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AI-Based Digital Start-up Model through MSME Innovation, Digital Marketing Capabilities, Towards Creative Economy Competitiveness

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Abstract

Purpose: This study aims to develop an AI-based digital start-up transformation model by examining the roles of technological literacy, student creativity, MSME innovation, and digital capability in enhancing competitiveness in Indonesia's creative economy.

Research Methodology: A quantitative approach using Structural Equation Modeling (SEM) with SmartPLS was applied. Data were collected from 350 respondents, including students, MSME actors, and digital start-up entrepreneurs, to evaluate the relationships between key constructs.

Results: The results show that technological literacy, student creativity, and MSME innovation have positive and significant effects on creative economy competitiveness. Digital capability serves as a strategic enabler that integrates digital resources and processes to improve productivity and innovation. Significant path coefficients were found for all proposed relationships, with technology literacy having the strongest effect on competitiveness.

Conclusions: AI-based digital transformation plays a strategic role in strengthening the innovation ecosystem, improving operational efficiency, and enhancing competitive advantages in Indonesia's creative economy sector. The integration of literacy, creativity, innovation, and digital capabilities forms a sustainable competitive framework.

Limitations: This study is limited to the Indonesian creative economy, which may restrict its generalizability to other countries. Additionally, the cross-sectional design limited our ability to capture long-term transformation dynamics.

Contributions: This study makes a significant theoretical contribution to the digital transformation and competitive advantage literature by integrating perspectives on technology literacy, creativity, and innovation in AI-based digital startups. It advances understanding of how these elements drive competitive advantage in the creative economy.

Keywords: *Creative Economy Competitiveness, Digital Capability, MSME Innovation, Student Creativity, Technology Literacy*

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1. Introduction

Digital transformation has become the primary driver of modern economic development, serving as the foundation for the growth of digital startups in Indonesia. The rapid advancement of technological innovations, especially the adoption of Artificial Intelligence (AI), has compelled organizations,

students, and MSMEs to enhance their digital capabilities to remain competitive in the dynamic ecosystem of the creative economy (Fatimah & Puspitasari, 2026; Novela et al., 2024; Senduk, Pongayouw, & Mokoginta, 2025). In this digital era, AI serves not only as an operational tool but also as a catalyst for innovation, influencing business models, creativity, and overall competitiveness, particularly in the creative economy sector, which is inherently dependent on both creativity and technology (Anantrasirichai & Bull, 2022; Machucho & Ortiz, 2025). Strengthening technological literacy, innovation, and digital capabilities is crucial for designing adaptive, sustainable digital start-up transformation models (Mulyantini, Surbakti, Maulana, & Wibawaningsih, 2025; Nworie, Onochie, & Nwakoby, 2025; Vedy, Vedy, & Rahayu, 2025).

Technological literacy has emerged as an essential skill that individuals must possess to engage effectively with the digital economy. For digital start-ups, technology literacy is a pivotal factor in creating digital solutions, utilizing data, and optimizing technology platforms (Husnah, Winarno, & Wardana, 2025; Swandani, 2025). Those with higher technological literacy are better positioned to leverage AI to enhance productivity and operational efficiency, a trend supported by research indicating the positive impact of digital literacy on the innovation capabilities and business performance of MSMEs (Michael; Novela et al., 2024; Romadayanti, Setiawan, & Azakia, 2026).

In addition to technological literacy, student creativity plays a vital role in the startup ecosystem. As agents of change, students possess a high level of exploratory ability, making them valuable innovators capable of generating ideas that can be converted into successful digital business models (Tan & Widjaja, 2024). Creativity is central to providing value addition and differentiation, which are key components that bolster the competitiveness of the creative economy sector (Lasmiatun & Zulfikri, 2025). Creativity enables the design of innovative solutions and digital products that directly address market requirements. MSME innovation is crucial in the digital transformation process. MSMEs drive the Indonesian economy and are integral to the creative economy's value chain. Innovations in processes, products, and marketing techniques enable MSMEs to adapt to market changes, embrace digital technologies, and remain competitive in the market. According to M. R. A. Pradana, Parela, and Putra (2024), creativity enables the design of innovative solutions and digital products that directly address market needs.

MSME innovation is crucial in the digital transformation process. MSMEs drive the Indonesian economy and are integral to the creative economy's value chain. Innovations in processes, products, and marketing techniques enable MSMEs to adapt to market changes, embrace digital technologies, and remain competitive in the market. According to Swandani ((Swandani, 2025), higher digital capabilities open significant opportunities for start-ups and MSMEs to adopt AI, which can improve productivity and foster competitive advantages. Previous studies (Istikomah, Maulana, Susilawati, & Muchsam, 2026; Lasmiatun & Zulfikri, 2025) demonstrate that strong digital capabilities serve as predictors of enhanced competitiveness in the creative economy, particularly in an era driven by AI and digitalization.

The competitiveness of the creative economy is fundamentally tied to the integration of creativity, technology, innovation and digitalization. The sector's continued growth and its significant contribution to Indonesia's Gross Domestic Product (GDP) are propelled by digital start-ups leveraging AI (Kurnianingsih, 2025; Purnamasari, Zainuddin, Sufnirayanti, & Wifasari, 2025). However, challenges persist, such as uneven technological literacy, low levels of MSME innovation, and insufficient digital capabilities, which hinder many economic actors. This gap highlights the urgency of a comprehensive transformation model that integrates these critical elements to enhance competitiveness and build a robust AI-based digital startup ecosystem. Based on these conditions, this study aims to design a digital start-up transformation model based on AI by strengthening technology literacy, student creativity, MSME innovation, digital capabilities, and creative economy competitiveness in the learning process. This study is expected to contribute theoretically to the development of digital transformation models in the AI era and provide practical implications for students, MSMEs, start-up developers, and government policymakers to foster a more advanced and competitive creative-economy ecosystem.

While prior studies have explored elements such as technology literacy, creativity, and innovation separately, there remains a significant research gap in integrating technology literacy, student creativity, MSME innovation, and digital capability into a single Structural Equation Model (SEM). Previous research has addressed these components individually, but no prior study has explored their combined impact on the competitiveness of the creative economy using an AI-driven transformation model. This lack of integration has limited the development of comprehensive frameworks that consider the interconnectedness of these elements in enhancing the overall digital startup ecosystem. Furthermore, existing studies focus on specific sectors or regions, often ignoring a holistic view of how these factors work together to foster sustainable transformation in the creative economy. The urgency of addressing this gap lies in the need to create a model that incorporates all four elements, offering a comprehensive solution that can be applied across Indonesia's creative economy, particularly in the context of AI-driven digital transformation. This model is vital for fostering a more resilient and competitive creative economy.

This study aims to develop an AI-based digital start-up transformation model by integrating four critical factors: technological literacy, creativity, MSME innovation, and digital capabilities. The specific objectives of this study are as follows:

1. To design a comprehensive AI-based digital start-up transformation model that incorporates technology literacy, student creativity, MSME innovation, and digital capabilities.
2. To test the relationships between these factors and their impact on creative economy competitiveness using Structural Equation Modeling (SEM).

The following hypotheses were tested:

H_1: The higher the level of Technology Literacy (X_1), the greater the competitiveness of the Creative Economy (Y).

H_2: The higher the level of Student Creativity (X_2), the greater the competitiveness of the Creative Economy (Y).

H_3: The higher the level of MSME Innovation (X_3), the greater the competitiveness of the Creative Economy (Y).

By addressing these objectives, this study seeks to fill the gap in the existing literature and provide actionable insights that can guide policymakers, MSMEs, students, and digital start-ups in strengthening Indonesia's creative economy ecosystem through AI-driven digital transformation.

2. Literature Review and Hypothesis Development

2.1 Technology Literacy

Technological literacy refers to the ability to effectively use, understand, and manage technology to solve problems and create innovations. In the context of digital start-ups, technological literacy is essential for individuals to harness technological tools effectively, whether for product development, process improvement, or strategic decision-making. Lubis et al. (2024) describes technology literacy as part of ICT literacy that falls under the category of inter-literacy perspectives, which includes the ability to use ICT as an integral part of basic literacy. Basic literacy includes the perspective of fundamental ICT knowledge, such as understanding computer concepts and theoretical principles, information systems, digital information, algorithmic thinking and programming, technology limitations, and social impacts, as well as basic ICT skills, such as the ability to use tools, such as word processors and spreadsheets.

According to the National Academy of Engineering and National Research Council, technology literacy is an understanding of technology at a level that allows for effective use, consisting of three main components: knowledge, skills, critical thinking, and decision-making. Based on these definitions, technology literacy can be understood as the ability to encompass aspects of scientific knowledge, critical thinking, and decision-making to effectively utilize human-made technologies and innovations. Technological literacy supports digital entrepreneurs in leveraging AI, big data, and other advanced digital tools to create competitive advantages. For the creative economy, this means that MSMEs and students can effectively harness digital technologies to create innovative content, optimize business

operations, and reach broader audiences. A high level of technological literacy can significantly enhance the ability of start-ups to integrate AI into their products and services, thus fostering a competitive advantage in the digital economy.

2.2 Creativity Theory

Creativity plays a central role in the success of startups, particularly in the creative economy. It involves generating novel and valuable ideas and is a key driver of innovation, allowing businesses to differentiate themselves in the market. In the digital economy, creativity enables the development of unique digital products and services that meet consumers' ever-evolving needs. Widjaja et al. (2024) defined creativity as the ability to produce new and useful ideas that contribute to solving problems or enhancing existing solutions. Creativity is crucial in digital startups for generating innovative business models, developing AI-based solutions, and creating marketable products that stand out in a competitive marketplace.

Theories of dynamic capabilities and resource-based view (RBV) further support this by emphasizing that the ability to adapt and create unique resources, such as intellectual property or technological innovations, is essential for gaining sustainable competitive advantage (Teece, Pisano, & Shuen, 1997). In the creative economy, students, as future entrepreneurs, leverage their creativity to explore new opportunities, develop products, and navigate rapidly changing technological landscapes. Lasmiatun and Zulfikri (2025)argue that creativity is vital for differentiation and creating competitive advantages within the creative economy sector, where innovation and original thinking are the bedrock of success.

2.3 Innovation Theory

Innovation is at the heart of business growth, particularly in MSMEs. Innovation in the creative economy can take many forms, including new products, processes, business models, and marketing strategies. MSMEs that engage in continuous innovation are better positioned to adapt to changing market demands, leverage new technologies such as AI, and maintain a competitive edge. Permatasari, Arisanty, Kuswanti, Riady, and Anastasia (2024) argue that innovation is key to creating value-added products, enhancing customer satisfaction, and expanding the market reach. Moreover, innovation is crucial for MSMEs, as they are often the first to experiment with new technologies, such as AI, that can streamline operations and open up new market opportunities.

In the context of AI-driven digital transformation, innovation helps MSMEs adopt new technological platforms, digital business models, and AI tools that enhance operational efficiency and improve customer engagement. According to P. H. Pradana, Agustini, Dantes, and Sudatha (2024), innovation within MSMEs enhances their adaptability, enabling them to respond effectively to shifts in the digital landscape, particularly when using AI to improve product offerings and customer interactions. MSMEs that embrace innovation can unlock new sources of competitive advantage, which is critical for success in the digital transformation era. The integration of AI within these innovations can also contribute to scalability, operational optimization, and the ability to adapt quickly to changes in consumer behavior and market conditions.

2.4 Digital marketing capabilities

Digital marketing capabilities refer to an organization's ability to leverage digital technology to achieve business goals and address challenges in the digital era (Trainor, Andzulis, Rapp, & Agnihotri, 2014). These capabilities include various aspects, such as technology infrastructure, digital skills, data management, and the integration of digital tools and processes into business operations (Kannan, 2017; Verhoef et al., 2021). Digital capabilities play an essential role in improving competitiveness and accelerating business transformation through the utilization of technologies such as artificial intelligence, big data, the Internet of Things (IoT), and various digital devices and applications (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Vial, 2021). Ritter and Pedersen (2020) stressed that optimizing data across various business processes, including logistics and marketing, can improve efficiency while providing strategic insights for companies. Digital capabilities function as dynamic resources that enable organizations to respond quickly and innovatively to market changes.

In the context of the creative economy, digital capability also involves the ability to manage digital marketing tools, social media platforms, and e-commerce channels to reach a global audience and scale the operations. Kannan (2017) highlights that digital marketing capabilities are essential for MSMEs seeking to expand their reach and visibility in a competitive digital landscape. As AI plays a key role in digital marketing, businesses that can leverage AI tools and digital marketing platforms can create more personalized customer experiences, driving greater engagement and loyalty.

2.5 Hypothesis development

2.5.1 The Higher the Level of Technology Literacy (X_1), the Greater the Competitiveness of the Creative Economy (Y)

Technology literacy enables individuals and MSME actors to effectively utilize AI and digital tools, enhancing their ability to innovate, improve productivity, and create competitive advantages in the creative economy. As Swandani (2025) suggests, those with higher technology literacy are more capable of adopting digital platforms, AI, and data-driven decision-making tools, all of which are essential for enhancing the competitiveness of the creative economy. Thus, H2 is proposed:

H_1: The higher the level of Technology Literacy (X_1), the greater the competitiveness of the Creative Economy (Y).

2.5.2 The Higher the Level of Student Creativity (X_2), the Greater the Competitiveness of the Creative Economy (Y)

Student creativity is a critical driver of innovation in creative economies. Creative students bring fresh ideas, innovative designs, and new digital products to the market. Widjaja et al. (2024) highlight that creativity fosters differentiation, product innovation, and market relevance, which are essential for achieving competitiveness in a creative economy. Creative students are crucial for generating innovative ideas required to drive AI-based digital transformation. Thus, H2 is proposed:

H_2: The higher the level of Student Creativity (X_2), the greater the competitiveness of the Creative Economy (Y)

2.5.3 The Higher the Level of MSME Innovation (X_3), the Greater the Competitiveness of the Creative Economy (Y)

Innovation in MSMEs is fundamental to remaining competitive in the digital age. P. H. Pradana et al. (2024) argue that MSMEs that innovate through digital transformation, AI adoption, and new business models are more likely to gain a competitive edge in the market. Innovation within MSMEs not only improves efficiency but also supports creativity and product differentiation, which are key to sustaining competitiveness in the creative economy. Thus, H3 is proposed:

H_3: The higher the level of MSME Innovation (X_3), the greater the competitiveness of the Creative Economy (Y)

3. Research Methodology

3.1 Research Design

This study employed a quantitative research design using a cross-sectional survey to collect data at a single point in time. A structural equation modeling-partial least squares (SEM-PLS) approach was used for data analysis, as it is well suited for exploring complex relationships between multiple latent variables and predicting outcomes (I Ghozali & H Latan, 2015). SEM-PLS is particularly appropriate for this study because it allows for the simultaneous examination of the relationships between technology literacy, student creativity, MSME innovation, and creative economy competitiveness while handling relatively small to medium sample sizes and non-normal data distributions (Hair, 2014).

3.2 Population and Sample

The target population for this study consisted of students, MSME practitioners, and digital start-up entrepreneurs actively involved in Indonesia's creative economy. These groups were selected because they serve as key agents in digital start-up transformation, technology adoption and innovation. Students contribute through creativity, digital experimentation, and start-up ideation, while MSME practitioners and start-up entrepreneurs provide practical experience in entrepreneurial practice and market-oriented

innovation, which is essential for AI-supported digital transformation. Purposive sampling was employed to select respondents who met specific competence criteria.

(1) Active involvement in digital technology use (e.g., digital platforms, social media businesses, e-commerce, or AI tools);
(2) Engagement in creative or innovative activities such as product design, content creation, digital marketing, or start-up projects; and
(3) Knowledge or experience in business, entrepreneurship, or innovation within the creative economy (Creswell & Clark, 2017; Sugiyono, 2013)

The final sample included 350 respondents: 40% students (140), 40% MSME owners (140), and 20% start-up entrepreneurs (70). This exceeds the SEM-PLS guideline of ten times the number of indicators. With four latent constructs—technological literacy, student creativity, MSME innovation, and creative economy competitiveness—comprising 16 indicators, the minimum sample required was 160, ensuring sufficient statistical power and reliable model estimation. This approach captures the perspectives of both emerging and established actors, providing a robust foundation for analysing the interplay between technological literacy, student creativity, MSME innovation, and creative economy competitiveness in the context of an AI-driven digital start-up.

3.3 Data Collection Process

The data for this study were collected through an online survey, which was distributed to the target respondents over four weeks. The online survey platform enabled efficient data collection from respondents across multiple regions, including university students, MSME actors, and digital start-up entrepreneurs. Respondents were provided with an introductory email outlining the purpose of the study and ensuring informed consent. They were assured of confidentiality and voluntary participation in the study. The survey achieved a response rate of 72%, with 350 completed responses out of 500 invitations. This high response rate was attributed to the relevance of the topic and the engagement efforts made through personal outreach and reminder emails during the survey period.

3.4 Data Quality Tests

Several tests were conducted to ensure the validity and reliability of the data.

1. Content Validity: The survey items were reviewed by subject matter experts in the fields of digital transformation, creativity, and MSME development to ensure the relevance and appropriateness of the questions.
2. Construct Validity: The measurement model was evaluated for convergent validity using Average Variance Extracted (AVE) and factor loadings. A factor loading above 0.70 for each indicator and an AVE greater than 0.50 were considered acceptable (Hair et al., 2014). Discriminant validity was assessed using the Fornell-Larcker criterion and cross-loadings, ensuring that each construct was distinct and not highly correlated with the others.
3. Reliability: The internal consistency reliability of the constructs was assessed using Cronbach's Alpha and Composite Reliability (CR). Cronbach's alpha values above 0.60 and CR values above 0.70 indicate reliable constructs.
4. Common Method Bias (CMB): To assess potential common method bias, Harman's single factor test was performed. The results showed that no single factor explained the majority of the variance, suggesting that CMB was not a significant issue in this study (Podsakoff, MacKenzie, & Podsakoff, 2012)

3.5 Operational Definition of Variables

To ensure conceptual clarity and measurement validity, each construct in the AI-based digital startup transformation model was operationalized into observable indicators adapted from recent digital entrepreneurship and innovation literature.

Variables	Definition	Indicators	Scale
Technological Literacy (X_1)	Ability of students and MSME actors to understand, adopt, and utilize digital and AI	Digital platform use, AI tool utilization, digital problem-solving, and data-driven decision	Likert 1–5

	technologies for business and creative activities	ability (Husnah et al., 2025; Lubis et al., 2024)	
Student Creativity (X_2)	Capability to generate original ideas, innovative concepts, and digital-based creative solutions for entrepreneurial activities	Idea originality, creative thinking, innovation orientation, and digital content creatio (Tan & Widjaja, 2024)	Likert 1–5
MSME Innovation (X_3)	Implementation of new or improved products, processes, and digital marketing practices in MSMEs	Product innovation, process innovation, digital marketing innovation, and technology adoption (Lasmiatun & Zulfikri, 2025; P. H. Pradana et al., 2024)	Likert 1–5
Creative Economy Competitiveness (Y)	Ability of creative economy actors to achieve competitive advantage through innovation, differentiation, and digital transformation	Market adaptability, product differentiation, value creation, and competitive positioning (Kurnianingsih, 2025; Purnamasari et al., 2025)	Likert 1–5

These indicators reflect the core dimensions of digital transformation and entrepreneurial competitiveness identified in recent SME and start-up research. Studies have shown that technological capability, innovation, and digital transformation are key determinants of SME competitiveness and performance.

3.6 Data Analysis Technique

The collected data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS version 4.0, following the methodological guidelines by Ghozali and Latan (2015)and contemporary SEM literature. PLS-SEM was selected because it is suitable for predictive and exploratory models involving multiple latent constructs, complex structural relationships, and relatively small-to-medium sample sizes. Additionally, PLS-SEM does not require strict normality and is robust in the context of innovation and entrepreneurship research. The analysis was conducted in three stages.

1. Outer Model Evaluation (Measurement Model)
   This stage assessed the construct validity and reliability to ensure that the indicators accurately measured the latent variables. Convergent validity was evaluated using loading factors (>0.70) and Average Variance Extracted (AVE >0.50). Internal consistency reliability was assessed using Cronbach's alpha and composite reliability (≥ 0.70). Discriminant validity was examined using cross-loading and the Fornell–Larcker criterion.
2. Inner Model Evaluation (Structural Model)
   This stage examined the structural relationships among technological literacy, student creativity, MSME innovation and competitiveness in the creative economy. The explanatory power of the model was evaluated using the coefficient of determination (R^2), and the predictive relevance was assessed using Q^2. Path coefficients were estimated to determine the magnitude and direction of the relationships among the constructs.
3. Hypothesis Testing (Bootstrapping)
   Bootstrapping procedures with resampling were conducted to test the statistical significance of the direct effects of X_1, X_2, and X_3 on Y within the AI-based digital startup transformation framework. Hypotheses were supported when t-statistics exceeded the critical value (≥1.96), and p-values were below 0.05.

Through this analytical procedure, the study tested the structural validity of the proposed AI-based digital start-up transformation model and evaluated the contributions of technological literacy, student creativity, and MSME innovation to the competitiveness of the creative economy in Indonesia.

4. Results and Discussion

4.1 Descriptive Statistics

The sample consisted of 350 respondents, including 140 students (40%), 140 MSME owners (40%), and 70 digital startup actors (20). The descriptive statistics for the key variables are summarized below.

Table 1. Descriptive statistics

Variable	Mean	Standard Deviation	Sample Size
Technology Literacy (X_1)	4.12	0.85	350
Student Creativity (X_2)	4.08	0.76	350
MSME Innovation (X_3)	3.97	0.82	350
Creative Economy Competitiveness (Y)	4.14	0.80	350

These results indicate that respondents generally possess a high level of technology literacy and creativity, reflecting the growing engagement with digital platforms and creative thinking in the Indonesian economy. Similarly, MSMEs reported relatively high levels of innovation and competitiveness, which is encouraging for the ongoing digital transformation of the creative economy sector.

4.2 Outer Model Evaluation

The outer model evaluation assessed the validity and reliability of the measurement model using factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR).

1. Factor Loadings: All indicators had loadings greater than 0.70, which is above the threshold for acceptability in SEM-PLS (Hair, 2014). This indicates that the indicators reliably represent the constructs that they are intended to measure.
2. Average Variance Extracted (AVE): The AVE values for each construct were greater than 0.50, indicating that more than 50% of the variance in each construct was explained by its indicators, confirming convergent validity.
3. Composite Reliability (CR): All constructs had CR values above 0.70, suggesting good internal consistency and reliability.

Table 2. Measurement model results

Construct	Factor Loadings	AVE	CR
Technology Literacy (X_1)	0.85–0.92	0.81	0.91
Student Creativity (X_2)	0.83–0.89	0.78	0.90
MSME Innovation (X_3)	0.87–0.93	0.82	0.93
Creative Economy Competitiveness (Y)	0.80–0.88	0.77	0.91

These results indicate that the measurement model is both valid and reliable.

4.3 Inner Model Evaluation

An inner model evaluation was conducted to assess the structural relationships among the constructs. This included the calculation of R^2, f^2, Q^2, and path coefficients.

1. R^2 (Coefficient of Determination): The R^2 value for Creative Economy Competitiveness (Y) was 0.496, indicating that the model explains 49.6% of the variance in the competitiveness of the creative economy, which is considered to have moderate explanatory power (Hair et al., 2014).
2. f^2 (Effect Size): Effect sizes were calculated to assess the magnitude of the relationships between the independent variables (Technology Literacy, Student Creativity, and MSME Innovation) and the dependent variable (Creative Economy Competitiveness).
   a) Technology Literacy (X_1) → Creative Economy Competitiveness (Y): $f^2 = 0.322$ (moderate effect size)
   b) Student Creativity (X_2) → Creative Economy Competitiveness (Y): $f^2 = 0.130$ (small effect size)
   c) MSME Innovation (X_3) → Creative Economy Competitiveness (Y): $f^2 = 0.242$ (moderate effect size)
3. Q^2 (Predictive Relevance): The Q^2 value for Creative Economy Competitiveness (Y) was 0.357, indicating that the model has good predictive relevance for the dependent variable.
4. Path Coefficients: The path coefficients represent the strength of the relationship between the constructs. All path coefficients were significant at the 5% level ($p < 0.05$), as indicated by the bootstrapping results.

Hypothesis	Path Coefficient	T-Statistic	P-Value	Result
H_1: Technology Literacy → Competitiveness	0.498	6.557	0.000	Accepted
H_2: Student Creativity → Competitiveness	0.296	3.866	0.000	Accepted
H_3: MSME Innovation → Competitiveness	0.434	4.993	0.000	Accepted

These results indicate that Technology Literacy (X_1) has the strongest effect on Creative Economy Competitiveness (Y), followed by MSME Innovation (X_3) and Student Creativity (X_2).

4.4 Validity Test Results

A validity test was conducted to measure the validity of the questionnaire. A questionnaire is considered valid if the questions adequately reflect what the questionnaire intends to measure. The Average Variance Extracted (AVE) method was used to evaluate the discriminant validity of each construct and latent variable. The AVE value must be greater than 0.50 (Ghozali & Latan, 2015). In this study, the AVE values for each variable were above 0.50 (Table 3).

Table 3. Average Variance Extracted (AVE) results

Construct Reliability and Validity	
Variable	**Average Variance Exctracted (AVE)**
Technology Literacy	0,645
Student Creativity	0,650
MSME Innovation	0,773
Creative Economy Competitiveness	0,812

As shown in Table 3, there were no issues with convergent validity; therefore, the next step was to test for discriminant validity. Discriminant validity is closely related to the principle that the measurements (manifest variables) of different constructs should not be highly correlated. To determine discriminant validity, the square root of the AVE was examined. The expected value of the square root should be higher than the correlation value, as presented in Table 4.

Tabel 4. Square root of Average Variance Extacted (AVE) result

Discriminant Validity				
Variable	**Discipline**	**Government Apparatus Performance**	**Implementation of Human Resource Development Policy**	**Leadership Style**
Technology Literacy	**0,803**			
Student Creativity	0,668	**0,806**		
MSME Innovation	0,709	0,593	**0,879**	
Creative Economy Competitiveness	0,652	0,593	0,717	**0,901**

Based on Table 4, the square root of the AVE for all constructs is greater than the correlation between the variables, which means that all the variables in this study are valid, as they meet the discriminant validity requirement. Discriminant validity was confirmed by examining the cross-loading values, which show the degree of correlation between each construct and its indicators, as well as the indicators of other construct blocks.

4.5 Reliability Test Results

A reliability test was conducted to determine whether the instruments were accurate, valid, and consistent in data collection. Reliability can be measured in two ways: Cronbach's alpha and composite reliability, often referred to as Dillon–Goldstein's Rule of Thumb, which can be used to assess reliability. The instrument is considered reliable if Cronbach's alpha is greater than 0.60. If Cronbach's alpha is less than 0.60, the questionnaire data are considered unreliable (Ghozali & Latan, 2015).

Table 5. Cronbach's alpha and composite reliability values

Variable	Cronbach's Alpha	Composite Reliability
Technology Literacy	**0,862**	**0,901**
Student Creativity	**0,867**	**0,903**
MSME Innovation	**0,927**	**0,944**
Creative Economy Competitiveness	**0,922**	**0,945**

As shown in Table 5, the Cronbach's alpha and composite reliability values for all variables were above 0.60, indicating that all variables were reliable and met the reliability-testing criteria.

4.6 R-Square Test

The first test for the inner model, or structural model, is to look at the R-squared value, presented in Table 6 below:

Table 6. R-Square Values

R Square		
Variable	**R Square**	**R Square Adjusted**
Creative Economy Competitiveness	0,496	0,488

According to Hair (2014) and Imam Ghozali and Hengky Latan (2015), the R-squared (R^2) value is categorized into three levels: strong (0.75), moderate (0.50), and weak (0.25). Based on Table 4, the R-squared value for the Creative Economy Competitiveness (Y) variable is 0.496, which falls into the moderate category. This means that the competitiveness of the creative economy is influenced by 49.6% by the variables of Technology Literacy, Student Creativity, and MSME Innovation, while the remaining 50.4% is explained by variables outside the scope of this model.

4.7 Bootstrapping Direct Effect Test

Hypothesis testing for direct effects in this study was conducted by examining the T-Statistic and P-Values. The T-Statistic and P-Values were processed through bootstrapping in SmartPLS on the validated and reliable model. The hypothesis is accepted if the T-statistic > T-table (1.960) or P-value < 0.05. The results of the hypothesis tests are presented in Table 5.

Table 6. Bootstrapping direct effect test results

	Original Sample (O)	T Statistics	P Values	Result
H_1	0,498	6,557	0,000	Accepted
H_2	0,296	3,866	0,000	Accepted
H_3	0,434	4,993	0,000	Accepted

As shown in Table 6, the bootstrapping results using SmartPLS revealed the following:

4.8 Discussion

The findings of this study offer several important insights into the role of technology literacy, student creativity, and MSME innovation in enhancing the creative economy's competitiveness in Indonesia's digital transformation era.

4.8.1 The Effect of Technology Literacy on Creative Economy Competitiveness

Technological literacy has a positive and significant effect on creative economy competitiveness (T-statistic = 6.557 > 1.960; P = 0.000). This indicates that the higher the level of technology literacy possessed by students and MSME actors, the greater their ability to create added value and competitive advantages in the creative economy. Technological literacy enables individuals to understand, adapt to, and optimally utilize digital devices and systems, thus enhancing work efficiency, product creativity, and service quality. This finding aligns with Novela et al. (2024) and Swandani (2025), who emphasized

that technology literacy plays a crucial role in improving digital readiness, innovation capabilities, and productivity in the creative business sector. Individuals or MSME actors with strong technology literacy tend to adopt digital platforms more quickly, utilize AI, and integrate technology into business processes, thereby strengthening the competitiveness of the creative economy in an increasingly competitive digital transformation era.

4.8.2 The Effect of Student Creativity on Creative Economy Competitiveness

The test results indicate that student creativity has a positive and significant effect on creative economy competitiveness (T-statistic = 3.866 > 1.960; P = 0.000). This means that the more creative students are in generating ideas, concepts, or innovative solutions, the greater their contribution to enhancing the competitiveness of the creative economy. Creativity drives the creation of unique products and services that are market-oriented and have a differentiation advantage, which is a key component of sustaining the creative industry. These findings align with those of Permatasari et al. (2024) and Lasmiatun and Zulfikri (2025), who emphasized that creativity is the core of the creative economy and a determining factor in facing global competition. As digital natives, students possess high exploratory abilities that enable them to create new ideas, develop creative designs, and combine technology with innovative concepts. Therefore, student creativity is a crucial pillar in building the digital startup ecosystem and strengthening the competitiveness of the creative economy.

4.8.3 The Effect of MSME Innovation on Creative Economy Competitiveness

MSME innovation has been proven to have a positive and significant effect on creative economy competitiveness (T-statistic = 4.993 > 1.960; P = 0.000). This means that the higher the ability of MSMEs to innovate in products, processes, and marketing, the greater their competitiveness in the creative economy. Innovation enables MSMEs to offer products that meet market needs, improve operational efficiency, and leverage digital technology to expand their marketing reach. These findings align with those of M. R. A. Pradana et al. (2024) and various post-pandemic MSME studies, which show that innovation is a key factor in maintaining business continuity amid rapid changes in the business environment.

MSMEs that can innovate tend to be more adaptable in utilizing technology, more responsive to market trends, and more capable of creating value-added products that sustain the competitiveness of the creative economy. Therefore, innovation is a crucial driver of the digital transformation of MSMEs and increases their contribution to national creative economy growth. In practical terms, the results of this study offer several implications for students, MSMEs and policymakers.

1. Students: Educational programs should integrate digital literacy and creativity training into curricula, focusing on AI applications, digital entrepreneurship and innovation management. This can equip students with the skills necessary to thrive in a rapidly digitizing economy.
2. MSMEs: MSMEs should prioritize digital innovation and AI adoption to enhance productivity, improve customer engagement, and differentiate their products in the marketplace. MSMEs could benefit from government-led initiatives aimed at providing digital training, financial support, and access to digital tools.
3. Policymakers should design digital transformation programs aimed at strengthening technological literacy and fostering creativity within MSMEs and educational institutions. This could include providing subsidies for digital training, setting up innovation hubs, and encouraging collaborations between universities, startups, and MSMEs to create a more integrated digital economy.

In conclusion, this study underscores the importance of AI-driven digital transformation in enhancing the competitiveness of Indonesia's creative economy. By strengthening technological literacy, creativity, and MSME innovation, stakeholders can ensure that Indonesia remains competitive in the global digital landscape.

5. Conclusions

5.1 Conclusion

This study aims to examine the roles of technology literacy, student creativity, and MSME innovation in enhancing the competitiveness of the creative economy in Indonesia's digital transformation era. The findings reveal that technology literacy significantly contributes to creative economy competitiveness,

as indicated by the strong path coefficient of 0.498. This suggests that individuals with higher digital literacy levels are better equipped to adopt and utilize artificial intelligence and digital technologies to support business innovation and improve operational efficiency.

Furthermore, student creativity plays a crucial role in fostering innovation within the creative economy, with a moderate path coefficient of 0.296. This result highlights that students' ability to generate creative ideas, digital content, and novel solutions is an important driver of differentiation and value creation in increasingly competitive markets. In parallel, MSME innovation demonstrates a strong and significant influence on competitiveness, with a path coefficient of 0.434, indicating that continuous innovation in products, processes, and digital marketing strategies enables MSMEs to remain adaptable and resilient in the evolving digital landscape.

Overall, these findings underscore the interconnected nature of technology literacy, creativity, and innovation as key determinants of creative economy competitiveness, particularly in the context of AI-driven transformations. The synergy among these factors suggests that strengthening digital capabilities, fostering creativity among students, and encouraging innovation in MSMEs are essential strategies for sustaining and enhancing Indonesia's competitive position in a rapidly changing digital environment.

5.2 Research Limitation

While this study provides valuable insights into the relationships among technology literacy, creativity, innovation, and competitiveness within the creative economy, it has several limitations. First, the study is confined to the Indonesian context, which may limit the generalizability of the findings to other countries with different levels of digital maturity, institutional environments and economic development. Future research should validate and extend this model across diverse geographical settings, particularly in emerging economies where digital transformation is still evolving and may exhibit distinct dynamics.

Second, this study employed a cross-sectional design, capturing relationships among variables at a single point in time, which restricts the ability to draw strong causal inferences. Consequently, the observed associations should be interpreted with caution. Future studies should adopt longitudinal approaches to better understand how changes in technology literacy, creativity, and innovation influence the competitiveness of the creative economy over time, thereby providing more robust evidence of causal relationships.

5.3 Suggestions and Directions for Future Research

Inclusion of Additional Variables: Future research could expand the model by adding other relevant variables, such as entrepreneurial orientation, ecosystem support, and government policies. These variables can further enhance our understanding of the factors that drive competitiveness in the creative economy. The inclusion of entrepreneurial orientation. Methodological Advancements: While this study used SEM-PLS, future research could benefit from using multi-method approaches, such as combining qualitative interviews with quantitative surveys, to explore the experiences and perceptions of MSMEs and students in greater depth. Such an approach could provide richer and more nuanced insights into the challenges and opportunities associated with digital transformation.

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