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INTEGRATION OF GREEN ENTREPRENEURSHIP IN VOCATIONAL EDUCATION AS A STRATEGY FOR STRENGTHENING GREEN SKILLS AND SUSTAINABLE DEVELOPMENT

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Abstract
The global environmental crisis demands a transformation of vocational education towards a sustainability paradigm. This study aims to analyze the factors that influence the implementation of green entrepreneurship in Vocational High Schools (SMK) and to formulate strategies for strengthening a sustainability-based entrepreneurship education management model in order to improve graduates' readiness to face the challenges of the green economy. Data were collected using a structured questionnaire via Google Form from 470 respondents and analyzed using Partial Least Squares-Structural Equation Modeling (PLS-SEM). The results show that Entrepreneurial Education (EE), Entrepreneurial Self-Efficacy (ESE), Opportunity Entrepreneurial (OE), Entrepreneurial Orientation (EO), and Green Entrepreneurial Intention (GEI) have a significant and mutually reinforcing effect in shaping an environmentally-oriented entrepreneurial education system. EE plays an important role in increasing self-efficacy and green entrepreneurial orientation, while ESE encourages the ability to recognize green opportunities that have an impact on increasing environmentally friendly entrepreneurial intentions. GEI functions as the main mediating variable that connects educational, psychological, and contextual factors to PKB. The resulting model has high explanatory power ($R^2 = 0.742$; $Q^2 = 0.611$) and is empirically valid, demonstrating the effectiveness of integrating entrepreneurial and sustainability values in the context of vocational education. These findings provide theoretical and practical contributions to the development of environmentally conscious education policies and encourage the transformation of vocational schools into green schools that are adaptive to the green economy.
Keywords: green entrepreneurship education, entrepreneurial self-efficacy, green business opportunities, entrepreneurial orientation, green entrepreneurial intention.

INTRODUCTION

Education plays an important role in driving economic growth by improving the quality of human resources (HR). Education plays a role not only in expanding knowledge, but also in developing skills and critical thinking abilities that have a direct impact on increasing productivity (Kokkinopoulou et al., 2025). Investment in the education sector has the potential to produce a competent and highly competitive workforce, which ultimately strengthens the foundations of national economic development (Patzak et al., 2025; World Bank, 2025).

Vocational education plays a strategic role in preparing a skilled workforce that is ready to meet the needs of modern industry. The OECD report (2023) emphasizes that vocational education is key to responding to global demand for relevant technical skills. However, there is still a gap between the competencies of graduates and the needs of the industrial world, due to limitations in facilities, resources, and training for teaching staff (UNESCO, 2018; ILO, 2019). This situation calls for innovation in the learning system to make it more adaptive to the changing times.

Vocational education still faces a negative stigma as a "second choice" compared to academic pathways (World Bank, ILO, & UNESCO, 2023). To overcome this, innovation in learning methods is needed, such as technology integration, project-based learning, and the use of industry simulations (McKinsey & Company, 2020). In addition, strengthening soft skills such as communication and teamwork is also a key requirement in the digital age (World Economic Forum, 2020). Collaboration between vocational schools and industry is an important step in ensuring the relevance of the curriculum and the employability of graduates (CEDEFOP, 2021).

Global environmental issues require education systems to integrate sustainability values through the concept of a green economy (UNEP, 2025). The shift towards a green economy creates a need for green skills, which are skills that support environmentally friendly practices and resource efficiency (Sern et al., 2018). In this context, vocational education is an important platform for preparing a workforce that can contribute to sustainable development and adapt to climate change. UNESCO emphasizes the importance of vocational education as a means to facilitate the transition to a green economy through green skills-based training (UNESCO, 2021). ASEAN countries, including Indonesia, have sought to develop vocational training that emphasizes productivity, occupational safety, and environmental awareness. Thus, vocational curricula must be geared toward mastery of technical skills, environmental knowledge, and professional attitudes that support sustainable development (Setiawan, 2017; Kamis et al., 2017).

The integration of green entrepreneurship in vocational high schools (SMK) is a strategic step in shaping a generation of entrepreneurs who are oriented towards sustainability. Green entrepreneurship emphasizes resource efficiency and the development of environmentally friendly products (Bacq et al., 2016; Cehan et al., 2020). Recent studies indicate that implementing this concept not only increases students' environmental awareness but also fosters creativity and motivation to learn (Kulkov, 2023; Gast et al., 2022). Despite its potential, the implementation of green entrepreneurship in vocational schools still faces various obstacles, such as students' lack of understanding of environmental issues, limited teaching materials, and a lack of training for teachers (Gast et al., 2022; Sumbogo et al., 2023). Additionally, educational policies that do not prioritize sustainability aspects also slow down the implementation of this concept. Therefore, entrepreneurship education in vocational schools needs to be directed toward the formation of innovative and sustainable business behaviors.

Entrepreneurship education in vocational schools plays an important role in reducing unemployment and promoting national economic growth. The Indonesian government, through Presidential Regulation No. 2 of 2022, has set a target of 3.95% of the total population to be entrepreneurs by 2024. However, data from the Central Statistics Agency (2023) shows that the unemployment rate among vocational school graduates is still as high as 12.4%. This condition emphasizes the need to strengthen entrepreneurship programs and competency certification so that vocational school graduates are ready to work or become entrepreneurs (Directorate General of Vocational Education, 2025).

The BMW concept (Work, Continuing Education, and Entrepreneurship) was developed to ensure that vocational school graduates have a variety of career options (Directorate General of Vocational Education, 2021). This program emphasizes project-based learning and industrial practice in order to produce graduates who are adaptive and globally competitive. Support for character education, industry networking, and entrepreneurship training are important aspects to prepare students to face the challenges of the modern world of work (Bappeda West Java, 2019; MalangPoscoMedia, 2023). Although entrepreneurship education has been included in the Strategic Plan of the Directorate of Vocational School Development (2020), its implementation is still not optimal. Many graduates lack the confidence to start their own businesses because entrepreneurship education is still theoretical and not integrated with the environmental context. In this context, this study aims to analyze the factors that influence the implementation of green entrepreneurship in vocational schools and formulate strategies to strengthen the sustainability-based entrepreneurship education management model to improve graduates' readiness to face the challenges of the green economy.

METHOD

The population of this study includes all vocational high school (SMK) students in Indonesia, consisting of students, teachers, educational staff, and principals. Sampling was conducted by involving 470 respondents. The research instrument was a questionnaire with a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). This study used six latent variables, namely Entrepreneurial Education (X1), Entrepreneurial Self-Efficacy (X2), Opportunity Entrepreneurial (X3), Entrepreneurial Orientation (X4), Green Entrepreneurial Intention (Y1), and Sustainable Green Entrepreneurship Education (Y2).

Validity and reliability tests were conducted to ensure the quality of the instruments and measurement models. Convergent validity was tested by assessing the factor loading values of each indicator against its construct. All indicators showed factor loading values above 0.70 and were therefore declared valid (Hair et al., 2022). The Average Variance Extracted (AVE) value for each construct was also above 0.50, further strengthening the evidence of convergent validity. The reliability of the instruments was tested using two measures, namely Cronbach's Alpha and Composite Reliability (CR). The results of the analysis showed that all constructs had Cronbach's Alpha and CR values greater than 0.70, indicating good internal consistency and adequate reliability (Hair et al., 2022; Sarstedt et al., 2021).

Next, a discriminant validity test was conducted to ensure that each construct had clear differences from other constructs in the model. Testing using the Heterotrait-Monotrait (HTMT) ratio showed that all HTMT values were below the threshold of 0.90, confirming the fulfillment of discriminant validity (Sarstedt et al., 2021). Based on these results, it can be concluded that all research instruments have met the validity and reliability criteria required to proceed to the structural model analysis stage. Data analysis was performed using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) method, with the research model design presented in Figure 1.

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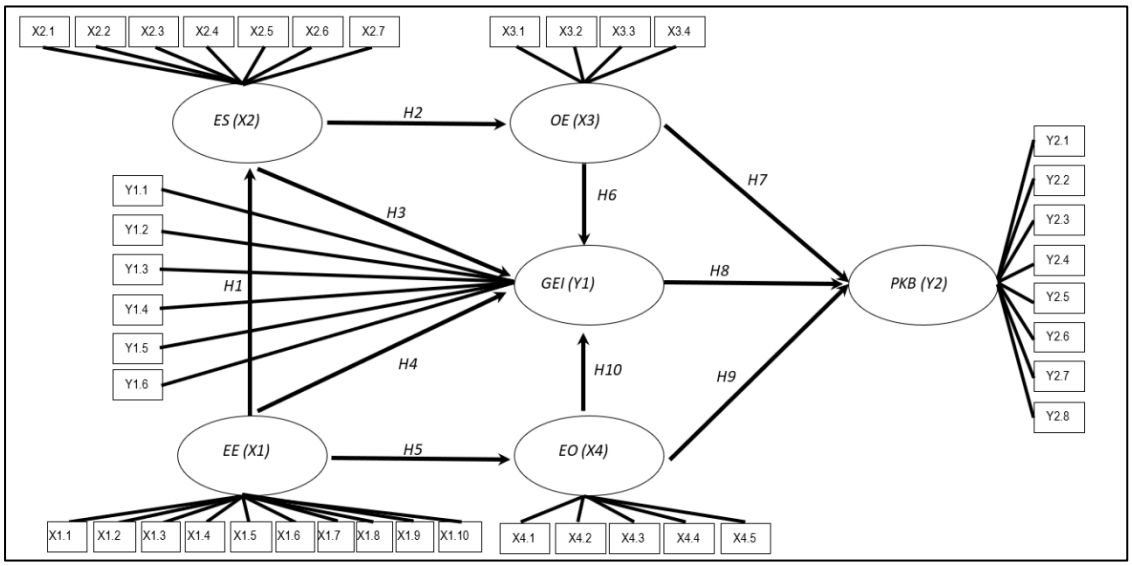

Figure 1. Research Model

RESULTS AND DISCUSSION

Respondent Characteristics

This study involved 470 respondents from vocational high schools (SMK) in East Java Province that have implemented the Creative Products and Entrepreneurship ( ) subject and developed Teaching Factories (TeFa). The distribution of respondents consisted of 325 students (69%), 115 teachers (24%), 16 educational staff (3%), and 14 school principals (3%). This composition reflects the hierarchical structure of vocational education institutions and ensures that perspectives from various organizational levels are represented in the research data.

Based on gender, the composition of respondents was fairly balanced, with 230 (49%) males and 240 (51%) females. This relatively balanced distribution is important to avoid gender bias in the analysis and ensure that the research findings can be generalized to both gender groups.

In terms of age, the majority of respondents were in the 16-25 age group, totaling 309 people (66%), followed by the 36-45 age group with 61 people (13%), the 26-35 and 46-55 age groups with 36 people (8% each), as well as 18 people (4%) under the age of 15 and 10 people (2%) over the age of 56. This distribution reflects a reasonable demographic structure in the context of vocational education, with a predominance of younger age groups who are the main focus of entrepreneurship education.

The educational level of respondents was dominated by high school graduates, numbering 328 people (70%), followed by bachelor's degree holders, numbering 107 people (23%), master's degree holders, numbering 30 people (6%), and diploma holders, numbering 3 people (1%). This distribution reflects the qualification structure of educators and staff in vocational schools. In terms of experience participating in entrepreneurship programs, 45% (213 people) of respondents had participated in such programs, while 55% (257 people) had not. This distribution indicates that although entrepreneurship programs have been implemented in vocational schools, there is still a significant proportion of students and staff who have not been formally exposed to such programs. Regarding environmental training, 37% (173 people) of respondents had participated in training, while 63% (297 people) had never participated. This data shows a greater gap in exposure to environmental issues compared to general entrepreneurship programs, underlining the importance of integrating environmental education into the SMK curriculum.

Descriptive Statistics of Research Variables

Descriptive analysis of the research variables provides an overview of respondents' perceptions of the measured constructs. Table 1 presents the mean and standard deviation for each research variable.

Table 1. Descriptive Statistics of Research Variables

Variable	Mean	Std. Deviation
Entrepreneurial Education (EE/X1)	3.9	0.656
- Green Entrepreneurship Characteristics (X1.1)	3.85	0.658
- Steps to Start Green Entrepreneurship (X1.2)	3.84	0.702
- Practical Entrepreneurship Management (X1.3)	3.84	0.649
- Building Business Networks (X1.4)	4.01	0.612
- Identifying Business Opportunities (X1.5)	3.98	0.661
Entrepreneurial Self-Efficacy (ES/X2)	3.85	0.681
- Green Entrepreneurship Belief (X2.1)	3.82	0.679

Variable	Mean	Std. Deviation
- Business Management Confidence (X2.2)	3.82	0.692
- Confidence in Success (X2.3)	3.83	0.699
- Perseverance (X2.4)	3.90	0.647
- Creative Thinking Confidence (X2.5)	3.90	0.687
Entrepreneurial Opportunity (OE/X3)	3.86	0.672
- Recognizing Business Opportunities (X3.1)	3.93	0.636
- Ability to Recognize Opportunities (X3.2)	3.7	0.775
- Intent & Confidence in Creating a Business (X3.3)	4.03	0.585
- Knowledge & Skills in Creating a Business (X3.4)	3.76	0.692
Entrepreneurial Orientation (EO/X4)	3.93	0.672
- New Green Entrepreneurship Ideas (X4.1)	3.99	0.604
- Identification of Entrepreneurship Opportunities (X4.2)	3.75	0.733
- Business Management Skills (X4.3)	3.76	0.697
- New Learning Ideas (X4.4)	4.09	0.632
- Implementation of PKK Subjects (X4.5)	4.05	0.677
Green Entrepreneurial Intention (GEI/Y1)	3.9	0.655
- Strong Entrepreneurial Intention (Y1.1)	3.84	0.691
- Making Efforts (Y1.2)	3.9	0.661
- Professional Goals (Y1.3)	4.05	0.635
- Strong Determination (Y1.4)	3.96	0.620
- Entrepreneurial Confidence (Y1.5)	3.89	0.670
- Risk-Taking (Y1.6)	3.9	0.656
Sustainable Green Entrepreneurship Education (PKB/Y2)	3.98	0.660
- Education Curriculum (Y2.1)	3.98	0.706
- Stakeholders (Y2.2)	3.95	0.684
- Available Resources (Y2.3)	4.01	0.622
- Learning Model (Y2.4)	3.99	0.628

The descriptive analysis results show that overall, respondents gave positive ratings (tending to agree) to all research variables, with average scores ranging from 3.70 to 4.09 on a scale of 1-5. The highest average scores were found in the indicators "Building Business Networks" (X1.4 = 4.01), "Confidence in Perseverance" and "Confidence in Creative Thinking" (X2.4 and X2.5 = 3.90), "Intention & Confidence in Creating a Business" (X3.3 = 4.03), "New Learning Ideas" (X4.4 = 4.09), "Application of PKK Subjects" (X4.5 = 4.05), and "Professional Goals" (Y1.3 = 4.05). The standard deviation values ranging from 0.585 to 0.775 indicate that, in general, there is fairly good agreement among the respondents, although there are still reasonable differences of opinion. The greatest differences were seen in the indicators "Ability to Recognize Opportunities" with a standard deviation of 0.775 and "Identification of Entrepreneurial Opportunities" with a standard deviation of 0.733. This illustrates that respondents' views on their ability to recognize and identify green business opportunities still vary considerably.

Convergent Validity Test

Convergent validity was tested through factor loading analysis and Average Variance Extracted (AVE). The ideal factor loading value is ≥ 0.70, indicating that more than 50% of the indicator variance is explained by the measured latent construct (Hair et al., 2022).

Table 2. Convergent Validity Test Results

Construct	Indicator	Factor Loading	AVE	Description
EE (X1)	X1.1	0.775	0.598	Valid
	X1.2	0.799		Valid
	X1.3	0.787		Valid
	X1.4	0.830		Valid
	X1.5	0.803		Valid
	X1.6	0.829		Valid
	X1.7	0.730		Valid
	X1.8	0.752		Valid
	X1.9	0.796		Valid
	X1.10	0.765		Valid
ES (X2)	X2.1	0.801	0.668	Valid
	X2.2	0.821		Valid

Construct	Indicator	Factor Loading	AVE	Description
	X2.3	0.832		Valid
	X2.4	0.815		Valid
	X2.5	0.819		Valid
	X2.6	0.823		Valid
	X2.7	0.804		Valid
OE (X3)	X3.1	0.848	0.686	Valid
	X3.2	0.840		Valid
	X3.3	0.763		Valid
	X3.4	0.860		Valid
EO (X4)	X4.1	0.800	0.594	Valid
	X4.2	0.801		Valid
	X4.3	0.749		Valid
	X4.4	0.771		Valid
	X4.5	0.737		Valid
GEI (Y1)	Y1.1	0.787	0.671	Valid
	Y1.2	0.848		Valid
	Y1.3	0.780		Valid
	Y1.4	0.825		Valid
	Y1.5	0.845		Valid
	Y1.6	0.819		Valid
PKB (Y2)	Y2.1	0.742	0.621	Valid
	Y2.2	0.729		Valid
	Y2.3	0.821		Valid
	Y2.4	0.780		Valid
	Y2.5	0.824		Valid
	Y2.6	0.801		Valid
	Y2.7	0.812		Valid
	Y2.8	0.781		Valid

The results of the convergent validity test in Table 2 show that all indicators have a loading factor ≥ 0.70, indicating good convergent validity. The AVE values for all constructs are above 0.50, ranging from 0.594 to 0.686, which meets the criteria.

Construct Reliability Test

Construct reliability testing was conducted using two main indicators, namely Cronbach's Alpha and Composite Reliability. A Cronbach's Alpha value greater than or equal to 0.70 indicates a good level of internal consistency, while a Composite Reliability value of ≥ 0.70 indicates that the construct has sufficient reliability for confirmatory research.

Table 3. Construct Reliability Test Results

Construct	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Interpretation
EE (X1)	0.907	0.915	0.924	Reliable
ES (X2)	0.917	0.917	0.933	Reliable
OE (X3)	0.847	0.848	0.897	Reliable
EO (X4)	0.830	0.832	0.880	Reliable
GEI (Y1)	0.901	0.901	0.924	Reliable
PKB (Y2)	0.912	0.912	0.928	Reliable

Note: EE = Entrepreneurial Education; ES = Entrepreneurial Self-Efficacy; OE = Opportunity Entrepreneurial; EO = Entrepreneurial Orientation; GEI = Green Entrepreneurial Intention; PKB = Sustainable Entrepreneurship Education

The results of construct reliability testing in Table 3 show that all constructs have Cronbach's Alpha and Composite Reliability values well above the minimum threshold of 0.70. In general, Cronbach's Alpha values range from 0.830 to 0.917, while Composite Reliability (rho_c) values range from 0.880 to 0.933. This confirms that all instruments used in the study have excellent internal consistency and are reliable for measuring each construct. The ES (Entrepreneurial Self-Efficacy) construct showed the highest reliability value, with a Cronbach's Alpha of

0.917 and a Composite Reliability of 0.933. This finding indicates that the indicators used to measure entrepreneurial self-efficacy have the highest internal consistency among all constructs tested, so they can be trusted to represent the concept consistently and accurately.

Goodness of Fit Model

The evaluation of goodness of fit in structural models is conducted using several model fit indices commonly used in the PLS-SEM approach. This test aims to assess the extent to which the constructed model is able to explain the data empirically and has good predictive power.

Table 4. Structural Model Goodness of Fit Indices

Criteria	Cut-off Value	Calculation Results	Interpretation
R-Square (R^2)	≥ 0.75 (*substantial*)	0.84	Very Good
Q-Square (Q^2)	> 0	0.49	Good Predictivity
SRMR	< 0.08–0.10	0.10	Acceptable
NFI	≥ 0.90	0.90	Good
RMSEA	< 0.12–0.14	0.138	Acceptable

Table 4 shows that the R^2 value of 0.84 indicates that 84% of the variance in the Sustainable Green Entrepreneurship Education (PKB) construct can be explained by the predictor variables in the model, namely Entrepreneurial Education (EE), Entrepreneurial Self-Efficacy (ES), Opportunity Evaluation (OE), Entrepreneurial Orientation (EO), and Green Entrepreneurial Intention (GEI). An R^2 value above 0.75 means that the model has very strong predictive power. Furthermore, the Q^2 value of 0.49 indicates good predictive relevance. A positive Q^2 value indicates that the model is not only able to explain the variance in the existing data, but also to accurately predict new data (Hair et al., 2022).

The SRMR (Standardized Root Mean Square Residual) index of 0.10 is still within the acceptable tolerance limit. Although the ideal value is below 0.08, Henseler et al. (2014) state that values up to 0.10 are still acceptable for PLS-SEM models. In addition, the NFI (Normed Fit Index) value of 0.90 indicates a good level of model fit because it meets the recommended minimum threshold.

Meanwhile, the RMSEA (Root Mean Square Error of Approximation) has a value of 0.138, which is still within the acceptable range (0.12–0.14) for PLS-SEM predictive models (Hair et al., 2022). Although slightly higher than the ideal value, this is still tolerable given the complexity of the model and the characteristics of the data used. Overall, these results indicate that the structural model has a good level of fit and adequate predictive power. Overall, the goodness of fit evaluation shows that the structural model fits the empirical data very well and is able to explain and predict endogenous variables strongly and consistently.

Hypothesis Testing

At the structural model analysis stage, the relationships between latent variables are tested to determine the strength and direction of the influences formed in the research model. This hypothesis testing aims to verify the theoretical relationship between constructs and measure the contribution of each variable to other variables within the framework of Structural Equation Modeling–Partial Least Squares (SEM-PLS). The resulting structural model illustrates the flow of direct relationships between constructs that have been empirically tested. The model graph can be seen in Figure 2 below.

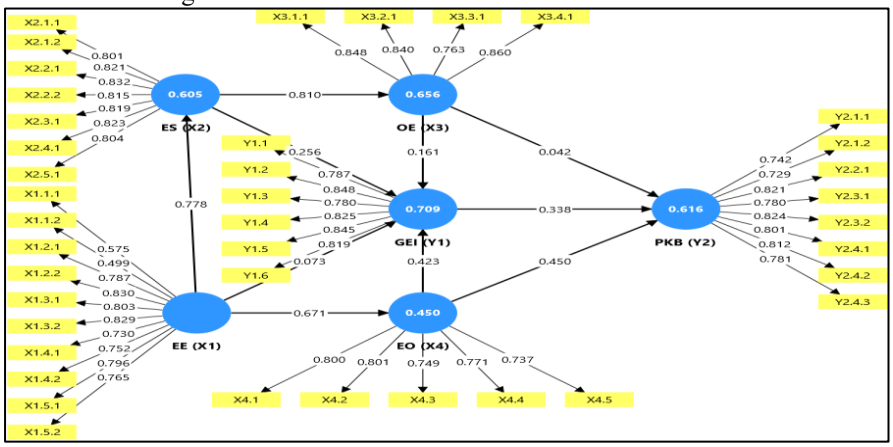

Figure 2. Sustainable Green Entrepreneurship Education Model

Based on the model in Figure 2, it can be seen that the Entrepreneurial Education (EE) variable has a strong influence on Environmental Support (ES) with a path coefficient of 0.778, and also contributes to Entrepreneurial Orientation (EO) by 0.671. Furthermore, Environmental Support (ES) shows a significant influence on Organizational Environment (OE) (0.810) and Green Entrepreneurial Intention (GEI) (0.256). Meanwhile, Organizational Environment (OE) has a positive influence on Green Entrepreneurial Intention (GEI) of 0.161, although relatively small. The Green Entrepreneurial Intention (GEI) variable is an important mediating construct

with a direct effect on Sustainable Entrepreneurial Behavior (SEB) of 0.338. In addition, Entrepreneurial Orientation (EO) also plays a role in SEB with a path coefficient value of 0.450. The R-square values listed for each construct indicate the model's ability to explain variability, with GEI having the highest value (0.709), followed by OE (0.656), ES (0.605), EO (0.450), and PKB (0.616), indicating that the model has a fairly good explanatory power overall.

Direct Effect

The analysis of the direct effect between variables in the structural model aims to determine the extent to which each exogenous variable contributes directly to the endogenous variable in the research model. The testing was conducted using the SEM-PLS approach to obtain accurate and reliable estimates of the relationship between latent constructs. The test results are presented in Table 5 below.

Table 5. Results of Direct Effect Hypothesis Testing

Hypothesis	Relationship	Coefficient (β)	P-Value	Decision
H1	EE → ES	0.955	0.000	Significant
H2	ES → OE	0.924	0.000	Significant
H3	ES → GEI	0.327	0.003	Significant
H4	EE → GEI	0.278	0.016	Significant
H5	EE → EO	0.805	0.000	Significant
H6	OE → GEI	-0.181	0.024	Significant
H7	GEI → GDP	0.442	0.000	Significant
H8	OE → GDP	0.306	0.000	Significant
H9	EO → GEI	0.473	0.000	Significant
H10	EO → GDP	0.128	0.007	Significant

The test results show that all direct effect hypotheses are statistically significant ($p < 0.05$). The strongest effect was found in the EE → ES path ($\beta = 0.955$), followed by ES → OE ($\beta = 0.924$), and EE → EO ($\beta = 0.805$). These three paths have very high coefficient values, indicating that entrepreneurship education and self-efficacy have a significant effect on the green entrepreneurship ecosystem. The test results showed ten significant direct influence hypotheses. However, there was a significant negative influence of OE on GEI ($\beta = -0.181$; $t = 1.980$; $p = 0.024$). This indicates that an orientation towards conventional entrepreneurial opportunities can actually reduce green entrepreneurial intention.

Indirect Effects Between Variables

Indirect effect analysis identified 16 significant mediation paths. Table 6 presents the results of the most substantial indirect effect tests.

Table 6. Results of Indirect Effect Testing of the Structural Model

Relationship	Coefficient (β)	P-value	Description
EE → ES → OE → GDP	0.407	0	Significant
ES → OE → GDP	0.426	0	Significant
EE → EO → GEI	0.381	0	Significant
EE → EO → GEI → GDP	0.168	0	Significant
EO → GEI → GDP	0.209	0	Significant
EE → ES → GEI	0.312	0.003	Significant
ES → GEI → GDP	0.144	0.004	Significant
EE → GEI → GDP	0.123	0.019	Significant
OE → GEI → GDP	-0.08	0.032	Significant
ES → OE → GEI	-0.167	0.024	Significant

The results of testing the indirect effect (mediation) of the structural model in Table 6 show that the mediation path through ES and OE provides the largest contribution ($\beta = 0.407$ and 0.426). However, there are several paths with negative effects, such as OE → GEI → PKB ($\beta = -0.080$), indicating the complexity of the relationship between variables in the context of green entrepreneurship.

Total Influence Between Variables

The total effect is calculated from the sum of the direct and indirect effects. Table 7 presents a summary of the total effect of exogenous variables on endogenous variables.

Table 7. Total Influence of Research Variables

Exogenous Variables	GEI (Y1)	PKB (Y2)
Entrepreneurial Education (X1)	0.278	0.401

Entrepreneurial Self-Efficacy (X2)	0.327	0.471
Opportunity Entrepreneurial (X3)	-0.181	0.261
Entrepreneurial Orientation (X4)	0.473	0.641
Green Entrepreneurial Intention (Y1)	-	0.442

Based on Table 7, Entrepreneurial Orientation (X4) has the greatest total influence on PKB (β = 0.641), followed by Entrepreneurial Self-Efficacy (β = 0.471) and Entrepreneurial Education (β = 0.401). These findings indicate the importance of developing a strong entrepreneurial orientation in the context of sustainable green entrepreneurship education.

Final Research Model

Based on the comprehensive analysis results, the final research model describes the structural relationships between variables that significantly influence Sustainable Green Entrepreneurship Education. This model is visualized in Figure 3.

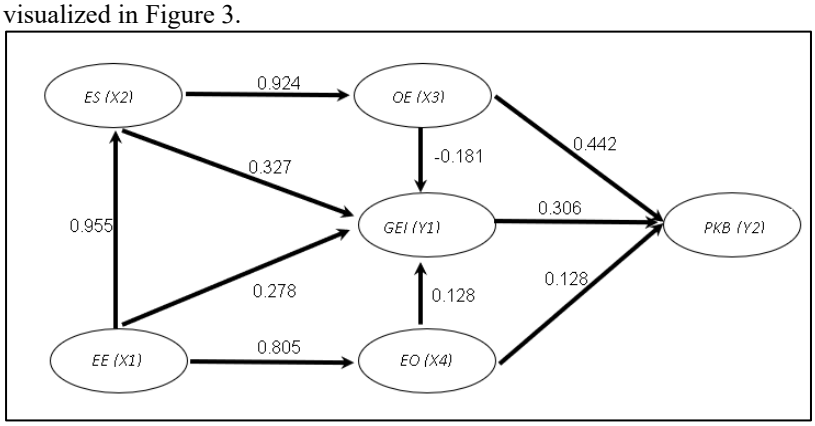

Figure 3. Final Model of Sustainable Green Entrepreneurship Education

The final model confirms that:

1. Opportunity Entrepreneurial has the highest direct influence on PKB (β = 0.442)
2. Entrepreneurial Orientation has the greatest indirect effect through GEI (β = 0.168)
3. Entrepreneurial Orientation has the greatest total effect on PKB through GEI mediation (β = 0.641)

DISCUSSION

The results show that Hypothesis 1, which states that Entrepreneurial Education (EE) has a significant effect on Entrepreneurial Self-Efficacy (ESE) with a path coefficient of 0.955 (t = 266.636; p < 0.001), is supported. This effect is very strong, indicating that entrepreneurial education, both formal and informal, has an important influence on shaping individuals' self-confidence in their entrepreneurial abilities. This finding is in line with the theory that increasing cognitive capacity and entrepreneurial skills through direct education has an impact on self-confidence, which is an important factor in business success. The results of this study are consistent with the findings of Pebriyanti & Rizky (2024) and Prayitno, Rahayu, & Wardhana (2024), who found a significant effect of entrepreneurship education on self-efficacy. Hoang et al. (2020) further showed that self-efficacy acts as a mediator between entrepreneurship education and entrepreneurial intention. Theoretically, these findings reinforce Bandura's Social Cognitive Theory (1997), which emphasizes that learning experiences (mastery experiences) are the primary source of self-efficacy formation.

Hypothesis 2 shows a path coefficient of 0.924 (t = 113.242; p < 0.001), meaning that individuals who have high self-efficacy in entrepreneurship tend to be more proactive and thorough in recognizing business opportunities around them. This finding is consistent with social cognitive theory, which states that self-efficacy is a major predictor of entrepreneurial behavior, including decision-making and innovation. This study is in line with Zhao et al. (2021) and Staniewski et al. (2025), which show that entrepreneurial self-efficacy acts as an internal psychological factor that increases a person's tendency to explore business ideas and create innovative solutions. Self-efficacy encourages confidence that business opportunities can be developed into successful ventures, even in complex economic contexts.

The results of Hypothesis 3 testing show a significant positive effect (β = 0.327; t = 2.791; p = 0.003), confirming that individuals with high self-efficacy are not only confident in entrepreneurship in general, but also motivated to take more environmentally responsible actions. Although the effect is more moderate than the relationship between other variables, this finding remains theoretically and practically significant. This study is consistent with the findings of Maryani (2023), Ediagbonya et al. (2024), and Tanoto & Indrastata (2025), which show that entrepreneurial self-efficacy has an important influence in shaping green entrepreneurial intention. Theoretically, these results support the Theory of Planned Behavior, which states that perceived behavioral control (closely related to self-efficacy) is a determining factor of behavioral intention. In the context of green entrepreneurship,

self-efficacy encompasses not only confidence in general business abilities but also confidence in overcoming specific challenges in sustainable business, such as integrating environmentally friendly practices, meeting sustainability standards, and creating both economic and ecological value.

Hypothesis 4 was confirmed with a coefficient of $\beta = 0.278$ ($t = 2.156$; $p = 0.016$), indicating that entrepreneurship education plays a role not only in fostering general business skills, but also in instilling environmental values and awareness, which in turn encourages the intention to run a green business. This finding is in line with the research by Talukder et al. (2025) and Wang et al. (2023), which shows that entrepreneurship education plays an important role in shaping green entrepreneurial intention, both directly and through mediation. These results confirm that integrating environmental issues into the entrepreneurship curriculum can increase students' awareness and commitment to sustainable business practices. Pedagogically, these findings indicate that effective entrepreneurship education must go beyond the transfer of technical business knowledge and include the formation of a value system oriented towards sustainability. A transformative learning approach that changes students' perspectives on the relationship between business and the environment is key to success.

The results of the study show a very strong effect ($\beta = 0.805$; $t = 32.162$; $p < 0.001$), confirming Hypothesis 5 that entrepreneurship education not only provides technical knowledge but also shapes an entrepreneurial mindset. This finding indicates that the more entrepreneurial education a person receives, the higher their orientation toward innovative, bold, and opportunity-responsive business practices. These results are consistent with Cho & Lee (2018), Angelia & Hidayah (2024), and Hassan et al. (2021), who found that entrepreneurship education increases entrepreneurial orientation through the formation of innovative attitudes, risk-taking, and proactivity. Theoretically, these findings support the concept of entrepreneurial orientation as a multidimensional construct that can be developed through educational intervention. The magnitude of this influence ($\beta = 0.805$) indicates that entrepreneurship education is a major factor in shaping an entrepreneurial mindset. This implies that curriculum design and learning methods play a crucial role in developing students' entrepreneurial character.

The results of Hypothesis 6 testing show a significant negative effect between individuals' perceptions of conventional entrepreneurial opportunities and their intention to start an environmentally friendly business ($\beta = -0.181$; $t = 1.980$; $p = 0.024$). This finding indicates that the more individuals focus on conventional business opportunities, the less likely they are to engage in green entrepreneurship. This condition reflects a conflict between short-term economic orientation and sustainability motivation, which demands the integration of social and ecological values in accordance with the triple bottom line principle. Theoretically, these results challenge the common view that the ability to recognize opportunities always has a positive impact on entrepreneurial outcomes, because in the context of sustainability, the evaluation of opportunities cannot be based solely on economic potential but must also consider social and environmental aspects. The results of this study contradict most green entrepreneurship studies that emphasize the synergy between business opportunities and sustainability. Wicaksono (2025) asserts that green entrepreneurship can generate economic profits and environmental benefits through the use of eco-innovation and circular economy principles, so that green opportunities can actually be a source of sustainable competitive advantage. However, the study by Zein et al. (2024) supports this finding by emphasizing the need for value, ethical, and environmental regulatory interventions to overcome the dominance of short-term economic orientation, which can hinder sustainable entrepreneurial intentions. Thus, this study enriches the theoretical discourse by showing that an orientation towards conventional opportunities can be an obstacle to green entrepreneurial intentions and emphasizes the importance of reorienting the paradigm of opportunity recognition to be in line with the triple bottom line principle, so that business opportunities are not only oriented towards material profits but also reflect social responsibility and environmental integrity.

Hypotheses 7 and 8 show a significant positive effect with coefficients $\beta = 0.442$ ($t = 11.817$; $p < 0.001$) and $\beta = 0.306$ ($t = 3.579$; $p < 0.001$). These findings confirm that the greater an individual's intention to engage in environmentally friendly entrepreneurship, the greater the likelihood of their involvement in sustainable green entrepreneurship education. These results are in line with the research by Makuya & Changalima (2024) and Rahmanto et al. (2024), which shows that green entrepreneurial intention encourages participation in sustainable entrepreneurship education. Theoretically, these findings are consistent with the Theory of Planned Behavior, which states that intention is the strongest predictor of actual behavior. In the context of education, these results indicate that green entrepreneurship education programs will be more effective if they target individuals who already have a basic intention to engage in green entrepreneurship. However, this also means that educational institutions have a responsibility to foster this intention first through awareness campaigns and values education.

The results of Hypothesis 9 and 10 testing show a significant positive effect of EO on GEI ($\beta = 0.473$; $t = 8.035$; $p < 0.001$) and on PKB ($\beta = 0.128$; $t = 2.441$; $p = 0.007$). These findings confirm that individuals with a high entrepreneurial orientation tend to be more courageous in starting businesses with sustainable and environmentally friendly values. The results of this study are in line with Nuringsih et al. (2022), Mursyidah et al. (2023), and Ediagbonya (2024), which show that green entrepreneurial orientation has a positive effect on sustainable performance and green entrepreneurial intention. Conceptually, these findings indicate that the characteristics of entrepreneurial orientation, namely innovation, proactivity, and risk-taking, can be directed toward sustainability goals. This implies that the development of entrepreneurial orientation must be accompanied by the internalization of environmental values so that entrepreneurial orientation does not only focus on profit maximization but also on sustainable value creation.

This study makes an important theoretical contribution by developing an integrative model of Green Entrepreneurship Education that links classical entrepreneurship constructs with sustainability orientation, while enriching the literature on green entrepreneurship education. The results also validate the mediating role of green entrepreneurial intention as the main link between antecedent factors and sustainable learning outcomes, supporting the Theory of Planned Behavior in the context of green entrepreneurship. Furthermore, the finding regarding the negative influence of Opportunity Entrepreneurial on green entrepreneurial intention opens up a new perspective on the potential conflict between opportunity and sustainability orientations, while the strengthening of the role of self-efficacy emphasizes the importance of psychological mechanisms in transforming education into intention and action, in line with Social Cognitive Theory. Practically, these research results encourage the need for curriculum design that integrates sustainability values comprehensively in entrepreneurship learning in vocational schools. Experiential learning approaches such as project-based learning, business simulation, and real-world projects need to be strengthened to build self-efficacy and green entrepreneurial orientation. In addition, educational institutions are expected to develop a supportive ecosystem through green incubators, partnerships with green industries, and access to green mentors. However, this study has several limitations, including the use of a cross-sectional design that limits causal conclusions, as well as limitations in generalization because the sample only covers vocational schools in East Java. Furthermore, the use of a single questionnaire has the potential to cause common method bias, and external factors such as policy, institutional support, and macroeconomic conditions have not been fully accommodated.

CONCLUSION

This study produced a conceptual and empirical model of Sustainable Green Entrepreneurship Education (SGEE) which shows that all variables tested, namely Entrepreneurial Education (EE), Entrepreneurial Self-Efficacy (ESE), Opportunity Entrepreneurial (OE), Entrepreneurial Orientation (EO), and Green Entrepreneurial Intention (GEI) have a significant and mutually reinforcing influence in shaping a sustainability-oriented entrepreneurship education system. EE has been proven to be a determining factor in increasing self-efficacy, orientation, and green entrepreneurial intention, in line with the Theory of Planned Behavior framework. ESE plays an important role as a psychological driver that increases the ability to recognize green opportunities and fosters sustainable entrepreneurial intentions, while OE and EO contribute directly to the formation of intentions and the implementation of green entrepreneurship education in the school environment. GEI is the main mediating variable that connects educational, psychological, and contextual factors in the development of the PKB system. The resulting model has high explanatory power ($R^2 = 0.742$; $Q^2 = 0.611$) and is empirically validated, indicating that the integration of EE, ESE, OE, and EO through GEI mediation is capable of describing the dynamics of sustainable green entrepreneurship education in vocational schools. Overall, this model provides theoretical and practical contributions in strengthening the implementation of adaptive environmental vocational education in response to green economy demands and supports the transformation of schools towards sustainable green schools.

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