

The Effects of Digital Fashion Literacy, Critical Thinking, and Perseverance on Students' Creative Thinking Ability in Fashion Design Education

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Abstract

Creativity is considered an essential competence in vocational education, particularly in fashion design learning where students are required to generate innovative design ideas and develop original fashion products. However, the development of students' creative thinking skills is influenced by multiple cognitive and non-cognitive factors. The purpose of this study is to examine the effects of digital fashion literacy, critical thinking, and perseverance on students' creative thinking ability in vocational fashion education. The study employed a quantitative correlational research design involving 128 eleventh-grade vocational students enrolled in fashion design programs in two public vocational senior high schools located in East Java Province, Indonesia. Information was obtained through questionnaires that participants completed independently without assistance to measure digital fashion literacy, critical thinking, and perseverance, while creative thinking ability was assessed through a performance-based design task evaluated using a structured rubric. Multiple linear regression techniques were employed as the primary statistical method to examine and interpret the dataset with the assistance of Stata MP 17. The results indicate that digital fashion literacy ($\beta = 0.338, p < 0.001$), critical thinking ($\beta = 0.182, p = 0.015$), and perseverance ($\beta = 0.282, p < 0.001$) have positive and significant effects on students' creative thinking ability. Simultaneously, the regression model explains 33.4% of the variance in creative thinking ability ($R^2 = 0.334$). These findings highlight the importance of integrating digital competence, higher-order thinking skills, and perseverance within vocational learning environments to enhance students' creative potential in fashion design education.

1. Introduction

Creativity has become one of the most important competencies in 21st-century education, particularly in vocational fields that emphasize design, innovation, and problem-solving skills. Modern educational frameworks highlight creativity as a key competence required to respond to rapid technological and industrial changes (Binkley et al., 2020; Zhao, 2012). Scholars also emphasize that fostering creativity in education requires learning environments that encourage exploration, experimentation, and innovation (Beghetto & Kaufman, 2014; Sternberg, 2022). In vocational fashion design education, students are expected to master technical production skills and to develop the skill to generate original and innovative design ideas. Creative thinking ability enables students to explore various design possibilities, combine aesthetic elements, and develop fashion products that reflect both functionality and artistic value. Vocational learning environments such as fashion design programs are therefore designed to integrate technical competencies with creative abilities to prepare students for the demands of creative industry (Suhartini, 2022; Suhartini, 2024).

Fashion design education requires students to develop a combination of technical production skills, aesthetic understanding, and creative problem-solving abilities. Students must be able to transform ideas into visual design concepts and produce fashion products that demonstrate originality and aesthetic quality. Research on fashion designer competencies highlights the importance of strengthening both technical and creative capabilities to support students' professional readiness in the fashion industry (Suhartini, 2019). Consequently, developing students' creative thinking ability has become a key objective in vocational fashion education. Factors affecting the development of creative thinking ability can be technological competencies, cognitive abilities, and personal characteristics. Among the factors, the rise of digital literacy has been emphasized over the last few years. In the context of fashion education, digital literacy may be defined as digital fashion literacy, which can be explained as the capability of students to evaluate, access, and use digital information related to fashion design. Digital technologies provide students the opportunity to explore global fashion trends, digital design tutorials, and inspiration that can stimulate their creativity. Previous studies have shown that digital technologies can play an important role in the development of creativity by providing learners

the opportunity to access various sources of information for generating innovative ideas (Henriksen et al., 2016; Ng, 2015).

From a cognitive perspective, digital literacy supports creativity because digital environments stimulate idea generation, information integration, and flexible thinking processes. Access to diverse digital resources enables learners to compare multiple perspectives, identify patterns, and combine information into new conceptual forms. Cognitive learning theory also suggests that exposure to varied digital stimuli may enhance divergent thinking and cognitive flexibility, both of which are fundamental components of creativity (Henriksen et al., 2016; Zhao, 2012). In fashion design education, students who are digitally literate are more capable of transforming visual information from digital platforms into innovative design concepts through processes of interpretation, evaluation, and creative synthesis. Therefore, digital fashion literacy does not merely function as a technical skill, but also as a cognitive mechanism that facilitates creative idea construction and problem-solving during the design process.

Besides technological competencies, cognitive abilities, such as critical thinking, are also considered important for the development of creativity. Critical thinking helps students to analyze the information, evaluate different ideas, and make rational decisions during the design process. In the process of fashion design learning, students have to evaluate the color combinations, materials, structures of the garments, and aesthetic balance, among other factors. Analytical thinking and reflective thinking are the basic aspects of critical thinking, which are essential for complex problem-solving and innovation, as suggested by the research (Runco & Acar, 2017). Furthermore, personal characteristics such as perseverance also contribute to the development of creative abilities. Perseverance refers to an individual's persistence, determination, and sustained effort when facing challenges in completing tasks. In creative learning environments, students often encounter difficulties when developing design concepts or refining their ideas. Students who demonstrate higher levels of perseverance are more likely to remain engaged in the creative process and continue improving their work. Psychological research has shown that persistence and sustained effort are important components supporting long-term creative achievement (Duckworth, 2016).

Previous studies have examined the role of digital literacy, cognitive skills, and personal characteristics in supporting creativity in education. However, most studies tend to examine these factors separately. Research on creativity in education often focuses either on technological aspects such as digital literacy or on cognitive abilities such as critical thinking, while relatively few studies investigate the integrated influence of technological competencies, cognitive skills, and non-cognitive characteristics in shaping students' creative thinking ability. In addition, empirical research focusing specifically on vocational fashion design education remains relatively limited compared to research conducted in general educational contexts. Digital literacy has also been widely recognized as a key competence in modern education systems. International frameworks emphasize the importance of developing digital skills to enable students to evaluate, access and utilize digital information effectively in various learning contexts (OECD, 2021). Furthermore, the development of higher-order thinking abilities for example critical thinking is essential for enabling learners to interpret information critically and make informed decisions (Facione, 2020).

Therefore, there is a need for empirical studies that examine how digital fashion literacy, critical thinking, and perseverance interact in influencing students' creative thinking ability within vocational learning environments. The novelty of this study lies in the integration of technological, cognitive, and non-cognitive factors within a single analytical model in context of vocational fashion design education. First, this study introduces the concept of digital fashion literacy as a domain-specific form of digital literacy relevant to fashion design learning. Second, the study examines the combined influence of critical thinking and perseverance in shaping creative thinking ability. Third, the study provides empirical evidence from the context of vocational fashion design students, a context that has received limited attention in creativity research. Therefore, the purpose of this study is to examine the influence of digital fashion literacy, critical thinking, and perseverance on students' creative thinking ability in vocational fashion design education. By integrating technological competence, cognitive thinking skills, and perseverance within a single empirical model in vocational fashion education, this study provides new insight to multidimensional factors that shape students' creative thinking ability.

2. Method

This research utilized a quantitative correlational approach aimed at investigating the associations among digital fashion literacy, critical thinking, perseverance, and creative thinking ability among vocational students. A quantitative study was chosen because it allows the measurement of correlations between variables and provides statistical evidence of their influence. This research was carried out in two public vocational senior high schools located in East Java Province, Indonesia, which offer fashion design education programs. These schools were selected because they implement vocational learning activities related to fashion design and garment production. The total population of this study consisted of 157 eleventh-grade students enrolled in fashion design programs in the selected schools. A total of 128 students participated in this study and were

selected using purposive sampling techniques because they were actively involved in fashion design learning activities and had received learning experiences related to fashion design development.

Self-administered questionnaires and a performance-based design assessment were used in this research for data collection. The questionnaires were used to measure digital fashion literacy, critical thinking, and perseverance among the respondents based on a Likert scale. Digital fashion literacy was measured based on the students' access to digital fashion resources, the use of online design tools, and the evaluation of fashion information obtained from digital media sources. Critical thinking was used to measure the analytical and evaluative thinking of the students in solving problems, while perseverance was used to measure the persistence, effort, and determination of the students in completing the fashion design. Data collection was conducted in February 2026, specifically during the second semester. The questionnaires were administered to the respondents during the regular classroom sessions for the fashion design course. Students completed the questionnaires individually under the supervision of the researcher and the subject teacher to ensure that the responses reflected the students' actual learning experiences.

Creative thinking ability was measured using a performance-based assessment in which students were required to develop a fashion design concept and produce a design sketch based on a given theme related to fashion learning activities. The performance test was conducted after the completion of the questionnaire session during a scheduled design studio class to allow students sufficient time to express their creative ideas. The students' design works were evaluated by two independent raters who were experienced fashion design teachers using a structured scoring rubric. The four aspects of creative thinking ability that were assessed were originality, flexibility, elaboration, and aesthetic quality. The final score of the creative thinking ability was computed by averaging the results of the two raters to ensure the objectivity and reliability of the result.

Prior to the data analysis, the results of the validity and reliability analysis of the questionnaire are presented in Table 1.

Table 1. Instrument Validity and Reliability

Variable	Number of Items	r-value Range	Cronbach Alpha
Digital Fashion Literacy	14	0.42–0.71	0.86
Critical Thinking	14	0.41–0.69	0.84
Perseverance	14	0.44–0.72	0.87

All the items were found to meet the requirements for validity and had sufficient reliability for the purposes of research.

The data was analyzed through the application of descriptive statistics and multiple linear regression analysis. This was done through the assistance of the computer software Stata MP 17. Before the regression model was established, a number of classical tests were undertaken to ascertain whether the data met the necessary requirements for the application of the regression model. The classical tests included the assessment for normality, the assessment for the presence of multicollinearity among the predictor variables, and the assessment for the presence of heteroscedasticity. The need for the classical tests was to ascertain whether the statistical model met the necessary requirements for the purposes of the analysis.

3. Results and Discussion

3.1. Results

To present a general outline of the characteristics of the research data, descriptive statistical analysis was conducted for all variables. Descriptive statistics summarize the distribution of the dataset by presenting the minimum value, maximum value, mean score, and standard deviation of each variable (Hair et al., 2019). This analysis provides an initial understanding of the general tendency of students' responses before further inferential analysis is conducted. The descriptive statistics results are in Table 2.

Table 2. Descriptive Statistics of Research Variables

Variable	N	Min	Max	Mean	SD
Digital Fashion Literacy (X_1)	128	29	54	39.99	5.80
Critical Thinking (X_2)	128	26	51	40.07	5.37
Perseverance (X_3)	128	28	53	39.84	5.57
Creative Thinking Ability (Y)	128	8	32	20.12	5.25

The descriptive results indicate that digital fashion literacy has a mean 39.99 with standard deviation = 5.80. This suggests that students generally demonstrate a relatively good level of digital fashion literacy in

accessing and utilizing digital resources related to fashion design learning. The moderate standard deviation indicates that students' responses were relatively consistent around the mean value. Critical thinking shows mean = 40.07 with standard deviation = 5.37. This finding suggests that students possess a reasonably strong ability to evaluate and analyze information within the process of learning. The distribution of scores also indicates moderate variability among participants.

The mean for perseverance is 39.84 and the standard deviation is 5.57. This suggests that students exhibit a good level of perseverance and determination in completing learning activities related to design. The dependent variable for this study is creative thinking ability. It has a mean of 20.12 and a standard deviation of 5.25. The scores vary from 8 to 32. This suggests that there are different creative abilities among students. It appears that students exhibit moderate to high digital literacy skills, critical thinking skills, perseverance, and creative thinking ability.

Before conducting regression analysis, it is important to first examine the dataset to determine whether it satisfies the assumption of normal distribution. Normality testing is conducted to verify whether the residual values are distributed in accordance with the assumptions of a normal distribution, which is one of the fundamental assumptions of parametric statistical analysis (Field, 2018). In this study, Shapiro-Wilk test was applied because it is recommended for sample sizes below 200. The outcomes of the normality analysis are presented in Table 3, which summarizes the distribution characteristics of the data examined in this study.

Table 3. Shapiro-Wilk Normality Test

Variable	N	W	z	Sig.
Digital Fashion Literacy	128	0.984	1.054	0.1459
Critical Thinking	128	0.992	-0.525	0.7001
Perseverance	128	0.988	0.371	0.3553
Creative Thinking	128	0.988	0.504	0.3072

The results indicate that all variables have significance values > 0.05. Therefore, the data can be considered normally distributed, satisfying the assumption required for regression analysis. Another important assumption in regression analysis is the absence of multicollinearity among independent variables. Multicollinearity occurs when independent variables are highly correlated, which may affect the stability of regression coefficients (Hair et al., 2019). To detect multicollinearity, the Variance Inflation Factor (VIF) test was conducted. The results are presented in Table 4.

Table 4. Multicollinearity Test Results

Variable	VIF	Tolerance
Critical Thinking	1.06	0.941
Perseverance	1.04	0.957
Digital Fashion Literacy	1.04	0.964

All VIF values < 10 and tolerance > 0.10, indicating that multicollinearity is not present in the regression model. To examine whether the regression model met the homoscedasticity assumption, the Breusch-Pagan test was conducted. The analysis produced a Chi-square value of 0.73 with a significance value of 0.3942. Since the significance value was greater than 0.05, the regression model can be considered free from heteroskedasticity problems. Therefore, the assumption of homoscedasticity was satisfied, indicating that the residual variances were relatively constant across observations.

After all classical assumptions were satisfied, multiple linear regression procedure was employed to investigate the influence of digital fashion literacy, critical thinking, and perseverance on creative thinking ability. Regression analysis allows the estimation of the correlation among dependent and independent variables simultaneously (Wooldridge, 2020). The results are presented in Table 5.

Table 5. Results of Multiple Linear Regression Analysis

Variable	Coefficient	Std. Error	t	Sig.
Digital Fashion Literacy	0.338	0.067	5.00	0.000
Critical Thinking	0.182	0.074	2.47	0.015
Perseverance	0.282	0.071	3.99	0.000
Constant	-11.957	4.186	-2.86	0.005

The regression results reveal that each of the independent variables exerts a positive influence on individuals' creative thinking skills. To enhance clarity through visual representation of the influence of each

independent variable on students' creative thinking ability, the regression coefficients are illustrated in Figure 1.

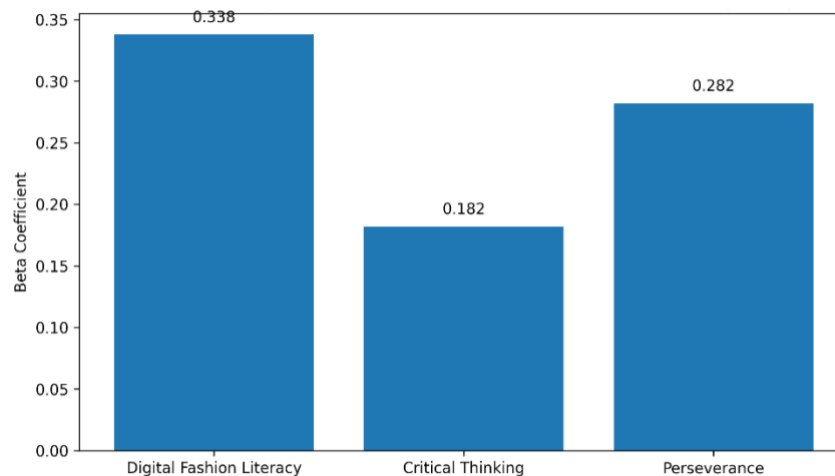


Figure 1. Regression Coefficients of Digital Fashion Literacy, Critical Thinking, and Perseverance on Students' Creative Thinking Ability

Figure 1 illustrates the magnitude of the regression coefficients obtained from the multiple regression analysis. Digital fashion literacy shows the strongest influence on students' creative thinking ability ($\beta = 0.338$), followed by perseverance ($\beta = 0.282$) and critical thinking ($\beta = 0.182$). The visualization confirms the statistical findings presented in Table 5, indicating that students' ability to utilize digital resources in fashion learning plays the most prominent role in enhancing creative thinking.

3.2. Discussion

The findings of this study indicate that digital fashion literacy, critical thinking, and perseverance significantly influence students' creative thinking ability in fashion design education. These findings demonstrate that creativity in vocational learning environments cannot be viewed solely as an artistic ability, but rather as the result of interaction between technological competence, cognitive processing, and psychological persistence. The integration of these three dimensions reflects the multidimensional nature of creativity development within vocational education settings where students are expected to solve practical design problems while maintaining originality and innovation. This result supports the argument that creativity emerges through the interaction between knowledge, thinking skills, and motivational factors that shape learners' capacity to generate and refine ideas (Beghetto & Kaufman, 2014).

The results demonstrate that digital fashion literacy positively and significantly affects students' creative thinking ability. This finding indicates that students who are capable of utilizing digital fashion resources effectively tend to demonstrate stronger creative performance during fashion design activities. Cognitively, digital literacy enhances students' ability to process visual information, integrate multiple sources of inspiration, and generate alternative design ideas through divergent thinking processes. Access to digital platforms also broadens students' exposure to global fashion trends, design references, and multimedia learning materials that stimulate idea exploration and innovation. Rather than merely functioning as a technical skill, digital fashion literacy appears to facilitate cognitive flexibility and creative synthesis during the design process. These findings are consistent with previous studies emphasizing that digital technologies can stimulate creativity by expanding learners' opportunities to explore and combine new ideas in innovative ways (Henriksen et al., 2016; Van Laar et al., 2017).

In the context of 21st-century learning, digital literacy has become an essential competence that supports creativity and innovation in educational environments. Students who possess strong digital literacy skills are more capable of critically evaluating information, identifying relevant learning resources, and utilizing digital platforms to support creative production. In vocational fashion education, digital literacy enables students to translate visual information into meaningful design concepts and encourages experimentation with different creative alternatives. This finding suggests that digital literacy contributes not only to information access but also to students' cognitive readiness to engage in creative problem-solving processes. The present result aligns with the argument that digital competence is closely associated with innovation, collaboration, and creative learning performance in contemporary education (Redecker, 2021; Voogt et al., 2020).

The findings also reveal that critical thinking significantly contributes to students' creative thinking ability. This result indicates that creativity in fashion design education is strengthened when students are able to

evaluate information critically, analyze alternatives systematically, and make reflective decisions during the design process. In vocational learning environments, students are frequently required to balance aesthetic considerations, technical feasibility, and functional aspects of fashion products. These processes require analytical reasoning and evaluative judgment, which are central dimensions of critical thinking. The result suggests that creativity is not solely dependent on imagination but also relies on students' ability to refine and improve ideas through reflective cognitive processes. This interpretation supports previous studies stating that critical thinking functions as an important mechanism for evaluating and developing innovative ideas into feasible creative outcomes (Runco & Acar, 2017; Abrami et al., 2020).

The study further demonstrates that perseverance has a positive and significant effect on students' creative thinking ability. This finding implies that students who maintain effort and persistence when encountering difficulties are more likely to sustain engagement in creative learning activities and continue improving their design outcomes. Creative processes in fashion education often involve repeated revisions, experimentation, and problem-solving activities that require sustained commitment over time. Students with high perseverance are therefore better prepared to tolerate challenges and continue refining their ideas until satisfactory results are achieved. Psychologically, perseverance supports self-regulation and resilience, both of which are essential for maintaining motivation during complex creative tasks. These findings reinforce previous research emphasizing that sustained effort and self-regulated learning behaviors contribute significantly to long-term creative and academic achievement (Duckworth, 2016; Zimmerman, 2013).

Overall, the findings of this study confirm that students' creative thinking ability in vocational fashion education is influenced by the interaction between technological competence, higher-order thinking skills, and personal persistence. Digital fashion literacy provides students with access to diverse creative resources and opportunities for idea exploration, while critical thinking enables students to evaluate and refine creative concepts systematically. At the same time, perseverance strengthens students' ability to remain engaged in the demanding and iterative process of creative production. The interaction of these factors demonstrates that creativity development in vocational education requires not only technical mastery but also cognitive and psychological readiness. These findings support broader educational perspectives highlighting the importance of integrating digital competence, critical thinking, and self-regulated learning within 21st-century vocational education to foster innovation and creativity among learners (Zhao, 2012; Bandura, 2018).

3.3. Implications

The findings of this research showed that digital fashion literacy has a significant role in supporting the creative thinking ability of students. This implies that vocational education, particularly fashion design learning, needs to include digital literacy learning activities in the fashion design education curriculum. Learning activities that include digital design, online fashion resources, and digital trend analysis could provide wider creative thinking for students, allowing them to explore different design innovations.

Significant role of critical thinking in supporting the creative thinking ability of fashion design students implies that the development of higher-level cognitive abilities is considered a crucial aspect within vocational education. It is recommended that teachers encourage critical thinking abilities among fashion design students through different approaches, such as learning activities, including approaches to instruction, project-based learning, design critique, and reflective learning.

The results underscore the significance of perseverance as another significant non-cognitive factor facilitating creativity. In fact, creative processes involve a series of constant experimentation, revising, and improving. Thus, teachers should design a learning environment that can facilitate or enhance students' perseverance in creative tasks.

From a wider perspective, this research indicates that creativity in vocational fashion education can be affected by the combination of technological competence, cognitive ability, and motivational characteristics. By incorporating these three aspects, teachers can promote or enhance the creative performance of students, which can better meet the needs of the contemporary fashion industry.

3.4. Limitations

Nevertheless, it is important to note that the present research also has a number of limitations, which need to be taken into consideration when evaluating and interpreting the results obtained. Firstly, it is important to note that this research was based on three independent variables, i.e., digital fashion literacy, critical thinking, and perseverance. Although it was established that the regression model explained 33.40% of the variance in creative thinking ability, it is also important to note that a significant portion of the variance remains unexplained. Other variables, such as learning environment, learning strategies, intrinsic motivation, and creative self-efficacy, may also play a significant role in influencing students' creativity. Future research needs to explore these variables as well. Secondly, it is also important to note that this research was based on a specific

educational scenario, i.e., vocational high school students studying fashion design. Therefore, it can be argued that the scope of this research is limited. Future research needs to be carried out in different regions of the world.

Third, the study used self-report questionnaires as a way of measuring a number of variables in the research study. Although the questionnaires were well designed, they are also likely to be affected by the participants' perceptions as well as possible response bias. Future research could be improved by using other research approaches, such as interviews and observations within a classroom setting, in order to get a comprehensive understanding of the dynamics of the learning process that contributes to the development of creativity in the classroom.

Lastly, the use of a cross-sectional research approach in the study limits the ability of the research study to explore the development of creativity in students over different periods of time. This is because, with a cross-sectional research approach, the research study does not allow for the observation of the development of creativity in the classroom over different periods of time. A longitudinal research approach could provide a deeper and comprehensive understanding of the way in which digital literacy, cognitive competence, and perseverance relate and affect the development of creativity in the classroom.

4. Conclusion

This study concludes that digital fashion literacy, critical thinking, and perseverance significantly contribute to students' creative thinking ability in vocational fashion design education. The findings indicate that creativity development in vocational learning environments is shaped through the interaction between technological competence, higher-order cognitive skills, and personal persistence. Digital fashion literacy enables students to access and synthesize diverse sources of design inspiration, critical thinking strengthens students' ability to evaluate and refine creative ideas systematically, while perseverance supports sustained engagement throughout the creative process. These results emphasize that creativity in fashion education should not be understood merely as an artistic talent, but as a multidimensional competence influenced by cognitive, technological, and psychological factors. Therefore, vocational education institutions are encouraged to integrate digital literacy development, critical thinking enhancement, and perseverance-building strategies into learning activities to support students' creative readiness in the contemporary fashion industry.

Author Contributions

Diani Novia Indriati: Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Writing – Original draft preparation. Ratna Suhartini and Soeryanto: Supervision, Validation, Writing - Review & Editing. Every contributor involved in this work has carefully reviewed the completed manuscript and has given their consent for its final version to be approved.

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The authors affirm that there are no potential conflicts of interest related to the conduct of the study, the preparation of the manuscript, or the decision to publish the findings presented in this article.

Data Availability

The datasets generated during and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

The authors state that artificial intelligence (AI) technologies were utilized solely for the purpose of enhancing the manuscript's clarity and linguistic quality, and their use occurred under careful human oversight. These tools were not used in the development of research concepts, analyzing the data, interpreting the findings, and drawing the conclusions of the research.

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