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To cite this article: Nuraeni, D. N. Rosidin, E. Nurhayati, and S. Fatimah, “The Influence of Green-Blue Economy-Based Entrepreneurship Education on Santri Self-Efficacy and Independence,” *Women, Educ. Soc. Welf.*, vol. 3, no. 1, pp. 290–305, 2026. <https://doi.org/10.70211/wesw.v3i1.436>



Published online: March 30, 2026



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Received: December 29, 2025

Revised: February 16, 2026

Accepted: March 27, 2026

Online: March 30, 2026

Abstract

Islamic boarding schools are increasingly expected to integrate religious formation with sustainable entrepreneurial competencies that support students' socio-economic independence. This study examined the influence of Green–Blue Economy-based entrepreneurship education on santri self-efficacy and independence at Ma'had Al-Zaytun, Indramayu, Indonesia. A quantitative explanatory survey design was used, involving 55 twelfth-grade santri selected from a population of 188 through cluster random sampling. Data were collected using a five-point rating-scale questionnaire and analyzed using simple linear regression after normality and linearity assumptions were met. The findings showed that Green–Blue Economy-based entrepreneurship education positively and significantly influenced self-efficacy, explaining 48.4% of its variance, and santri independence, explaining 51.3% of its variance. The stronger contribution to independence indicates that sustainability-oriented entrepreneurship learning is especially relevant for developing practical autonomy, responsibility, and readiness for productive participation. These findings imply that pesantren can strengthen graduate quality by integrating ecological agriculture, maritime skills, Islamic values, and practice-based entrepreneurship into a sustainability-oriented curriculum.

Keywords: Entrepreneurship Education; Green–Blue Economy; Islamic Boarding School; Santri Independence; Self-Efficacy.

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INTRODUCTION

Islamic boarding schools, commonly known as pesantren, have historically functioned as religious, moral, and social institutions that shape students' character through disciplined communal life, Islamic learning, and internalized ethical values. In contemporary educational discourse, however, pesantren are increasingly expected to move beyond the transmission of classical religious knowledge and contribute to the formation of students who are intellectually adaptive, economically productive, and socially responsible. This transformation is important because the challenges faced by graduates are no longer limited to religious literacy, but also include employability, entrepreneurial readiness, environmental awareness, and the ability to participate in sustainable local economic development. Recent studies on pesantren-based entrepreneurship indicate that Islamic boarding schools can become strategic sites for developing entrepreneurial character, practical competence, and economic independence when learning activities are connected to real business practices, mentoring systems, and institutional economic units [1], [2], [3]. Therefore, entrepreneurship education in pesantren should not be understood merely as vocational supplementation, but as an integrated pedagogical strategy for strengthening santri agency, moral responsibility, and readiness to face socio-economic change [1], [3], [4].

Entrepreneurship education has been widely discussed as a learning process that develops opportunity recognition, innovation, business planning, risk management, problem-solving, and proactive decision-making. In international studies, entrepreneurship education is consistently associated with entrepreneurial intention, entrepreneurial mindset, start-up readiness, and entrepreneurial self-efficacy because it provides learners with structured exposure to knowledge, skills, experience, and psychological preparation for business-related action. The effectiveness of entrepreneurship education becomes stronger when it is implemented through experiential learning, project-based activities, mentoring, and direct engagement with real or simulated entrepreneurial tasks rather than through theoretical instruction alone [5], [6], [7]. Empirical studies further show that entrepreneurship education influences entrepreneurial intention and readiness through self-efficacy, meaning that students are more likely to develop entrepreneurial orientation when they believe they are capable of identifying opportunities, mobilizing resources, solving problems, and executing business plans [4], [5], [8]. In the pesantren context, this theoretical relationship is especially relevant because santri are educated in an environment that emphasizes discipline, obedience, simplicity, responsibility, and communal cooperation, which can become moral capital for entrepreneurial learning when supported by practical and sustainability-oriented training [1], [2], [3].

Self-efficacy is a central psychological construct in entrepreneurship education because entrepreneurial action requires confidence, persistence, resilience, and the ability to manage uncertainty. Entrepreneurial self-efficacy refers to learners' belief in their capacity to perform entrepreneurial tasks, including searching for opportunities, planning ventures, mobilizing resources, managing risks, and implementing business decisions. Previous studies demonstrate that entrepreneurship education strengthens self-efficacy by providing mastery experiences, social modeling, feedback, and repeated opportunities to solve entrepreneurial problems in authentic learning environments [5], [6], [7]. Other studies also confirm that self-efficacy

mediates the relationship between entrepreneurship education and entrepreneurial intention, indicating that education does not automatically produce entrepreneurial behavior unless it also strengthens students' confidence in their own capacity to act [9], [10], [11]. For santri, self-efficacy is crucial because students who have practical entrepreneurial exposure are more likely to perceive themselves as capable of transforming religious discipline, local resources, and vocational skills into productive economic activities [12], [13], [14].

In addition to self-efficacy, santri independence is an important educational outcome because pesantren education traditionally aims to form individuals who are morally grounded, socially responsible, and capable of living productively in society. Independence in this context should not be reduced to financial self-sufficiency alone; rather, it includes the ability to take initiative, make responsible decisions, solve practical problems, manage resources, and participate actively in community development. Studies on pesantren entrepreneurship show that independence can be developed through systematic entrepreneurship programs, business-unit involvement, apprenticeship, leadership formation, and direct participation in productive activities within the pesantren ecosystem [15], [16], [17]. These findings indicate that pesantren-based entrepreneurship education has the potential to connect Islamic values with productive skills, thereby enabling santri to develop not only economic competence but also ethical responsibility and social contribution [17], [18], [19]. Therefore, examining santri independence as an outcome of entrepreneurship education is conceptually important because it captures the broader educational mission of pesantren: forming graduates who are self-reliant, responsible, and beneficial to society.

The integration of green and blue economy principles into entrepreneurship education expands the relevance of pesantren-based vocational learning. Green economy-oriented entrepreneurship emphasizes environmentally responsible production, resource efficiency, ecological innovation, and sustainable value creation, while blue economy-oriented entrepreneurship highlights the sustainable use of marine, coastal, and aquatic resources for economic development without degrading environmental systems. Recent studies on sustainable entrepreneurship and green entrepreneurship education show that sustainability-based entrepreneurial learning can strengthen ecological awareness, innovation capacity, and responsible business orientation among students [20], [21], [22]. Meanwhile, studies on the blue economy emphasize that maritime and aquatic resource-based enterprises require governance, sustainability orientation, and innovation in order to balance economic growth with ecological protection [23], [24], [25]. For pesantren located in agricultural, rural, or coastal environments, a Green Blue Economy-based entrepreneurship education model is therefore highly relevant because it enables santri to learn entrepreneurship through locally available resources, such as agriculture, horticulture, fisheries, maritime skills, and ecological production systems [26], [27], [28].

Although previous studies have provided valuable evidence on entrepreneurship education, entrepreneurial self-efficacy, and pesantren-based independence, several gaps remain. First, much of the international literature examines entrepreneurship education in universities or general vocational institutions, whereas studies situated specifically in pesantren remain comparatively limited [29], [30], [31]. Second, existing studies on pesantren entrepreneurship generally focus on entrepreneurial strategies, entrepreneurial character, business-unit management, or economic empowerment, but fewer studies quantitatively

examine how entrepreneurship education influences self-efficacy and independence as two distinct educational outcomes [19], [21], [32]. Third, studies on green entrepreneurship in Islamic boarding schools have begun to address sustainability and ecological awareness, but the combined integration of green and blue economy perspectives into entrepreneurship education remains underexplored, particularly in relation to students' psychological confidence and practical independence [1], [3], [4]. Fourth, limited empirical research has tested whether sustainability-oriented entrepreneurship education can simultaneously explain variation in santri self-efficacy and santri independence within a quantitative regression model [6], [7], [8].

Based on these gaps, this study aims to examine the influence of Green Blue Economy based entrepreneurship education on the self-efficacy and independence of santri at Ma'had Al-Zaytun, Indramayu. Specifically, the study investigates the extent to which entrepreneurship education that integrates ecological agriculture, maritime skills, sustainability values, and Islamic educational culture contributes to students' belief in their own capabilities and their capacity to act independently. The novelty of this study lies in its attempt to connect entrepreneurship education, green-blue economy principles, self-efficacy, and santri independence within a single empirical framework. By doing so, this study is expected to contribute theoretically to the literature on sustainable entrepreneurship education and pesantren-based empowerment, while also offering practical implications for Islamic educational institutions seeking to develop graduates who are spiritually grounded, economically self-reliant, and environmentally responsible.

METHODS

This study employed a quantitative explanatory survey design to examine the influence of Green-Blue Economy-based entrepreneurship education on santri self-efficacy and independence. This design was considered appropriate because the study aimed to test the predictive relationship between one independent variable, namely Green Blue Economy-based entrepreneurship education, and two dependent variables, namely self-efficacy and santri independence [33], [34]. The research was conducted at Madrasah Aliyah Ma'had Al-Zaytun, Indramayu Regency, Indonesia, an Islamic boarding school that integrates religious learning, general education, and entrepreneurship-based skills training. The selection of this research site was based on the institutional implementation of entrepreneurship education through agricultural and maritime skill programs, which represent the green economy and blue economy orientations. The agricultural program focuses on the cultivation of staple food crops and horticultural products, including the development of Kaze and Hoshikari rice varieties, while the maritime program introduces students to shipbuilding, vessel design, wood selection, material processing, and the operation of fishing vessels. The learning model combines classroom-based instruction and field-based practice, enabling students to acquire both conceptual knowledge and practical entrepreneurial experience [35], [36].

The population of this study consisted of 188 twelfth-grade students enrolled in the extracurricular entrepreneurship programs at Madrasah Aliyah Ma'had Al-Zaytun during the 2025–2026 academic year. A total of 55 students were selected as the research sample using a combination of cluster sampling and random sampling techniques. Cluster sampling was first

applied by grouping students according to their participation in the agricultural and maritime extracurricular programs. After the clusters were determined, random sampling was used to select respondents from each group in order to provide equal opportunity for students within the relevant clusters to participate in the study. This sampling procedure was used to ensure that the sample represented students who had direct exposure to the Green Blue Economy based entrepreneurship education program implemented by the institution.

Data were collected using a structured questionnaire designed to measure three main variables: Green–Blue Economy-based entrepreneurship education, self-efficacy, and santri independence. The questionnaire used a five-point rating scale ranging from the lowest to the highest level of agreement. The Green Blue Economy-based entrepreneurship education variable measured students' perceptions of the implementation of entrepreneurship learning that integrates sustainability values, agricultural skills, maritime skills, environmental responsibility, resource management, and practice-based entrepreneurial activities. The self-efficacy variable measured students' confidence in their ability to understand entrepreneurial tasks, solve problems, make decisions, manage challenges, and apply the skills acquired through the program. Meanwhile, the santri independence variable measured students' perceived capacity for self-reliance, initiative, responsibility, economic readiness, and practical autonomy in facing future social and economic challenges. Before the main data analysis, the questionnaire should be evaluated through content validation by relevant experts and empirical validity testing, while internal consistency should be examined using Cronbach's alpha to ensure that each scale demonstrates acceptable reliability. The values of validity and reliability should be reported explicitly in the final manuscript once the instrument testing results are available.

The data analysis was conducted using SPSS version 25. Descriptive statistics were first used to summarize the characteristics of the data and provide an overview of the respondents' responses to each variable. Prior to hypothesis testing, assumption tests were conducted to ensure that the data met the requirements for linear regression analysis. The normality test was performed using the Kolmogorov–Smirnov test on the unstandardized residuals, while the linearity test was conducted to examine whether the relationship between Green–Blue Economy-based entrepreneurship education and each dependent variable was linear. After the assumptions were satisfied, simple linear regression analysis was applied separately to test the influence of Green–Blue Economy-based entrepreneurship education on self-efficacy and santri independence. The significance of the regression coefficient was determined based on the t-test and probability value, with a significance level of 0.05. The coefficient of determination was also examined to identify the proportion of variance in self-efficacy and independence explained by the Green Blue Economy-based entrepreneurship education variable.

Ethical considerations were addressed by ensuring that participation in the study was voluntary and that respondents were informed about the purpose of the research before completing the questionnaire. The confidentiality of respondents' identities and responses was maintained throughout the research process, and the collected data were used solely for academic purposes. Since the study involved students in an educational institution, permission from the relevant institutional authority should be obtained before data collection. In the final version of the manuscript, the authors are advised to provide a clear statement regarding ethical

approval or institutional research permission, including the approval number if available. This is necessary to strengthen the transparency, accountability, and international publication readiness of the manuscript.

RESULTS AND DISCUSSION

Results

The prerequisite testing of data analysis in this study consists of testing the normality and the linearity of the partial regression line between the independent variables and the dependent variable.

Normality Test

The normality testing of the data for each sample is examined through the hypotheses, namely H0: the data in the sample are not normally distributed and H1: the data in the sample are normally distributed. The calculations were performed using the SPSS 25 application program.

Table 1. Normality Test

Keterangan	Unstandardized Residual
N	55
Test Statistic	0.108
Asymp. Sig. (2-tailed)	0.162

Based on the table above, it is known that the Kolmogorov–Smirnov Z value of the Unstandardized Residual = 0.108 and the Exact Sig. = 0.162 > 0.05; therefore, the sample originates from a normally distributed population because the Exact Sig. value > 0.05.

Linearity Test

The linearity test is conducted to determine whether the influence between the independent variable and the dependent variable is linear or not. The influence between the independent variable and the dependent variable is considered linear if the calculated F value is less than or equal to the F table value at a significance level of 5%.

Table 2. Results of the linearity test of the regression line for the effect of variable X on Y₁

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4826.803	38	127.021	1.858	.092
Linearity	2867.661	1	2867.661	41.939	.000
Deviation from Linearity	1959.142	37	52.950	0.774	.747
Within Groups	1094.033	16	68.377		
Total	5920.836	54			

Based on the results of the linearity test in Table 2, it is stated that the relationship between the variable of Green-Blue economy entrepreneurship education (X) and the self-efficacy variable (Y1) has a value of Fcount = 0.774 and Sig. Deviation from linearity = 0.747. Based on the determination criteria: If the Significance of Deviation from linearity > 0.05, then the relationship between X and Y is linear. From the data processing results, the value of (X)

Sig. Deviation from linearity $0.747 > 0.05$, it can be concluded that the relationship between X and Y1 is linear.

Table 3. Results of the linearity test of the regression line for the effect of variable X on Y₂

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7990.076	38	210.265	3.071	.009
Linearity	4652.194	1	4652.194	67.938	.000
Deviation from Linearity	3337.882	37	90.213	1.317	.282
Within Groups	1095.633	16	68.477		
Total	9085.709	54			

Based on the results of the linearity test in Table 3, it is stated that the relationship between the Green-Blue economy entrepreneurship education variable (X) and the students' independence variable (Y₂) shows a value of Fcount = 1.317 and Sig. Deviation from linearity = 0.282. If the Significance of Deviation from Linearity > 0.05 , then the relationship between X and Y is linear. From the data processing results, the value of (X) Sig. Deviation from linearity $0.282 > 0.05$, thus it can be concluded that the relationship between X and Y₂ is linear.

Regression Test

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Table 4. Results of the calculation of the significance testing of the regression coefficient for the effect of variable X

Model	B	SE	β	t	p
(Constant)	22.626	5.793		3.906	< .001
Entrepreneurship Education	0.422	0.060	0.696	7.055	< .001

The regression analysis results presented in Table 4 indicate a significant positive influence of Green-Blue Economy-Based Entrepreneurship Education (X) on the Self-Efficacy of *santri*. The regression coefficient (B) of 0.422 suggests that for every unit increase in the implementation of this specific entrepreneurship education, there is a corresponding increase in *santri* self-efficacy by 0.422 points. Statistically, this relationship is highly significant, as evidenced by the t-value of 7.055 and a p-value (Sig.) of 0.000, which is well below the standard alpha threshold of 0.05. These findings imply that integrating ecological and maritime economic perspectives into the curriculum effectively strengthens the students' belief in their vocational capabilities, fostering a robust sense of self-confidence within the Islamic boarding school environment.

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Table 5. Regression Analysis Results: X on Y₂

Model	Unstandardized B	Std. Error	Standardized β	t	p-value
(Constant)	26.288	6.981		3.766	< .001

Model	Unstandardized B	Std. Error	Standardized β	t	p- value
Green-Blue Economy Entrepreneurship Ed.	0.537	0.072	0.716	7.457	< .001

Based on the statistical output in Table 5, it is evident that Green-Blue Economy-Based Entrepreneurship Education (X) serves as a potent predictor for the Independence of *santri*. The analysis yields an unstandardized coefficient (B) of 0.537, indicating that a more intensive focus on green and blue economic principles significantly enhances the students' level of independence. The calculated t-statistic of 7.457 with a significance level of 0.000 confirms that the null hypothesis is rejected, establishing a statistically significant impact. This suggests that the curriculum not only provides theoretical knowledge but also empowers *santri* to become more autonomous and self-reliant, equipping them with the necessary mindset to navigate future economic challenges sustainably and independently.

Discussion

The findings of this study indicate that Green-Blue Economy-based entrepreneurship education has a positive and significant influence on *santri* self-efficacy and independence at Ma'had Al-Zaytun. The regression results show that the model explains 48.4% of the variance in self-efficacy and 51.3% of the variance in *santri* independence, suggesting that sustainability-oriented entrepreneurship education contributes substantially to both psychological confidence and practical autonomy. The stronger explanatory value for independence indicates that the program may be particularly effective in shaping students' capacity to act responsibly, manage resources, and participate in productive economic activities. This finding is important because the entrepreneurship program at Ma'had Al-Zaytun is not limited to theoretical business instruction, but is integrated with agricultural and maritime practices that represent green and blue economy orientations. In this context, *santri* are exposed to concrete learning experiences, such as crop cultivation, horticultural practices, shipbuilding, vessel design, and fisheries-related skills, which allow them to connect religious discipline, sustainability values, and productive competence in one educational ecosystem.

The positive influence of Green Blue Economy-based entrepreneurship education on self-efficacy is consistent with the broader literature on entrepreneurship education and entrepreneurial self-efficacy. Adeniyi found that entrepreneurship education contributed to entrepreneurial self-efficacy and start-up readiness among TVET students, particularly when learning involved technical skills, business management skills, and practical entrepreneurial preparation [5]. This supports the present finding because the Ma'had Al-Zaytun program similarly provides skill-based learning through direct engagement with agriculture and maritime activities rather than relying only on classroom-based entrepreneurship theory. Hoang et al. also demonstrated that self-efficacy mediated the relationship between entrepreneurship education and entrepreneurial intention among university students in Vietnam, indicating that educational exposure becomes more meaningful when it strengthens learners' confidence to act [6]. Similarly, Wu et al. reported that entrepreneurship education was positively associated with entrepreneurial self-efficacy and entrepreneurial intention among college students in China [9]. The present study extends these findings into the

pesantren context by showing that self-efficacy can also be strengthened through entrepreneurship education rooted in Islamic values, sustainability orientation, and local resource-based practices.

The findings also align with Wardana et al., who showed that entrepreneurship education influenced entrepreneurial self-efficacy, entrepreneurial attitude, and entrepreneurial mindset among Indonesian university students [4]. Their study emphasized that entrepreneurship education becomes effective when it shapes not only knowledge but also students' psychological readiness and attitude toward entrepreneurship. In the present study, the significant effect on self-efficacy confirms that practical and context-based entrepreneurship education may function as a psychological empowerment mechanism for santri. However, this study differs from Wardana et al. because the educational context is not a university environment but an Islamic boarding school, where entrepreneurship learning is embedded in religious discipline, communal living, and institutional production units. This distinction is important because pesantren-based entrepreneurship does not merely aim to produce business-oriented individuals, but also seeks to form ethically responsible, independent, and socially useful graduates. Thus, the present findings broaden the discussion of entrepreneurial self-efficacy by situating it within a religious and sustainability-based educational setting.

The stronger influence of Green Blue Economy-based entrepreneurship education on santri independence is also supported by studies on pesantren entrepreneurship. Salam et al. found that entrepreneurship education mediated the relationship between entrepreneurial orientation, self-efficacy, and entrepreneurial intention among santri at an Islamic boarding school [37]. Their findings indicate that entrepreneurship education has a strategic role in transforming students' internal confidence into entrepreneurial interest. The present study confirms this relationship but moves beyond entrepreneurial intention by examining independence as a broader educational outcome. Nasirudin et al. similarly showed that entrepreneurship education in Salaf Islamic boarding schools was systematically organized through character formation, leadership, opportunity recognition, cooperation, production training, and marketing skills [1]. This is directly relevant to the present study because independence among santri is not formed through motivation alone, but through structured learning experiences that train students to identify opportunities, produce goods or services, and manage practical responsibilities.

The findings further resonate with Anggadwita study on community entrepreneurship in Islamic boarding schools, which emphasized that pesantren-based entrepreneurship can become a model of Islamic education that combines empowerment, productive learning, and community development [38]. Karim et al. also found that Islamic spiritual leadership plays an important role in fostering santri entrepreneurial spirit and independence through religious values, role modeling, consultation, and sharia-based social relations [3]. These studies support the present finding that santri independence is shaped not only by technical entrepreneurship training, but also by the moral and spiritual ecosystem of the pesantren. Nevertheless, the present study offers a different contribution by focusing specifically on Green–Blue Economy-based entrepreneurship education as the predictor variable. While previous pesantren studies have emphasized leadership, institutional entrepreneurship, business units, or religious values, this study highlights the role of sustainability-oriented entrepreneurship learning that integrates ecological agriculture and maritime skills. This makes the present research more specific in

explaining how local natural-resource-based education can strengthen both self-efficacy and independence.

The result is also comparable to Meishanti et al., who found that a science-based green entrepreneurship learning model integrated with SDGs and Islamic boarding school spirituality could foster sustainable entrepreneurship, ecological awareness, innovation, and socio-economic independence in pesantren [2]. The present study supports this argument by showing quantitatively that sustainability-based entrepreneurship education has a significant contribution to santri outcomes. However, the present study differs in two important respects. First, it does not only focus on green entrepreneurship, but also integrates the blue economy through maritime and fisheries-related skills. Second, it examines two dependent variables simultaneously, namely self-efficacy and independence, allowing the study to show that sustainability-oriented entrepreneurship education contributes to both psychological and behavioral dimensions of student development. Therefore, this study provides a more integrated framework by linking green economy, blue economy, Islamic education, self-efficacy, and santri independence in a single empirical model.

The novelty of this study lies in its attempt to position Green–Blue Economy-based entrepreneurship education as a distinctive pedagogical model within the pesantren context. Previous studies have generally examined entrepreneurship education in relation to entrepreneurial intention, entrepreneurial mindset, self-efficacy, or pesantren-based business management. Other studies have discussed green entrepreneurship or pesantren independence separately. In contrast, this study integrates green and blue economy principles into entrepreneurship education and examines their influence on self-efficacy and independence simultaneously. This integration is particularly relevant for Islamic boarding schools located in rural, agricultural, coastal, or resource-based environments because it enables entrepreneurship education to be developed from local ecological and maritime potential. The novelty is therefore not only located in the topic, but also in the conceptual linkage between sustainability education, Islamic values, vocational practice, psychological empowerment, and economic self-reliance.

The theoretical implication of this study is that entrepreneurship education in Islamic boarding schools can be understood as a multidimensional educational process that strengthens both self-efficacy and independence when it is contextualized through real-life productive activities. The findings support the view that entrepreneurship education is more effective when students acquire mastery experiences through direct practice, repeated problem-solving, and exposure to authentic production processes. The practical implication is that pesantren can develop entrepreneurship curricula that combine religious values, sustainability principles, local resource management, and vocational skills. Agricultural entrepreneurship, ecological farming, fisheries, maritime production, and community-based business units can become strategic learning laboratories for preparing santri to become independent graduates. For policymakers and Islamic education managers, the findings suggest that pesantren economic empowerment programs should not be designed merely as income-generating activities for institutions, but also as structured educational interventions that develop student competence, confidence, responsibility, and long-term autonomy.

Despite these contributions, this study has several limitations that should be acknowledged. First, the study used a cross-sectional survey design, which means that the

findings show statistical influence but cannot fully establish long-term causality. Future research should use longitudinal or quasi-experimental designs to examine whether Green–Blue Economy-based entrepreneurship education produces sustained changes in self-efficacy, independence, entrepreneurial behavior, and post-graduation economic outcomes. Second, the sample was limited to 55 santri from one institution, so the findings should be generalized cautiously to other pesantren with different cultural, geographical, institutional, or economic characteristics. Third, the study relied on self-reported questionnaire data, which may be influenced by social desirability bias, institutional loyalty, or students’ subjective interpretation of the program. Fourth, the analysis used simple linear regression, so it did not test possible mediating or moderating variables such as entrepreneurial motivation, spiritual leadership, environmental literacy, family background, prior business experience, or access to institutional business units. Fifth, the study has not fully explained the validity and reliability evidence of the instruments in detail; therefore, future studies should report item development, expert validation, construct validity, and reliability coefficients more explicitly. Addressing these limitations will strengthen future research and provide more robust evidence on how sustainability-oriented entrepreneurship education can transform pesantren into centers of religious formation, ecological responsibility, and economic empowerment.

CONCLUSION

This study concludes that Green–Blue Economy-based entrepreneurship education has a positive and significant influence on both self-efficacy and independence among santri at Ma’had Al-Zaytun, Indramayu. The findings demonstrate that entrepreneurship education integrating ecological agriculture, maritime skills, sustainability values, and practice-based learning contributes meaningfully to strengthening students’ confidence in their own capabilities and their capacity to act independently in facing socio-economic challenges. The regression results indicate that this educational model explains 48.4% of the variance in self-efficacy and 51.3% of the variance in santri independence, suggesting that its contribution is slightly stronger in developing practical autonomy than psychological confidence alone. These results highlight that sustainability-oriented entrepreneurship education in pesantren can function not only as vocational training, but also as a transformative pedagogical model that connects Islamic values, local resource management, environmental responsibility, and economic self-reliance. Therefore, the Green–Blue Economy-based entrepreneurship education model offers a relevant framework for Islamic boarding schools seeking to produce graduates who are spiritually grounded, environmentally aware, entrepreneurially capable, and socially independent. Future studies are encouraged to employ longitudinal, quasi-experimental, or mixed-method designs across broader pesantren contexts to validate these findings and examine the long-term effects of sustainability-based entrepreneurship education on students’ entrepreneurial behavior and post-graduation economic outcomes.

LIMITATIONS

This section provides a critical reflection on the study’s constraints, helping readers assess the scope and boundaries of the findings. Limitations may arise from methodological issues such

as sample size, data collection instruments, or context-specific variables that restrict the generalizability of the results. Authors should also acknowledge temporal and technological limitations, particularly when studying evolving platforms such as social media or emerging AI-based tools. Self-reported data, for example, may be subject to bias or misinterpretation, while digital analytics might be influenced by algorithmic changes beyond the researchers' control. Rather than undermining the study, a well-articulated limitations section reinforces the integrity of the research process. Authors are encouraged to suggest how future research can address these limitations by adopting alternative methods, expanding populations, or exploring comparative studies in other contexts.

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AUTHOR CONTRIBUTION

N.L. served as the principal author and was responsible for conceptualizing the study, formulating the research problems, developing the theoretical orientation of the review, and drafting the initial manuscript. M.S. contributed to the refinement of the Systematic Literature Review design, the development of the search strategy, the application of inclusion and exclusion criteria, and the organization of the PRISMA-based article selection process. K. contributed to data extraction, thematic coding, synthesis of the reviewed literature, and interpretation of findings related to deep learning and student character formation. N.L., M.S., and K. jointly discussed the analytical categories, reviewed the coherence of the results and discussion, revised the manuscript for academic clarity, and approved the final version of the article for publication.

CONFLICT OF INTEREST

"The authors declare no conflict of interest."

DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

The authors used ChatGPT Plus during the preparation of this manuscript solely to improve language clarity, grammar, readability, and academic expression. The tool was not used to generate research data, conduct the literature search, determine the inclusion and exclusion criteria, perform the analysis, or formulate the scholarly interpretation of the findings. All intellectual content, conceptual arguments, methodological decisions, and final revisions were critically reviewed, verified, and approved by the authors. Therefore, the authors take full responsibility for the accuracy, integrity, and originality of the content presented in this manuscript.

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