning approaches influence facilitator competencies in non-formal education settings.

Furthermore, non-formal education is often perceived as less structured and less rigorous compared to formal education systems (M. Johnson & Majewska, 2022). This perception may influence the limited attention given to the quality of instructional design and pedagogical strategies in non-formal learning environments. Therefore, strengthening effective and innovative learning approaches becomes essential. By combining both, this research aims to create a strong framework for developing teaching competencies and 21st-century competencies related to critical thinking, collaboration, and creativity (Aldawsari et al., 2023). Therefore, the integration of

collaborative and project-based learning approaches is not only pedagogically relevant but also strategically important in enhancing the credibility and effectiveness of non-formal education.

In particular, Project-Based Learning (PJBL) has been widely linked to positive improvements in learner performance, including teaching and facilitation skills. According to (Pearlman & Thomas, 2000), PJBL promotes analytical thinking and contextual problem-solving abilities, which are essential for developing effective teaching competencies. Meanwhile, the Jigsaw method, a cooperative learning strategy, has been found to improve communication, collaboration, and knowledge synthesis, which are essential elements in strengthening pedagogical competence (Moskowitz et al., 1985). The combination of these two methods may offer synergistic effects that enhance learning outcomes in teacher preparation programs (Adeoye et al., 2024).

While earlier studies have reported the positive outcomes regarding the effectiveness of Project-Based Learning and Jigsaw independently, they tend to focus on general student outcomes such as engagement, motivation, and academic achievement. However, these studies rarely examine how the integration of both approaches specifically contributes to the development of teaching competence, particularly in non-formal education contexts. This limitation indicates that the potential synergistic effect of combining structured project inquiry with cooperative knowledge construction remains underexplored. Accordingly, this study seeks to explore how the integration of PJBL and Jigsaw can enhance pedagogical competence among pre-service facilitators.

Based on these considerations, this study aims to examine the effectiveness of integrating Project-Based Learning (PJBL) and the Jigsaw strategy in improving the teaching competence of prospective non-formal education facilitators. Specifically, this study seeks to: (1) analyze the differences in competence improvement between students exposed to integrated PJBL–Jigsaw strategies and those experiencing conventional learning, and (2) determine the magnitude of the effect of this integrative approach on teaching competence development.

METHOD

Quantitative methodology employing a quasi-experimental method with a pretest–posttest control group format was utilized in this research. This design is widely used in educational research to evaluate instructional effectiveness when random assignment is not feasible (Cresswell, 2009; Cohen et al., 2000). Quasi-experimental approaches are considered methodologically sound for examining causal tendencies in authentic classroom settings while maintaining control over baseline differences through pretesting. This design was selected to allow for systematic comparison between participants exposed to the integrated instructional approach and those receiving conventional learning while controlling for baseline competence differences.

The participants consisted of 80 undergraduate students enrolled in the Non-Formal Education Study Program at a State University of Surabaya. Although formally prepared within non-formal education pathways, these pre-service educators were also trained to facilitate learning activities for school-age children in community-based and supplementary educational settings, including elementary learning support programs. All participants were registered in the course Strategies and Methods of Non-Formal Education.

Through purposive sampling techniques, the participants were assigned into two groups consisting of 40 students in the experimental group and 40 students in the control group. The assignment of participants into experimental and control groups was conducted based on existing class groupings to maintain the natural classroom setting, as random assignment was not feasible

in this context. The participants were aged between 19 and 22 years, representing a transitional phase from academic preparation to professional facilitation practice. Purposive sampling was employed to ensure that participants met specific criteria relevant to the study objectives, namely being enrolled in a course focused on instructional strategies in non-formal education. The Jigsaw strategy was embedded within each project phase, requiring students to first master specific subtopics in expert groups and subsequently teach their peers in mixed groups. This structure emphasized collaboration, responsibility, and reflective practice (Dahms et al., 2020). The control group followed conventional instructional methods, which were dominated by lectures, guided discussions, and individual assignments.

This contextual orientation was considered relevant to elementary learning environments because non-formal educators frequently engage in community-based educational assistance programs involving elementary-aged learners.

Learning activities in the experimental class were organized by combining project-based learning principles with the Jigsaw cooperative techniques. Learning was organized around authentic non-formal education scenarios, including literacy initiatives, after-school assistance, elementary learning support programs, community learning programs, adult education initiatives, and lifelong learning activities. Within each project cycle, students collaboratively planned, implemented, and evaluated instructional strategies relevant to school-age learners and community education contexts (Shaik, 2025). The Jigsaw strategy was systematically embedded in each project phase (Revathy & Kamalakkannan, 2022). Students initially worked in expert groups to master specific subtopics related to instructional planning, learning strategies, or evaluation techniques. They then transitioned into mixed (home) groups, where each member was responsible for teaching their area of expertise to peers. This structure promoted positive interdependence, individual accountability, peer teaching, and reflective dialogue, key competencies for non-formal education facilitators. In contrast, the control group received conventional instructional methods, predominantly consisting of lectures, guided discussions, and individual assignments. While these methods provided foundational theoretical knowledge, they offered limited opportunities for experiential learning, collaborative problem-solving, and peer-based knowledge construction (Nyström et al., 2020).

Teaching competence was measured using a structured questionnaire developed to assess key pedagogical competencies relevant to facilitating collaborative learning among school-age learners in non-formal and supplementary educational contexts (Kihaga et al., 2025). The questionnaire included 15 validated items measured using a four-point Likert scale ranging from 1 (very irrelevant) to 4 (very relevant), encompassing competencies related to lesson planning and instructional practice, reflection, and evaluation. These dimensions were selected to represent essential competencies required for effective facilitation in non-formal learning contexts. The validity of the instrument content was evaluated through expert review, whereas construct validity was examined using item-total correlation procedures ($\alpha = 0.985$), indicating excellent internal consistency. Data were analyzed using SPSS version 22. Preliminary analyses included the Shapiro–Wilk procedures to examine data normality and Levene's test to verify homogeneity of variance. To identify score changes within each group, paired-sample t-tests were applied to compare pretest and posttest scores. Differences between the experimental and control groups were subsequently analyzed using independent-sample t-tests. In addition, Cohen's d was employed to estimate the practical magnitude of the intervention effect.

RESULTS

The instrument validity test was examined using the product–moment correlation technique at a significance level of 0.05 (r-table = 0.304). Of the 18 items, three items were found to be invalid (r < 0.304) and were excluded. The remaining 15 items were considered valid and used for data collection. The research was designed in an experimental and a control group:

Table 1. Experimental Design of the Study

Group	Pretest	Treatment	Posttest
Experimental	Teaching competence test	Integrated PJBL-Jigsaw learning	Teaching competence test
Control	Teaching competence test	Conventional learning	Teaching competence test

The dimensions of this test are divided into five aspects to measure teaching competence among prospective non-formal education facilitators: lesson planning, learning management, instructional strategies, reflection, and evaluation. The indicators for those dimensions are about learning objectives formulation, material selection, and lesson sequencing (Lesson Planning); Classroom organization, time management, learner engagement (learning management); Method selection, media use, collaborative facilitation (instructional strategies); Self-evaluation, responsiveness to learner feedback (reflection); Assessment methods, feedback provision, learning outcomes review (evaluation).

Reliability analysis using Cronbach's alpha produced a coefficient of 0.985, exceeding the acceptable reliability threshold of 0.6 and indicating a very high level of internal consistency of the instrument (Binus, 2023; Kumala, 2023).

Table 2. Reliability Table

Reliability Statistics	
Cronbach's Alpha	N of Items
.985	15

Preliminary assessment findings demonstrated that both groups possessed relatively comparable levels of baseline competence before the intervention was implemented. The experimental group obtained an average pretest score of 60, whereas the control group achieved a mean score of 62. After the instructional treatment, posttest scores increased in both groups; however, the improvement observed in the experimental group was considerably higher, reaching a mean score of 92 compared with 75 in the control group. These findings suggest that participants exposed to the integrated learning approach experienced stronger competence development than those receiving conventional instruction. Detailed pretst results for both groups are presented as follows:

Table 3. Pre-Test Scores Table

Groups	Number of Questions	Minimum Score	Maximum Score	Averages

Experiment	15	53	80	60
Control	15	46	80	62

The following are the results of the post-test:

Table 4. Post-Test Scores Table

Groups	Number of Questions	Minimum Score	Maximum Score	Averages
Experiment	15	73	100	92
Control	15	60	93	75

The magnitude of improvement was notably greater in the experimental group, which gained 32 points, compared with a 13-point increase observed in the control group. Shapiro-Wilk analysis was employed to assess the normality of the pretest and posttest data distributions in both groups due to the relatively limited simple size, namely 40 respondents (Ismail, 2022). The significance value (p) for each sample was compared with α=0.05. All p-values were >0.05, indicating that neither dataset deviated from a normal distribution. Thus, the assumption of normality was met.

Table 5. Normality test Result (Shapiro-Wilk)

Group of	N	Statistic Saphiro-Wilk	p	Conclusion
Experiment (Pretest)	40	0,970	0,587	Normal
Eksperiment (Post test)	40	0,980	0,910	Normal
Control (Pretest)	40	0,956	0,249	Normal
Control (Post Test)	40	0,978	0,813	Normal

Assumption testing was conducted prior to inferential analysis to ensure data suitability for parametric procedures. The Shapiro-Wilk normality test (p) were greater than 0.05 (sig>0.05), indicating that the distribution of pretest and posttest scores for both groups was normal and parametric analysis could be used. A test of variance homogeneity is required to ensure the assumption of equal variances between groups (Levene's test) before proceeding to the t-test. The results of the homogeneity test for the pretest and posttest are presented in the table below:

Table 6. Homogenity Test

Data	F (Levene)	p	Conclusion
Pretest	0,63	0,535	Homogen
Post Test	0,36	0,553	Homogen

The results of the homogeneity calculation show that the significance value p pre-test 0.535 > 0.05 and post-test 0.553 > 0.05, so it can be stated that the variance between groups, both the experimental group and the control group, is homogeneous or not significantly different. Thus, homogeneity is fulfilled, and the t-test analysis can be carried out in the next process.

To measure the impact of the treatment in each group, a paired samples t-test was conducted between the pretest and posttest scores. In the experimental group, the average score increased from 60 to 92 (showed a mean increase of 32 points). The paired t-test yielded a highly significant t-value (p<0.001), indicating that the posttest score increase was significantly higher than the

pretest score. Similarly, in the control group (average increase from 62 to 75, +13 points), the difference was also significant ($p<0.001$). Both findings indicate that both conventional learning strategies and the integration of PJBL-Jigsaw can enhance participants' competencies; however, the increase in the experimental group (PJBL-Jigsaw integration) was statistically stronger, demonstrating the effectiveness of the integrative approach used (Anggraini, 2021).

To determine the magnitude of the effect, Cohen's d was calculated. The results showed a very large effect size ($d > 0.80$) for the experimental group, indicating that the integration of Project-Based Learning and the Jigsaw strategy had a substantial impact on improving teaching competence (Sanchez-Muñoz et al., 2022; Martinez-Rodrigo et al., 2017). The rough calculation shows that the difference in pretest-posttest scores in the experimental group (increasing 32 points) resulted in a d value far above 0.8 (very large effect), while in the control group (increasing 13 points), d was also above 0.8, which falls into the large category. Similarly, the difference in posttest scores between groups resulted in $d > 0.8$. In conclusion, the integration of PJBL and Jigsaw has a very large effect on improving the teaching competencies of prospective facilitators compared to the control group (Roney, 2024; Patil & Kumbhar, 2022). Based on the data calculations and analysis conducted, the null hypothesis (Ho) is rejected, and the alternative hypothesis (Ha): the integration of project-based learning and Jigsaw strategies is effective in improving the teaching abilities of prospective facilitators, is accepted.

Collectively, these results suggest that the integration of PJBL and Jigsaw approach provides a more effective instructional approach than traditional learning methods in enhancing the teaching competence of prospective non-formal education facilitators (Pase et al., 2025).The marked improvement in teaching competence among students exposed to the integrated PJBL–Jigsaw approach can be attributed to the complementary strengths of both instructional strategies. Furthermore, learner-centered instructional designs have been widely recognized as essential in preparing future educators to navigate complex and dynamic educational contexts (Firdaus, 2024).

DISCUSSION

1. Integrating Project-Based Learning and Jigsaw to Improve Teaching Competence

This study found that integrating Project-Based Learning (PJBL) and the Jigsaw cooperative strategy significantly enhanced the teaching competence of prospective non-formal education facilitators compared to conventional teaching approaches. The substantial improvement was observed across key pedagogical dimensions, including lesson planning, reflective practice, classroom management, and collaborative instructional strategies, suggesting that the integration of these two approaches creates a more structured yet interactive learning environment. Previous studies have similarly demonstrated that collaborative and inquiry-based learning approaches contribute positively to pedagogical competence development, reflective teaching behavior, and instructional adaptability.

The findings suggest that PJBL and Jigsaw function as complementary strategies rather than independent approaches. PJBL provides authentic, problem-based learning experiences, while Jigsaw facilitates structured peer interaction and knowledge sharing. This combination enables participants to construct knowledge through real-world tasks while simultaneously internalizing pedagogical concepts through peer teaching and collaborative reflection. As a result, learning becomes more interactive, participatory, and aligned with the practical demands of non-formal

education contexts, consistent with previous research indicating that PJBL promotes critical thinking, engagement, and collaboration (Tsybulsky & Muchnik-Rozanov, 2023).

The stronger effect of the integrated PJBL–Jigsaw approach can be explained by the complementary mechanisms of both strategies. While PJBL emphasizes inquiry-based learning and authentic task engagement, it may lack structured peer interaction if implemented independently. Conversely, Jigsaw ensures active participation and knowledge distribution but may not always provide meaningful contextual application. By integrating both approaches, this study combines cognitive engagement through project-based inquiry with structured social interaction through peer teaching. This dual mechanism enhances both individual understanding and collaborative competence, resulting in a more comprehensive development of teaching skills.

Additionally, the two strategies are important for 21st-century competencies like collaboration and communication abilities, crucial for facilitator roles in non-formal education. Studies examining PJBL in various educational contexts have consistently reported positive outcomes on student engagement, social skills, and learning motivation. The Jigsaw strategy amplifies the interactive and interdependent nature of learning. In parallel, the Jigsaw strategy strengthens communication skills, individual accountability, and social interaction by requiring learners to become "experts" and teach their peers. Empirical studies have demonstrated that the Jigsaw cooperative strategy improves both cognitive achievement and affective outcomes, including motivation, positive attitudes, and interpersonal skills (Marhamah & Mulyadi, 2013). Together, these results confirm that integrating PJBL and Jigsaw creates a learning environment that not only supports knowledge acquisition but also develops essential pedagogical and social competencies required in non-formal education.

2. Synergistic Effects of Project-Based Learning and Jigsaw Integration

The remarkably higher gains in teaching competence in the experimental group suggest not just additive but synergistic effects between PJBL and Jigsaw. PJBL provides an authentic structure for pedagogical design and inquiry, while Jigsaw embeds structured peer interaction and accountability within that environment (Bell, 2010). When these strategies are integrated, students are not only designing and reflecting on projects but also engage in structured peer teaching and collaborative knowledge construction. This synergy promotes deeper cognitive engagement and higher-level social competencies, which are critical for effective non-formal facilitation. This dual engagement aligns with constructivist and sociocultural learning theories; these perspectives emphasize that learning occurs through active social engagement and shared meaning-making processes rather than passive knowledge transfer Click or tap here to enter text.(Vygotsky et al., 1978; Hmelo-Silver, 2004). The substantial effect size identified in this study (Cohen's $d > 0.8$) also indicates that the integrated PJBL-Jigsaw approach produced a strong impact on the development of higher-order thinking and collaborative skills.

Compared to conventional teacher-centered methods, the integrated model positions learners as active participants and co-constructors of knowledge. This shift is especially relevant in non-formal education, where facilitation requires adaptability, collaboration, and responsiveness to learners' needs, Specifically:

1. Curriculum designers can scaffold authentic project tasks that require collaborative contributions and shared expertise.
2. Instructors/lecturers should train facilitator candidates in peer teaching, reflective practice,

and team-based instructional tasks consistent with non-formal education's participatory ethos.

3. Institutions could embed professional development opportunities that deepen understanding of how to implement integrated learning approaches effectively.

These recommendations align with broader educational reforms advocating for learner-centered pedagogy that supports active, collaborative, and reflective professional preparation Click or tap here to enter text.(Slavin, 2014 & Johnson et al., 2014). Although the results are promising, the study has limitations. The study was conducted within a single institutional setting and involved participants with relatively similar characteristics, which may limit the broader applicability of findings. Future research could expand with multi-site studies, examine long-term effects of integrated learning on facilitator identity formation, or explore qualitative perspectives on how PJBL–Jigsaw influences reflective teaching practice. Additionally, investigating how these models affect other competencies such as learner engagement, professional confidence, or adaptive pedagogical judgment would provide richer insights and strengthen cross-contextual applicability.

CONCLUSION

The present study demonstrates that integrating Project-Based Learning with the Jigsaw cooperative strategy contributes positively to the development of teaching competence among pre-service non-formal educators for elementary learning contexts. Participants exposed to the integrated learning model showed stronger improvement in pedagogical dimensions related to instructional planning, collaborative learning management, reflection, and classroom interaction compared with those experiencing conventional instruction. Beyond statistical improvement, the findings indicate that combining inquiry-oriented projects with structured peer collaboration creates a more participatory and contextually meaningful learning experience. This study also highlights the relevance of collaborative and project-oriented pedagogies in preparing future educators for dynamic community-based learning environments. Nevertheless, this study was limited to one institutional context and a relatively homogeneous group of participants, which may affect broader generalizability. Future investigations are encouraged to involve wider educational contexts, longitudinal designs, and mixed-method approaches to explore how integrated collaborative learning influences professional identity formation, learner engagement, and adaptive pedagogical competence over time.

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