



Development of a Local Wisdom Based Entrepreneurship Course Model for Pre-Service Science Teachers to Enhance Entrepreneurial Skills

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ABSTRACT

This study aimed to design and evaluate a local wisdom-based entrepreneurship course model to enhance the entrepreneurial competencies of pre-service science teachers. The research followed the ADDIE (Analyze, Design, Develop, Implement, and Evaluate) instructional design framework and employed the Delphi and Fuzzy Delphi methods for expert validation involving ten specialists in science and entrepreneurship education. A true experimental design using a posttest-only control group was conducted with 62 participants enrolled in an entrepreneurship course at a university in Central Java, Indonesia. Data were analyzed through descriptive statistics, the Shapiro-Wilk normality test, independent sample t-tests, and Cohen's d to determine the effect size. The results demonstrated that the developed model achieved high validity across all instructional stages ($DV > 0.7$; $d < 0.2$). Empirical findings indicated that the experimental group exhibited significantly higher gains in entrepreneurial skills than the control group ($p < 0.05$), with a large effect size (Cohen's $d = 2.54$). The model effectively strengthened students' risk-taking abilities, opportunity recognition, self-efficacy, emotional intelligence, and innovative thinking. These findings underscore that integrating local wisdom into entrepreneurship education fosters contextualized learning experiences and promotes sustainable entrepreneurial behavior among future science educators. The proposed model provides a practical framework for higher education institutions to develop entrepreneurial competencies while preserving and utilizing local cultural values.

Keywords: entrepreneurship education; local potential; pre-service science teachers; entrepreneurial skills; fuzzy

INTRODUCTION

Entrepreneurial skills constitute a fundamental competence that should be intentionally cultivated within the educational process, particularly for pre-service science teachers. These skills play a vital role in various aspects of life, including earning a sustainable livelihood, solving real-world problems, and adapting to the dynamic pace of social and technological change (Ines et al., 2025; Kaya Capocci et al., 2025; Kaya-Capocci & Peters Burton, 2023). In this context, entrepreneurship education serves not only as a vehicle for economic empowerment but also as a transformative pedagogical approach that encourages creative thinking, innovation, and problem solving among future educators.

Developing entrepreneurial competence among pre-service science teachers is essential, as it nurtures new ways of acting and thinking about complex and uncertain problems (Njati & Omae, 2020; Peschl et al., 2021). Entrepreneurship oriented learning in higher education also aims to

prepare students to become holistic individuals who possess the knowledge, character, and practical abilities required of an entrepreneur (Miço & Cungu, 2023). Through systematic training, pre-service teachers can internalize entrepreneurial attitudes that empower them to apply innovative approaches both in their personal lives and future classrooms.

As emphasized by İ. Deveci and Çepni (2017), pre-service science teachers must be well equipped with entrepreneurial skills before entering the teaching profession so that they can later transfer these competencies to their students. This preparation is critical not only for fostering students' entrepreneurial potential but also for enhancing the teachers' own professional success. Entrepreneurial skills represent a set of abilities that support educators in achieving excellence in their profession (Savickas, 2010). Teachers who possess entrepreneurial qualities tend to exhibit higher self-efficacy, creativity, and adaptability characteristics that are essential for effective teaching and continuous professional growth (Newman et al., 2019).

Therefore, fostering entrepreneurial competence among pre-service science teachers is a strategic effort to develop educators who are adaptive, innovative, and capable of guiding students toward independent and sustainable ways of thinking. Integrating entrepreneurship education into science teacher preparation programs not only contributes to professional development but also aligns with the broader goals of integrated science education, which seeks to connect knowledge, skills, and values in meaningful and contextually relevant ways.

Beyond the pedagogical and professional dimensions, the cultivation of entrepreneurial skills also serves as a means to foster an entrepreneurial spirit that can drive economic success. For pre-service teachers, entrepreneurship plays an essential role in shaping independence, particularly in terms of economic self-reliance. Such independence enables future educators to remain adaptive, resilient, and competitive in today's globalized and rapidly changing environment (Othman et al., 2020). Empirical studies have shown that entrepreneurship education has a positive and significant influence on both entrepreneurial motivation and skill development (Budy, 2017; Lubis, 2018). Similarly, previous research suggests that education contributes to the establishment of an entrepreneurial culture and enhances the effectiveness of entrepreneurial initiatives (Marques & Albuquerque, 2012). Furthermore, Arasti et al. (2012) affirm that fostering entrepreneurial skills among pre-service teachers can improve the overall quality and professionalism of future entrepreneurs.

The development of entrepreneurial skills can be effectively achieved through the educational process, particularly within classroom learning contexts designed for pre-service teachers. In this regard, entrepreneurship education should aim not only to strengthen entrepreneurial competencies but also to inspire creativity, confidence, perseverance, and contribution to national economic growth (Lubis, 2018). Moreover, the successful implementation of entrepreneurship education requires the internalization of entrepreneurial values that align with local and cultural contexts (Mulyani, 2011).

According to Aydogmus (2021), entrepreneurial skills represent an individual's capacity to actualize ideas through both independent and collaborative efforts. In practice, entrepreneurship involves the innovative utilization of resources to generate change and create value that meets societal needs (González-Cruz & Deveci, 2018). Core indicators of entrepreneurial competence include the ability to take calculated risks, recognize opportunities, build self-confidence, demonstrate emotional intelligence, and exhibit creativity and innovativeness (İ. Deveci & Çepni, 2015).

Despite the extensive acknowledgment of their importance, the state of entrepreneurship in Indonesia remains below expectations. Over the past decade, the rate of entrepreneurial growth has shown only modest progress and continues to lag behind that of neighboring countries (Hutasuhut & Aditia, 2021). National statistics indicate that entrepreneurs comprise approximately 3.47% of the total population just above the 2% threshold commonly used as a benchmark for

developing nations (Wahyudi et al., 2024). Moreover, the majority of these entrepreneurs operate micro or small scale businesses employing fewer than five workers (Wihardja & Cunningham, 2021), which suggests limited capacity for innovation and business expansion (Gustina et al., 2020).

These findings underscore a critical need for educational initiatives that specifically target the enhancement of entrepreneurial skills among students. Strengthening entrepreneurship oriented learning in higher education particularly in teacher education programs can play a strategic role in addressing this gap. By equipping pre-service science teachers with entrepreneurial competence, the education system not only contributes to the development of individual capabilities but also supports broader national goals of fostering innovation, sustainability, and economic resilience.

Considering the critical role of entrepreneurial competence in strengthening Indonesia's entrepreneurial ecosystem, there is an urgent need to design systematic educational programs that cultivate these skills among students (Elpisah et al., 2024). In this context, universities hold a pivotal responsibility in preparing pre-service educators to acquire and apply entrepreneurial skills effectively. As key institutions in human resource development, universities serve not only as centers of knowledge creation but also as agents that shape adaptive, innovative, and opportunity oriented mindsets among future teachers. Globally, many countries have recognized the importance of embedding entrepreneurial skill development within the educational process (Kružić & Pavić, 2010). Entrepreneurship education at the tertiary level aims to equip students with essential knowledge, skills, and attitudes relevant to the business world, with the broader goal of transforming individuals into creative and independent entrepreneurs. Such integration fosters long term capacities for innovation, sustainability, and socio economic contribution.

In Indonesia, entrepreneurship education has been progressively introduced in higher education institutions in recent years. However, few studies have examined the effectiveness of learning models designed to enhance entrepreneurial competence particularly those that integrate local wisdom and regional potential as contextual learning resources (Mustafa et al., 2022; Wardhani & Nastiti, 2023). Previous findings also indicate that students' entrepreneurial skills remain at a moderate level and require further development (Siswanto et al., 2023). Responding to this gap, the present study aims to develop and evaluate a local wisdom based entrepreneurship course model designed to strengthen the entrepreneurial skills of pre-service science teachers. The integration of local potential in entrepreneurship education is expected to create a contextual, meaningful, and sustainable learning experience that not only enhances entrepreneurial competence but also supports the preservation of local cultural values and the promotion of community based economic resilience.

METHODOLOGY

Research Design

This research employed a developmental research design that adopted the ADDIE model, consisting of five systematic stages: Analysis, Design, Development, Implementation, and Evaluation (Hsu et al., 2014). The overall research procedure followed the sequence illustrated in Figure 2.1, which outlines the flow of the development process.

The research stages carried out are divided into three main parts. The first stage is the Development of the Learning Model Stages. At this stage, the learning model was systematically developed using the Delphi method, involving a panel of experts in science education and learning innovation (Hendrastuti et al., 2021). The experts participated in multiple rounds of evaluation and discussion to review, refine, and validate the proposed model components and instructional stages. Revisions were made iteratively based on expert feedback to ensure the model's conceptual clarity,

feasibility, and alignment with the objectives of entrepreneurship education. The second stage is the Development of Research Instruments. A research instrument in the form of a questionnaire was developed to measure students' entrepreneurial skills, serving as a primary indicator of the model's effectiveness. The instrument underwent content validation through expert judgment and was analyzed using Aiken's V coefficient to determine item validity (Nurjanah et al., 2023). Reliability was assessed through internal consistency testing, ensuring that all items were statistically reliable for measuring the intended constructs. The third stage is the Implementation of the Learning Model in the Entrepreneurship Course. The model was empirically tested through a true experimental design using a posttest only control group design. The field trial was implemented over one academic semester within the entrepreneurship course for pre-service science teachers. The experimental group received instruction using the developed local wisdom based entrepreneurship model, while the control group followed conventional instructional methods.

Participants

The study involved 62 pre-service science teachers, aged 18–20 years, enrolled at a university in Central Java, Indonesia. The participants were undertaking an eight semester undergraduate program focusing on science and pedagogy, with entrepreneurship included as a compulsory component of the curriculum. Data collection was conducted during the fourth semester, when students were enrolled in an entrepreneurship course. Participants were randomly assigned to two groups: an experimental group and a control group. The experimental group received instruction through the local wisdom-based entrepreneurship learning model, while the control group followed the conventional teaching approach. All participants completed the learning process in full and responded to the entrepreneurial skills questionnaire administered at the end of the instructional period.

Research Instrument

A questionnaire was developed to assess changes in the entrepreneurial skills of pre-service science teachers following the implementation of the developed learning model. The instrument consisted of 37 items representing five core indicators: risk-taking (7 items), opportunity recognition (9 items), self-efficacy (7 items), emotional intelligence (8 items), and innovativeness (6 items). Content validity was examined through expert judgment and analyzed using Aiken's V coefficient (Nurjanah et al., 2023). All items met the validity threshold. Reliability testing using Cronbach's Alpha yielded a coefficient of 0.935, indicating high internal consistency and stability of the instrument (Heale & Twycross, 2015). Prior to implementation, the learning model underwent expert consensus validation using the Fuzzy Delphi Method (FDM). The panel comprised 10 experts in science education and entrepreneurship pedagogy, including university lecturers and experienced science teachers. Each learning stage (syntax) was deemed valid when meeting the criteria of Threshold ($d \leq 0.2$) and Defuzzification Value ($DV \geq 0.5$), following the standard proposed by Hendrastuti et al. (2021).

Data Analysis

After validation, the questionnaire was administered at the end of the learning intervention. Descriptive statistics were employed to determine the mean scores and percentage achievements for each entrepreneurial skill indicator. Inferential statistical analysis was subsequently applied to evaluate the effectiveness of the learning model. Data normality was tested using the Shapiro–Wilk test as the basis for determining appropriate parametric analysis. Differences between the experimental and control groups were analyzed using independent sample t-tests for each indicator. The effect size of the treatment was further assessed using Cohen's d, which quantified the magnitude of the model's impact on enhancing the entrepreneurial skills of pre-service science teachers.

The research activities carried out, can be seen in Figure 1.

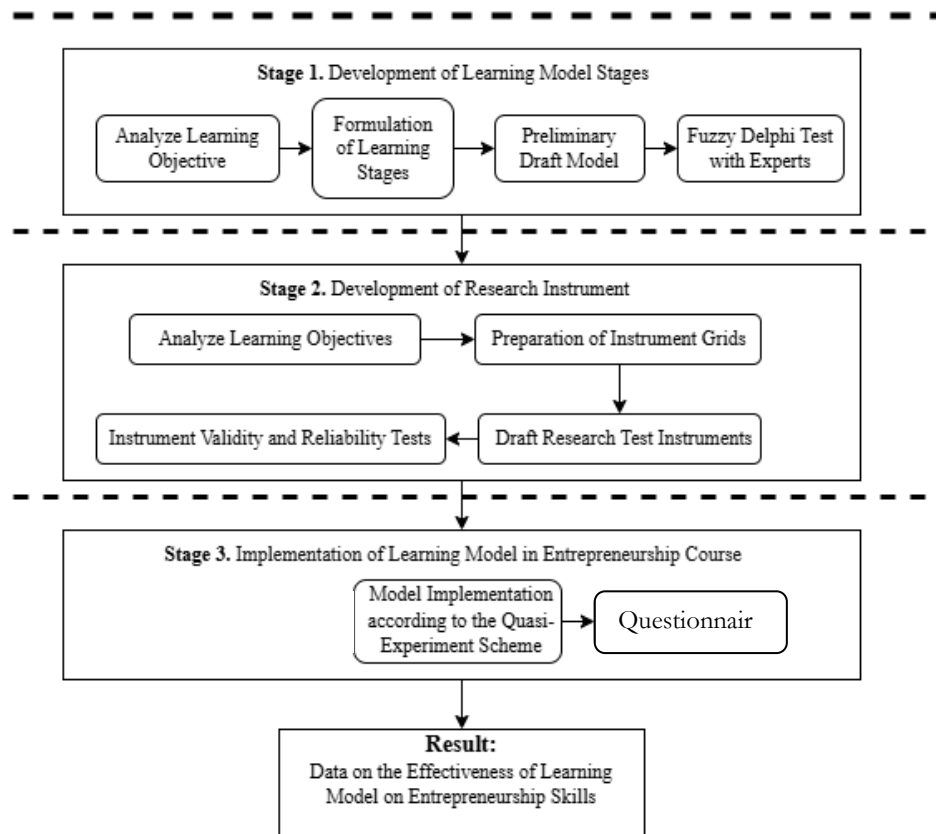


Figure 1. Research Flow Chart

RESULT AND DISCUSSION

The findings of this study are presented in two main parts: (1) the feasibility and validation results of the local wisdom based entrepreneurship learning model, and (2) the empirical results of measuring students' entrepreneurial skills and evaluating the effectiveness of the developed model in enhancing these skills. Before discussing the model's feasibility, it is important to note that the design and development of the model were guided by clearly defined learning objectives derived from the theoretical foundations of entrepreneurship education and the principles of local potential integration. These objectives served as the framework for formulating each learning stage, instructional activity, and assessment component within the model.

The following section provides a detailed explanation of the validation results, followed by a presentation of the quantitative findings related to the improvement of students' entrepreneurial skills, along with a discussion of their implications for entrepreneurship education in science teacher preparation programs.

Validity of the Learning Model for Entrepreneurship Lectures Based on Local Potential that Can Improve Student Entrepreneurship Skills

The validation of the developed teaching materials and learning model was carried out by involving ten experts, consisting of science education lecturers and science subject teachers with expertise in entrepreneurship education. Each expert evaluated the learning model based on four structured stages of the entrepreneurship course design: identification and mapping of local potential within each student's community or region; analysis and comprehension of the identified

local potential in terms of its educational and economic relevance; assessment of business opportunities derived from the analyzed potential, including the evaluation of profit–loss feasibility; and development of entrepreneurial projects grounded in the results of the previous analyses.

These four stages served as the key indicators for assessing the validity and coherence of the local potential based entrepreneurship learning model, particularly in terms of its ability to enhance students' entrepreneurial competencies. The validation results were analyzed using the Fuzzy Delphi Method (Hendrastuti et al., 2021), and the outcomes of the expert evaluations are summarized in Table 1.

Table 1. Validity of Local Potential-Based Entrepreneurship Lecture Model

Learning Stages	Defuzzification Process (DV) Value	Threshold (d) Value	Description
Identifying and mapping local potentials in each student's area.	0.78	0.02	Valid
Analyze and understand the identified local potentials.	0.76	0.04	Valid
Analyze business opportunities from each part of the local potential that has been analyzed, and map the profit and loss of each analysis result.	0.74	0.14	Valid
Create entrepreneurship based on analysis results.	0.74	0.14	Valid

Table 1 presents the validation results for each stage of the developed learning model. The analysis using the Fuzzy Delphi method indicated that all learning stages met the established validity criteria and were unanimously agreed upon by the panel of experts. This finding confirms that each stage of the local potential based entrepreneurship learning model is appropriate, coherent, and effectively oriented toward achieving the intended entrepreneurial skill development objectives for prospective science teacher students.

Effectiveness of the Learning Model for Entrepreneurship Lectures Based on Local Potential that Can Improve Student Entrepreneurship Skills

The data obtained from the entrepreneurial skills questionnaire, administered to a sample of 30 students, were subsequently analyzed to evaluate the impact of the developed learning model. The initial stage of data analysis involved calculating the mean scores and percentage of achievement for each indicator of entrepreneurial skills. These indicators were used to compare the performance of students in the experimental group who received instruction through the Local Potential Based Entrepreneurship Learning Model with those in the control group, who participated in conventional entrepreneurship lectures. The comparative results of the average achievements between the two groups are summarized in Table 2.

Table 2. Mean and Percentage Achievement of Entrepreneurship Skills Competency

Indicators/Aspects	Mean		Percentage Achievement	
	Control	Experiment	Control	Experiment
Take risks	3.13	3.62	63%	72%
Seeing opportunities	3.06	3.79	61%	76%
Believing in oneself	3.06	3.98	61%	80%
Emotional intelligence	2.77	3.77	55%	75%
Innovative	2.69	3.39	54%	68%

Table 2 illustrates that, overall, both the mean scores and percentage levels of achievement in the experimental class were consistently higher than those in the control class across all entrepreneurial skill indicators. For the first indicator, taking risks, the control class achieved a mean score of 3.13 with an achievement level of 63%, while the experimental class showed

improvement with a mean score of 3.62 and an achievement level of 72%. In the second indicator, recognizing opportunities, the control class obtained a mean score of 3.06 (61%), whereas the experimental class achieved a higher mean of 3.79 (76%). For the third indicator, self-confidence, the control class recorded a mean of 3.06 (61%), while the experimental class reached 3.98 (80%). Similarly, in the fourth indicator, emotional intelligence, the control class obtained a mean of 2.77 (55%), while the experimental class demonstrated a marked improvement with a mean of 3.77 (75%). Finally, in the fifth indicator, innovativeness, the control class had a mean of 2.69 (54%), whereas the experimental class achieved a higher mean of 3.39 (68%).

These findings indicate that students who participated in the Local Potential-Based Entrepreneurship Learning Model exhibited stronger entrepreneurial skills compared to those who received conventional instruction. To further validate these findings, the survey results from both groups were subjected to a mean difference analysis, preceded by a normality test as a prerequisite. The outcomes of the normality test for the experimental and control classes are presented in Table 3.

Table 3. Normality Test Results for Each Indicator

Indicators/Aspects	<i>Shapiro-wilk</i> (Sig. Value)	
	Control	Experiment
Take risks	0.170	0.101
Seeing opportunities	0.153	0.249
Believing in oneself	0.636	0.132
Emotional intelligence	0.490	0.490
Innovative	0.625	0.227

The normality test is carried out to determine the mean difference test scheme that will be used beforehand. Data is said to be normal if the value of Sig. > 0.05, from the test results conducted using SPSS software version 26 it can be seen that the Sig. value for each indicator and class is > 0.05 so that all data can be said to be normal. Because the data is normal, the next step is the Independent Sample T-test. The test results can be seen in Table 4 below.

Table 4. Independent Sample T-test Results

Indicators/Aspects	Sig. (2-tailed) Value
Take risks	0.000
Seeing opportunities	0.000
Believing in oneself	0.000
Emotional intelligence	0.000
Innovative	0.000

Table 4 presents the results of the Independent Sample T-test, which show that the Sig. (2-tailed) value is less than 0.05. This indicates a statistically significant difference between the experimental and control groups. Consequently, it can be concluded that the local potential-based entrepreneurship learning model is significantly more effective in enhancing students' entrepreneurial skills compared to the conventional learning model. Furthermore, an effect size analysis was performed to measure the magnitude of the difference between the two groups. The calculation yielded a Cohen's d value of 2.5436, which falls within the large effect category. This finding demonstrates that the implementation of a local potential-based entrepreneurship model had a substantial and meaningful impact on improving students' entrepreneurial competencies.

The effectiveness of this model is evident across all indicators of entrepreneurial skills. In general, entrepreneurship education emphasizes the development of students' knowledge, attitudes, and practical skills required to create and manage new ventures (Ahmed et al., 2017; Hutasuhut et al., 2020; Lackeus, 2014). Learning activities designed around local potential further enable preservice teachers to develop a positive entrepreneurial mindset, nurturing confidence in identifying opportunities and making strategic decisions in uncertain conditions (Bae et al., 2014;

Bakker & Shepherd, 2017; Jones & English, 2004). Through this process, students strengthen their creativity and innovation skills, which are core aspects of entrepreneurship (Ahmed et al., 2017; Ferreira et al., 2017). Each stage of the local potential-based learning model plays a distinct role in cultivating these abilities (Aydogmus, 2021). For example, during the stages of “identifying and mapping local potential” and “analyzing and understanding the identified potential,” students are trained to improve their skills in opportunity recognition and innovation.

By exploring and assessing local resources, preservice science teachers learn to observe their environment systematically, recognize unmet needs, and evaluate the feasibility of business opportunities in their local context (Samsudin, 2024; Costa et al., 2018; Rahim et al., 2022). This experience fosters a deeper understanding of how entrepreneurship can emerge from context-specific opportunities. Moreover, by creatively leveraging unique local resources, students are encouraged to design innovative business ideas that contribute to the creation of sustainable, community-oriented enterprises (Bardales-Cárdenas et al., 2024; Castro & Zermeño, 2021; Sergeeva et al., 2021). In essence, identifying and analyzing local potential not only strengthens entrepreneurial awareness but also nurtures independence and resilience in managing business ventures, aligning with the goals of science-based entrepreneurship education.

At the stage of “analyzing business opportunities from each part of the identified local potential and mapping the profit and loss of each analysis result,” students are primarily trained to strengthen their entrepreneurial competencies in the aspects of “risk-taking” and “self-confidence.” Engaging in profit–loss analysis and opportunity evaluation allows students to build a realistic understanding of business continuity and sustainability. This process cultivates a willingness to take calculated risks based on thorough and evidence-informed considerations (Aryani, 2019; Bae et al., 2014; Jones & English, 2004).

By assessing business feasibility and potential challenges, preservice science teachers develop the ability to manage uncertainty an essential trait of successful entrepreneurs (Ayalew & Zeleke, 2018; Martins et al., 2023). The integration of analytical evaluation into entrepreneurship learning encourages positive risk-taking, which has been empirically linked to stronger entrepreneurial intention and more decisive business behavior (Emami et al., 2021; Shukla & Kumar, 2024). Moreover, the process of in-depth analysis and practical business planning helps nurture self-efficacy and self-reliance, increasing students’ confidence in their entrepreneurial capacities. Entrepreneurship education that incorporates real-world simulation and experiential learning has been shown to enhance confidence, persistence, and entrepreneurial intention (Gielnik et al., 2020; Wang et al., 2023; Wardana et al., 2020).

In the final stage, namely “creating an entrepreneurial venture based on the analysis results,” the learning process primarily cultivates the dimensions of “innovation” and “emotional intelligence (EI).” Since aspects of local potential are often deeply rooted in the social and ecological characteristics of a region and thus difficult to modify, students must adopt creative approaches to adapt and develop sustainable business solutions (Africano, 2023). Prospective science teachers who establish enterprises grounded in local resources are naturally driven to innovate developing new products, services, or business models that align with local contexts and constraints (Dias et al., 2020).

Innovation, in this sense, emerges not merely from creativity but from the necessity to translate local wisdom into market-relevant value. Research supports that creativity and innovation are central entrepreneurial competencies, particularly when utilizing local knowledge and engaging with community-based challenges (Alwaely et al., 2024; Dabić et al., 2021; Puerta et al., 2022). Through this process, students enhance their capacity to generate original, adaptive, and sustainable business ideas, marking a transition from conceptual understanding to practical entrepreneurial action.

Additionally, the process of establishing and sustaining a business requires strong emotional intelligence (EI) a multidimensional construct encompassing enthusiasm, self-discipline, perseverance, resilience, and constructive thinking (Maulida et al., 2016). High EI enables students to regulate emotions, cope with uncertainty, and sustain motivation in challenging entrepreneurial contexts. Studies consistently show that EI is a significant predictor of entrepreneurial performance, often exceeding the predictive power of cognitive intelligence in dynamic environments (B. Pathinettampadiyan & Thavaraj, 2025; Puerta et al., 2022). Thus, developing EI through local potential-based learning not only enhances personal adaptability but also contributes to long-term entrepreneurial success.

Although the model developed can generally be said to improve the entrepreneurial skills of prospective science teachers, researchers infer that a systematic, practice-oriented education plan is needed to effectively develop these skills at all levels of the education system (Amalia & Von Korflesch, 2021; Rauf et al., 2024). Furthermore, it is also important to provide digital literacy and e-commerce training to prepare prospective science teachers for the modern business landscape (Agustin et al., 2024; Rahmi et al., 2025; Rohaetin, 2020). It is also important to establish partnerships with industry, government, and successful entrepreneurs to provide guidance, internships, and exposure to real business challenges (Dunggio et al., 2024; Saptono et al., 2020; Widodo et al., 2025). Finally, obstacles such as low digital literacy, lack of standardized curricula, and limited resources need to be addressed through targeted training for prospective science teachers, infrastructure investment, and policy support.

CONCLUSION

The development and implementation of a local wisdom-based entrepreneurship learning model proved highly effective in enhancing the entrepreneurial competencies of pre-service science teachers. The model, structured through systematic stages of identifying, analyzing, and utilizing local potential, successfully strengthened five key entrepreneurial dimensions risk-taking, opportunity recognition, self-confidence, innovation, and emotional intelligence. Statistical analyses revealed significant improvements across all indicators, supported by a large effect size, thereby confirming the pedagogical validity and practical efficacy of the developed model. These findings demonstrate that embedding local potential into entrepreneurship education not only contextualizes learning within students' socio-cultural environments but also promotes sustainable, community-oriented entrepreneurship relevant to regional development. Furthermore, the study underscores the strategic role of universities as catalysts in cultivating an entrepreneurial culture through adaptive, locally grounded curricula that bridge theory and practice. Future research should expand this work by exploring digital integration, cross-sector partnerships, and longitudinal analyses to evaluate the sustained impact of local wisdom-based entrepreneurship education on graduates' entrepreneurial engagement and its contribution to regional innovation ecosystems.

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