

Research Article

The Effect of Digital Marketing, E-Commerce, and Entrepreneurship Education (As Moderating Variables) on the Interest in Entrepreneurship Among Students of State Vocational Schools in Malinau Regency

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Abstract: This study analyzes the influence of Digital Marketing, E-Commerce, and Entrepreneurship Education on the entrepreneurial interest of vocational high school students in Malinau Regency and the moderating role of Entrepreneurship Education. The research method used a quantitative ex post facto approach with PLS-SEM analysis through SmartPLS 4.0 on 261 respondents in grade XII. The results show that Digital Marketing has a positive and significant effect on Entrepreneurial Interest, while E-Commerce has a positive but insignificant effect. Entrepreneurship Education has the strongest and most significant effect on Entrepreneurial Interest. Entrepreneurship Education negatively moderates the relationship of Digital Marketing, but positively and significantly strengthens the effect of E-Commerce on Entrepreneurial Interest. These findings emphasize the importance of practice-based entrepreneurship education and the integration of digital skills in enhancing students' entrepreneurial interest in the digital era.

Keywords: Digital Marketing; E-Commerce; Entrepreneurial Interest; Entrepreneurship Education; Vocational High School

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1. Introduction

The development of digital technology has changed various aspects of life, including the world of entrepreneurship. Digitalization provides great opportunities through easy market access, cost efficiency, and accelerated business processes through digital marketing and e-commerce (Chaffey & Ellis-Chadwick, 2019; Laudon & Traver, 2020). This phenomenon is also occurring in Malinau Regency, North Kalimantan, which has seen a 66.36% increase in internet access among the population (BPS Kalimantan Utara, 2024). However, the use of digital technology by vocational school students in entrepreneurship is still low, as seen in the results of a tracer study which shows that only about 23% of graduates are entrepreneurs.

Vocational schools, as vocational education institutions, have a strategic role in fostering entrepreneurial interest through entrepreneurship education that is adaptive to the digital era (Handayati et al., 2020). Unfortunately, the application of technology-based learning in the field of entrepreneurship is still not optimal and tends to be theoretical (Novita & Nuriadin, 2023). In fact, the integration of digital marketing and e-commerce in entrepreneurship learning has been proven to increase students' self-efficacy and interest in entrepreneurship (Bachmann et al., 2024). Therefore, it is important to examine the influence of digital marketing, e-commerce, and entrepreneurship education on the entrepreneurial interest of

vocational high school students in Malinau Regency, as well as to test the role of entrepreneurship education as a moderating variable that can strengthen the relationship between these variables.

The rapid advancement of digital technology has profoundly transformed the landscape of global entrepreneurship, redefining how individuals identify, create, and exploit business opportunities. Digital marketing has emerged as a crucial instrument that enables aspiring entrepreneurs to reach broader audiences, personalize consumer interactions, and efficiently analyze market behavior through data-driven strategies. This transformation has created both opportunities and challenges for young individuals, especially students, who are expected to possess digital competence and an entrepreneurial mindset simultaneously (Usman, et al. 2024).

E-commerce has equally revolutionized the entrepreneurial ecosystem, opening vast possibilities for small and medium enterprises to engage in commercial activities without traditional physical limitations. The growing accessibility of online platforms allows students and young entrepreneurs to explore business ideas, manage transactions, and establish brand visibility even at an early stage of their entrepreneurial journey. However, despite its accessibility, the potential of e-commerce remains underutilized in several educational settings where practical exposure and experiential learning are limited.

Entrepreneurship education has long been recognized as a vital component in shaping students' entrepreneurial intentions, attitudes, and competencies. Through structured learning, it provides the theoretical understanding and practical experience necessary to cultivate self-efficacy, risk-taking behavior, and innovative thinking. In vocational schools, entrepreneurship education is expected to go beyond traditional classroom instruction and focus on hands-on learning that simulates real business environments.

In Malinau Regency, a region characterized by its developing economic infrastructure and emerging digital initiatives, the role of vocational education becomes central to local empowerment. State vocational schools are entrusted with the mission of preparing students not only to be job seekers but also to be job creators capable of leveraging technology for innovation (Rongmin, & Fah, 2024). Yet, the implementation of entrepreneurship programs often encounters barriers related to limited resources, insufficient industry collaboration, and uneven access to digital technology.

Digital marketing functions as a bridge connecting entrepreneurial creativity with real market demands, empowering individuals to craft strategies that resonate with consumer behavior. Its integration into vocational learning can enhance students' ability to understand audience segmentation, branding, and digital communication, skills indispensable for launching sustainable businesses. Yet, many students still lack adequate exposure to these concepts due to the absence of structured digital marketing modules within their curriculum.

E-commerce education, when effectively combined with digital marketing knowledge, can accelerate students' capacity to transform business ideas into operational ventures. The ability to navigate online marketplaces, manage digital transactions, and utilize social commerce platforms enables students to experience the entrepreneurial process firsthand.

Entrepreneurship education also plays a moderating role in shaping how digital marketing and e-commerce influence students' entrepreneurial interest. When delivered effectively, it enhances cognitive and emotional readiness, guiding students to apply digital knowledge within an entrepreneurial framework.

The interplay between digital literacy, entrepreneurial learning, and technological access forms a crucial foundation for economic sustainability in rural and developing areas. Malinau Regency, with its growing investment in education and digital infrastructure, stands at a pivotal stage to harness this potential. Empowering vocational students through

comprehensive entrepreneurship education can significantly influence local economic development and employment creation.

2. Preliminaries or Related Work or Literature Review

Interest in Entrepreneurship

Interest in entrepreneurship is a psychological drive that fosters an individual's desire to start and develop a business independently (Shahab et al., 2019; Gultom, 2021). Based on the Theory of Planned Behavior (Ajzen, 1991), this interest is influenced by attitudes, subjective norms, and perceived behavioral control (Tseng et al., 2022). In addition, perceptions of the ease and usefulness of digital marketing and e-commerce technologies also strengthen entrepreneurial intent in the digital era (Che Nawi et al., 2022; Tong & Xiong, 2022).

Digital Marketing

Digital marketing is the use of digital technology in marketing strategies to effectively reach and engage consumers (Nishikawa, 2021; Suparno et al., 2023). Through media such as websites, social media, email, and other online platforms, digital marketing enables companies to promote products in real-time and on a wide scale (Chaffey & Ellis-Chadwick, 2019; Anggana, 2022). The main objective is to attract consumers' attention in a fast, efficient, and interactive manner (Kim et al., 2021). The advantages of digital marketing include speed of dissemination, ease of analysis, wide reach, cost efficiency, and increased brand awareness (Ardani, 2022). Thus, digital marketing has become a key element in modern technology-based marketing strategies.

E-Commerce

E-commerce is the process of buying and selling goods and services through electronic media, especially the internet, supported by information and communication technology (Qin et al., 2022; Gultom, 2021). The development of e-commerce is influenced by changes in consumer behavior, technological advances, and logistics efficiency (Tolstoy et al., 2022; Yuwono et al., 2022). Through digital platforms, businesses and consumers can interact directly, without time and geographical constraints, thereby increasing efficiency and market reach. E-commerce also provides transaction flexibility, ease of access, and broader and more cost-effective marketing opportunities. Thus, e-commerce has become an important part of digital transformation and modern business strategies in the global era.

Entrepreneurship Education

Entrepreneurship education is the process of nurturing and training students to have entrepreneurial knowledge, attitudes, and skills (Tanumihardja & Slamet, 2023). This education fosters creativity, innovation, and independence to shape a strong entrepreneurial character (Akhter et al., 2022). In the digital age, entrepreneurship education adapts through digital marketing and e-commerce to increase interest in entrepreneurship (Nguyen & Nguyen, 2024). Thus, entrepreneurship education plays an important role in producing globally adaptive and competent entrepreneurs.

Vocational High School (SMK)

Vocational High School (SMK) is a formal secondary education institution that focuses on developing work competencies in line with industry needs (Astuti et al., 2023; Sari & Rafiqah, 2024). Based on Law No. 20 of 2003, vocational education aims to equip students to be productive, independent, and ready to work in their respective fields of expertise. In addition, SMK also instills the values of professionalism, creativity, and social responsibility to develop a skilled workforce that is able to adapt to technological developments and the modern world of work.

3. Materials and Method

This study is a quantitative study with an ex post facto approach involving 12th grade students of public vocational schools in Malinau Regency (Fauzi, 2020). Data analysis used the Structural Equation Modeling (SEM) method to test the direct and indirect effects between exogenous and endogenous variables (Fawaid et al., 2022).

Data were obtained through questionnaires distributed to respondents. The research was conducted at three public vocational schools in Malinau Regency, namely SMK N 1 Malinau, SMK N 2 Malinau, and SMK N SPP Malinau, from June 21 to 30, 2025. The research population consisted of 261 students who had taken entrepreneurship, digital marketing, and e-commerce courses, with the following details: SMK N 1 Malinau (57 students), SMK N 2 Malinau (174 students), and SMK N SPP Malinau (30 students).

4. Results and Discussion

Hypothesis testing using bootstrapping in SmartPLS 4.0 to measure the significance of the relationship between variables. The analysis produced t-statistic values, p-values, and path coefficients. The results showed the direction and strength of the influence of independent variables on dependent variables that were empirically significant.

Direct Effect

Direct effects were analyzed to examine the contribution of Digital Marketing (X1), E-Commerce (X2), and Entrepreneurship Education (Z) to Entrepreneurial Interest (Y) without mediating variables. The analysis was conducted using bootstrapping in SmartPLS 4.0.

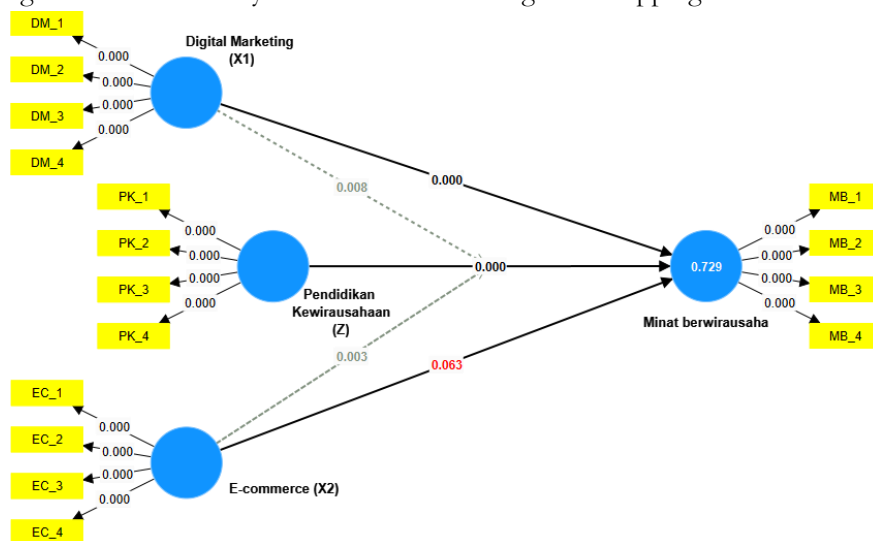


Figure 1. Bootstrapping Output Model PLS SEM Algorithm.

Table 1. Bootstrapping Path Coefficient Results for Direct Effects.

Hypothesis	Path Coefficient	Original Sample (O)	Sample Mean (M)	Standard Deviation (Stdev)	T Statistics (O/Stdev)	P Values	Notes
H1	Digital Marketing (X1) → Interest in entrepreneurship	0.379	0.386	0.063	6.057	0.000	Proven
H2	E-commerce (X2) → Interest in entrepreneurship	0.094	0.088	0.062	1.526	0.063	Not Proven
H3	Entrepreneurship Education (Z) → Interest in Entrepreneurship	0.441	0.440	0.049	8.909	0.000	Proven
H4	Digital Marketing (X1) x Entrepreneurship Education (Z) → Interest in Entrepreneurship	-0.131	-0.132	0.054	2.420	0.008	Proven
H5	E-commerce (X2) x Entrepreneurship Education (Z) → Interest in Entrepreneurship	0.119	0.121	0.043	2.754	0.003	Proven

Source: Smart PLS 4.0 (2025).

Based on the results of SmartPLS 4.0 bootstrapping, the following description of the relationship between latent variables in the model and its interpretation was obtained.

Hypothesis 1: The test results show that Digital Marketing (X1) has a positive and significant effect on Entrepreneurial Interest (Y), with a coefficient of 0.379, a t-statistic value of $6.057 > 1.96$, and a p-value of $0.000 < 0.05$. This finding indicates that increased use of digital marketing by students can encourage an increase in entrepreneurial interest. Thus, the first hypothesis (H1) is proven and accepted as significant.

Hypothesis 2: The analysis results show that E-Commerce (X2) has a positive but insignificant effect on Entrepreneurial Interest (Y), with a coefficient of 0.094, $t = 1.526$, and $p = 0.063 > 0.05$. This means that H2 is not proven, so e-commerce activities do not yet have a strong effect on increasing students' interest in entrepreneurship.

Hypothesis 3: The results show that Entrepreneurship Education (Z) has a positive and significant effect on Entrepreneurial Interest (Y), with a coefficient of 0.441, $t = 8.909$, and $p = 0.000 < 0.05$. This means that entrepreneurship education plays an important role in increasing students' entrepreneurial interest, so H3 is accepted.

Hypothesis 4: The results are significant with a coefficient of -0.131, t-statistic of 2.420, and p-value of 0.008. These results indicate that Entrepreneurship Education negatively moderates the relationship between Digital Marketing and Entrepreneurial Interest, meaning that an increase in entrepreneurship education can actually weaken the influence of digital marketing on students' entrepreneurial interest.

Hypothesis 5: The results proved significant with a coefficient of 0.119, t-statistic of 2.754, and p-value of 0.003. These results indicate that Entrepreneurship Education positively moderates the relationship between E-Commerce and Interest in Entrepreneurship, so that the influence of E-Commerce becomes stronger when moderated by Entrepreneurship Education.

Indirect Influence

An indirect effect analysis was conducted to examine the extent to which Digital Marketing (X1) and E-Commerce (X2) influence Entrepreneurial Interest (Y) through Entrepreneurship Education (Z) as a moderator variable. The test was conducted using the bootstrapping method in SmartPLS 4.0 to determine the significance of the mediating effect in the structural model.

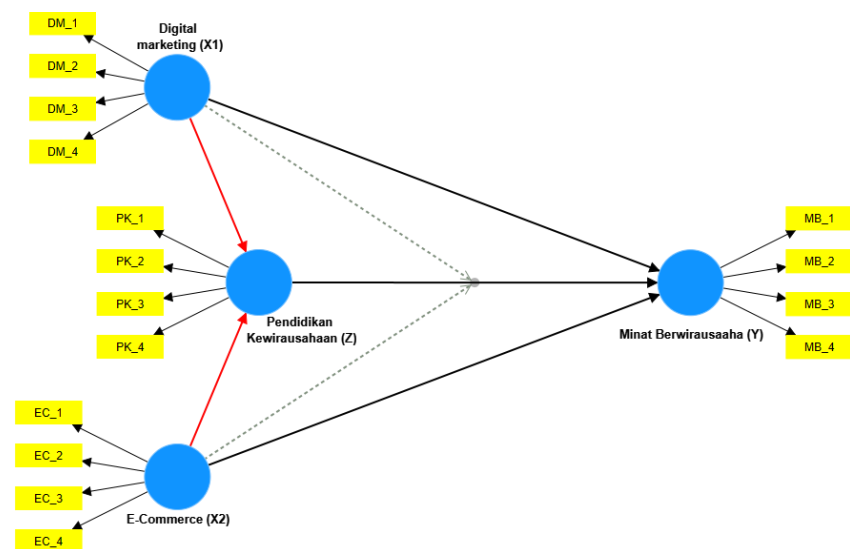


Figure 2. PLS SEM Algorithm Model After Adding Mediation Path (red).

After adding the mediation path, bootstrapping testing was conducted in SmartPLS 4.0 to see changes in the strength of the relationship between variables. The analysis results show the coefficient values, t-statistics, and p-values, with significance criteria if the t-statistics > 1.96 and p-value < 0.05 (Hair et al., 2021). The analysis results are as follows:

Table 2. Results of the Bootstrapping Path Coefficient Test for Specific Indirect Effects.

Path Coefficient	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values	Notes
Digital Marketing (X1) → Entrepreneurship Education (Z) → Interest in entrepreneurship	0.319	0.317	0.053	5.996	0.000	Proven
E-commerce (X2) → Entrepreneurship Education (Z) → Interest in entrepreneurship	0.016	0.016	0.050	0.329	0.371	Not proven

Source: Smart PLS 4.0 (2025).

Based on the specific indirect effect results, there are two indirect paths. Digital Marketing (X1) → Entrepreneurship Education (Z) → Interest in Entrepreneurship (Y) shows a coefficient of 0.319, t-statistic of 5.996, and p-value of 0.000, indicating a significant mediating effect. Entrepreneurship Education acts as a mediator and moderator (moderation coefficient -0.131), indicating inconsistent moderation. E-Commerce (X2) → Entrepreneurship Education (Z) → Interest in Entrepreneurship (Y) has a coefficient of 0.016, t-statistic of 0.329, and p-value of 0.371, which is not significant. However, the

moderation effect on the path $X2 \times Z \rightarrow Y$ is significant ($t = 2.758$; $p = 0.003$), indicating that Entrepreneurship Education plays a greater role as a moderator than as a mediator. Overall, these findings confirm that Entrepreneurship Education has a strategic role in strengthening the influence of Digital Marketing and E-Commerce on the entrepreneurial interest of vocational high school students.

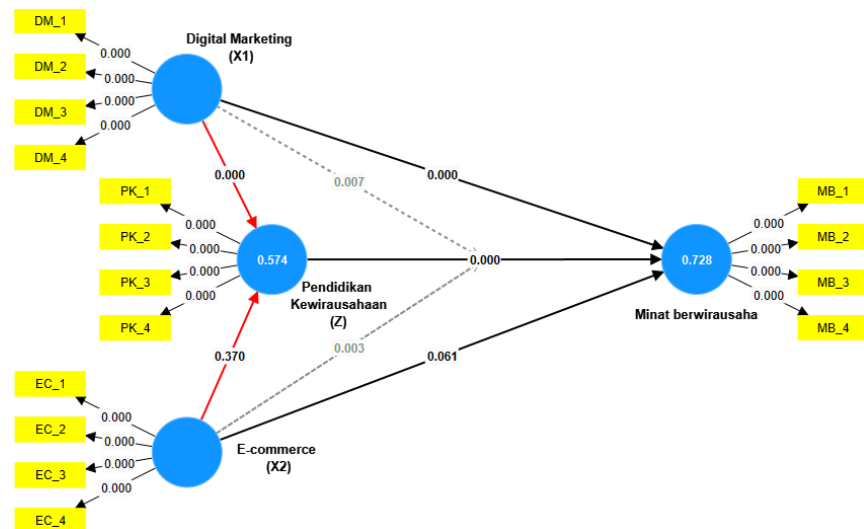


Figure 3. PLS SEM Model Results of Path Coefficient Bootstrapping Specific Indirect Effect Test.

F-Square

F-Square (F^2) is a measure used to assess the relative impact of an influencing variable (exogenous) on the variable it influences (endogenous).

Table 3. Path Coefficient Test Results - F-Square (F^2).

Variable	Digital marketing (X1)	E-Commerce (X2)	Entrepreneurship Education (Z)	Interest in Entrepreneurship (Y)	Note
Digital marketing (X1)				0.114	Moderate Effect
E-Commerce (X2)				0.010	Small Effect
Entrepreneurship Education (Z)				0.279	Strong Effect
Digital marketing (X1) x Entrepreneurship Education (Z)				0.022	Moderate Effect
E-Commerce (X2) x Entrepreneurship Education (Z)				0.027	Moderate Effect

Source: Smart PLS 4.0 (2025).

Based on the test results, the following interpretation can be made. (1) Digital Marketing (X1), Digital Marketing (X1) $\rightarrow$ Interest in Entrepreneurship (Y) with a value of $f^2 = 0.114$ indicates that the Digital Marketing variable has a small effect on Interest in Entrepreneurship. (2) E-Commerce (X2), E-Commerce (X2) $\rightarrow$ Interest in Entrepreneurship (Y) has a value of $f^2 = 0.010$, which means that E-commerce has a very small or insignificant effect, because the value is below 0.02 and the results can be ignored. (3) Entrepreneurship Education (Z), Entrepreneurship Education (Z) $\rightarrow$ Interest in Entrepreneurship (Y) has a value of $f^2 = 0.279$, which means that the Entrepreneurship Education variable has a moderate effect on Interest in Entrepreneurship directly. (4) Entrepreneurship Education (Z) as a moderator of Digital Marketing, the final path is the interaction between Digital Marketing (X1) $\times$ Entrepreneurship Education (Z) $\rightarrow$ Entrepreneurial Interest (Y), which has an f^2 test value of 0.022. This indicates that it also has a small effect, showing that Entrepreneurship Education moderates the effect of Digital Marketing on Entrepreneurial Interest. (5) Entrepreneurship Education (Z) as a moderator of E-Commerce (X2), next, the path of the E-Commerce (X2) $\times$ Entrepreneurship Education (Z) $\rightarrow$ Entrepreneurial Interest

(Y) construct has a test value of $f^2 = 0.027$, which means a small but significant effect as a moderating effect.

In conclusion, Entrepreneurship Education (Z) has the strongest contribution to Entrepreneurial Interest (Y) ($f^2 = 0.279$). Digital Marketing (X1) has a small but significant effect, while E-Commerce (X2) has a very small and almost insignificant effect. Both moderating effects show a small but important influence in explaining the role of Entrepreneurship Education as a moderator.

Predictive Relevance (Q^2)

Predictive Relevance (Q^2) measures the predictive ability of the model, where a Q^2 value > 0 indicates predictive relevance. According to Hair et al. (2019) and Fornell & Cha (1994), a model has predictive relevance to endogenous constructs if $Q^2 > 0$, with criteria: 0 (small), 0.25 (medium), and 0.50 (large) (Hair et al., 2019).

Table 4. Predictive Relevance (Q^2).

Variable	Q^2_{predict}	Description
Interest in entrepreneurship	0.718	High/Strong Predictive

A Q^2 value of 0.718 indicates that the model has very strong predictive power. This confirms that the PLS-SEM model has high predictive relevance and good structural validity in explaining the contribution of Digital Marketing, E-Commerce, and Entrepreneurship Education to the entrepreneurial interest of vocational high school students in Malinau Regency.

The Effect of Digital Marketing on the Entrepreneurial Interest of Vocational High School Students in Malinau Regency

The results show that Digital Marketing (X1) has a positive and significant effect on Entrepreneurial Interest (Y) ($\beta = 0.379$; $t = 5.933$; $p = 0.000$), thus accepting H1. This finding is in line with the Theory of Planned Behavior (Ajzen, 2020) and the Technology Acceptance Model (Schorr, 2023), which confirm that positive perceptions of technology and digital marketing increase entrepreneurial intent. Previous studies (Bachmann et al., 2024; Wibowo et al., 2023; Kingsnorth, 2019) also show that digital competence strengthens students' entrepreneurial self-efficacy. Thus, the integration of digital marketing skills in the vocational school curriculum is important for fostering entrepreneurial interest.

The Effect of E-commerce on the Entrepreneurial Interest of Vocational School Students in Malinau Regency

The results show that E-Commerce (X2) has a positive but insignificant effect on Entrepreneurial Interest (Y) ($\beta = 0.094$; $t = 1.509$; $p = 0.066$), so H2 is rejected. This finding indicates that involvement in e-commerce is not sufficient to shape entrepreneurial interest without the support of motivation and self-efficacy. These results are in line with the Theory of Planned Behavior (Ajzen, 2020) and TAM (Mir et al., 2023), which emphasize the importance of internal factors and perceptions of technology. Research by Putri & Wardana (2023) and Gultom (2021) also found that e-commerce does not significantly influence entrepreneurial intent.

The Effect of Entrepreneurship Education on the Interest in Entrepreneurship of Vocational High School Students in Malinau Regency

The results show that Entrepreneurship Education (Z) has the strongest and most significant effect on Interest in Entrepreneurship (Y) ($\beta = 0.441$; $t = 8.923$; $p = 0.000$). This means that the better the entrepreneurship education, the higher the students' interest in entrepreneurship. This finding is in line with Sun et al. (2023) and Gao & Qin (2022), who confirm that entrepreneurship education increases entrepreneurial mindset and entrepreneurial intention. Research by Anjum et al. (2023), Nguyen & Nguyen (2023), and Dinis (2024) also shows that entrepreneurship education builds skills, confidence, and attraction to entrepreneurship. This reinforces the Theory of Planned Behavior (Ajzen, 2020),

which emphasizes the importance of education in shaping entrepreneurial attitudes and intentions.

Entrepreneurship Education Moderates the Influence of Digital Marketing on the Entrepreneurial Interest of Vocational High School Students in Malinau Regency

The results show that the interaction between Digital Marketing (X1) and Entrepreneurship Education (Z) has a significant but negative effect on Entrepreneurial Interest (Y) ($\beta = -0.131$; $t = 2.403$; $p = 0.008$). This means that entrepreneurship education can weaken the influence of digital marketing on entrepreneurial interest. This is in line with TPB (Ajzen, 2020; Tseng et al., 2022) and the findings of Dinis (2024) and Chang et al. (2025), which confirm that an overly theoretical approach to entrepreneurship education reduces the effectiveness of digital marketing. Therefore, an experiential learning-based curriculum that integrates digital marketing practices is needed.

Entrepreneurship Education Moderates the Influence of E-commerce on the Entrepreneurial Interest of Vocational High School Students in Malinau Regency

The results of the study indicate that Entrepreneurship Education positively and significantly moderates the relationship between E-Commerce and Entrepreneurial Interest ($\beta = 0.119$; $t = 2.758$; $p = 0.003$). This means that although E-Commerce does not have a direct effect, its influence becomes significant when combined with entrepreneurship education. This finding is in line with Chang et al. (2025) and Che Nawi et al. (2022), who emphasize the importance of perceptions of technological usefulness in encouraging entrepreneurial intent, as well as Fauzi et al. (2025), who show that the adoption of e-commerce increases students' entrepreneurial self-efficacy. Thus, the synergy between the entrepreneurship curriculum and digital practices such as e-commerce is important for shaping young digital-based entrepreneurs.

5. Conclusion

Based on the results of the study, it can be concluded that digital marketing has a positive and significant effect on entrepreneurial interest, demonstrating the importance of understanding digital technology in building entrepreneurial intent. Meanwhile, e-commerce has a positive but insignificant effect on entrepreneurial interest without the support of experience and self-confidence. Entrepreneurship education has the strongest and most significant influence in shaping students' knowledge, attitudes, and entrepreneurial intentions. In addition, entrepreneurship education has been proven to negatively moderate the relationship between digital marketing and entrepreneurial interest, especially if the learning is too theoretical, but it positively moderates the relationship between e-commerce and entrepreneurial interest, which confirms the importance of applied learning in supporting digital entrepreneurship.

Based on these findings, it is recommended that vocational schools in Malinau Regency integrate digital marketing and e-commerce into their practice-based entrepreneurship curriculum. Entrepreneurship education needs to be conducted in an applied manner through online store projects, digital content training, and collaboration with local businesses. Teachers also need to receive ongoing training and establish cooperation with the digital industry and national e-commerce platforms. Additionally, the government and schools are expected to provide adequate digital business facilities and internet access to support digital entrepreneurship practices. Further research is recommended to expand the scope of study or add other variables such as creativity, self-efficacy, and the role of family.

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