Effects of Project-Based Blended Learning with E-Modules on Creative Thinking and Social Attitudes Moderated by Digital Literacy

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Abstract

The development of digital technology in higher education requires learning innovations that not only utilize technology but also develop 21st-century competencies such as creative thinking and social attitudes. However, preliminary findings on students in technology-based study programs show low creative thinking skills and weak social attitudes due to passive learning practices and a lack of meaningful technology integration. This study aims to examine the effect of the e-module-assisted Project Based Blended Learning (PBBL) model on students' creative thinking skills and social attitudes, as well as to determine the role of digital literacy as a moderator. The study used a one-way non-equivalent pretest–posttest control group experimental design with 2×2 factorial analysis. A total of 104 students were divided into experimental and control groups, and 79 additional students were involved in instrument testing. Creative thinking skills and social attitudes were measured using a situational judgment test, while digital literacy was measured using a five-point Likert questionnaire. Data analysis was performed using descriptive statistics and

MANCOVA at a 5% significance level. The results showed that e-module-assisted PBBL was significantly more effective in improving creative thinking skills than conventional learning. Digital literacy acted as a moderator, with students with high digital literacy showing better achievements. However, the learning model and interaction with digital literacy did not have a significant effect on social attitudes. These findings confirm that the effectiveness of technology-based learning is greatly influenced by students' level of digital literacy, so that future research can test digital learning strategies that are appropriate for students' readiness in terms of literacy in technology.

Key words: *Project Based Blended Learning, E-Module, Digital Literacy, Creative Thinking Skills, Social Attitude*

Introduction

The current transformation in education is leading to the implementation of appropriate and flexible learning models that are oriented towards the development of 21st-century skills (Prachagool & Nuangchalerm, 2021). On the one hand, this technological development requires digital literacy, which is very important for students to adapt to the rapid changes in learning methods (Deiniatur & Cahyono, 2024). This literacy also involves cognitive, motor, empathy, and emotional skills needed by individuals to effectively utilize the digital environment (Akayoglu et al., 2020). Thus, digital literacy is important for students to adapt amid technological developments and support the strengthening of 21st-century skills.

The rapid development of technology has made it increasingly important for education to focus on developing 21st-century skills, one of which is creative thinking. 21st-century skills such as creative thinking characterize excellent education and enable success in one's career (Irwandani et al., 2024). Currently, the world of work requires adaptive and creative graduates, but education and learning in educational institutions still focus on strengthening aspects that are irrelevant to the needs of the modern world of work (Yanuarto et al., 2025). Creative thinking skills for students are translated into various related ability indicators, such as connecting, creating, testing, and modifying ideas (Murphy et al., 2025). This competency can be developed by applying a learning model that actively involves students in the learning process (Priyanto & Dharin, 2021). Thus, it can be concluded that developing creative thinking skills in students is crucial.

In addition to creative thinking skills, one of the important competencies that institutions such as universities need to master and improve is social skills. Social skills are considered one of the most important competencies for individuals in today's technological era because they involve how people socialize, communicate, collaborate, and take responsibility for various social activities in the real world and in the digital environment (Karta et al., 2021). This competency is then redefined as an assessment with a narrower scope, such as affective reactions, for example, liking or disliking, and a person's behavior towards a particular object (Nikolaou et al., 2022). However, limited attention has been

given to the factors that may facilitate or hinder the development of this skill among college students (Wang et al., 2025). Therefore, it is important for educators to pay attention to the development of students' social attitudes to improve their academic success and readiness to enter the workforce.

Various studies show that the creative thinking skills of students at various levels in Indonesia are still low. A global survey shows that the creative thinking skills of students in Indonesia rank 115th out of 139 countries, with scores far below those of various countries in Southeast Asia (Musdi et al., 2024). In addition, research shows that the implementation of higher education that is oriented towards developing 21st-century skills, including creative thinking skills, is not yet optimal (Mutohhari et al., 2021). Furthermore, the development of artificial intelligence, which is increasingly being utilized, has given rise to bias against individual creativity in the digital age (Hattori et al., 2024). Moreover, the use of digital technology as an effort to improve creative thinking skills is supported by bibliometric studies that show this has been a strategic field of study in the last five years (Nguyen & Tran, 2025). Therefore, it is necessary to conduct research that seeks to foster creative thinking skills among students. On the one hand, the social and emotional attitudes of students in the digital age require special attention (Svenningsson et al., 2022). This is supported by various findings that explain the high number of cases of dishonesty, disputes, and even bullying among students and teenagers (Hungo, 2024). At the university level, similar phenomena also emerge in various forms, such as poor communication skills, lack of empathy towards differences between groups, and a weakening willingness to actively collaborate in academic activities. Therefore, social attitudes are important to consider and study in education, including at the university level.

The results of observations by researchers at one of the universities specializing in information and communication technology, namely ITB STIKOM Bali, show that students' creativity and social attitudes still need to be improved. This is supported by various student work results that tend to contain elements of plagiarism, low academic achievement, and dishonesty in completing learning tasks. Moreover, in the Human and Computer Interaction course, which contains many theories and concepts that must be learned, their tasks tend to

be done only perfunctorily. Observations also found that most students utilize *artificial intelligence* in completing their work or learning tasks, but they themselves do not know or even master what they have done (Abdaljaleel et al., 2024). In addition, most students tend to be less responsive in learning, especially in working together to complete learning tasks. However, ITB STIKOM Bali is known for its quality and complete learning facilities and infrastructure. This explains the gap in creativity and social attitude competencies among students with a quality of learning that should be able to support the achievement of creative college graduates with good social attitudes. Therefore, various efforts are needed to improve the quality of learning, especially in the Human-Computer Interaction course at ITB STIKOM Bali.

One innovative learning method that can be applied is the *Project Based Learning* model. This learning model is considered capable of developing students' creativity because it presents meaningful learning activities that are relevant to students' needs and the characteristics of the material being studied (Andini & Rusmini, 2022). Other studies show that indicators of fluency and elaboration skills among students increase as a result of learning using the *Project Based Learning* model (Wijayati et al., 2019). In addition, this learning model is also considered capable of strengthening creativity and social relationships among students because it allows them to work on assignments with a balanced workload (Chen et al., 2022). Then, in relation to learning in the digital era, one of the innovative strategies that can be applied is blended learning. This technology-based learning is relevant for implementation at the university level (Siregar, 2024). Blended learning provides high motivation for lecturers and students in relation to completing learning tasks, thereby developing their social attitudes (Banihashem et al., 2023). The implementation of effective blended learning basically focuses on the optimal use of available learning opportunities and tools to create an optimal learning environment (Purwasih et al., 2021). Thus, blended learning can be said to be relevant as a model or strategy that is integrated with the Project Based Learning model in an effort to strengthen students' creative thinking skills and social attitudes.

In line with the development of 21st century learning needs, various studies emphasize that the teaching and learning process needs to be designed and implemented more effectively through the use of technology in education (Prachagool & Nuangchalerm, 2021). One form of learning media that can be developed through the use of technology is e-modules. E-modules provide material structures and learning guides designed to support the independent learning process of students (Hidayati et al., 2022). This is in line with the main characteristic of e-modules as a self-instructional medium, which allows students to learn without dependence on educators or other parties, thereby helping to increase learning independence while optimizing their potential (Ginting et al., 2022). Lecturers play a very important role in developing students' creativity. Educators must not only create learning situations or activities oriented towards increasing student creativity, but also be actively involved in these situations (Ratminingsih et al., 2021). Educators must become more professional and possess digital skills in the current era of industrial revolution and *society* 5.0 (Ibda et al., 2023). Therefore, the implementation of e-modules can be an effort and form of educator involvement in developing students' creativity and social attitudes.

Based on the literature review conducted by the researcher, various studies show that blended learning is relevant and significantly capable of strengthening student performance in learning and increasing student active engagement to develop their creativity. This results in blended learning in the digital era being highly recommended for university students (Köseoğlu & Çobanoğlu, 2025). In addition, the implementation of the Project Based Blended Learning model has also been carried out previously to develop student learning outcomes. Studies on the PjBBL model show that the experimental group in this model is able to have better problem-solving strategies (R. M. M. Sari et al., 2022). Subsequent research examining the application of this model using a literature study method found that this model is effective in achieving good learning outcomes for students (Distyasa et al., 2021). The application of this innovative learning model also shows a significant influence on the development of students' creative thinking skills (Marsiti et al., 2023). Regarding digital literacy and the use of technology-based learning media, previous

research has assessed that the interaction between digital literacy and technology-based learning can improve student learning outcomes (Puniatmaja et al., 2023). Thus, various previous studies or research show that the implementation of the e-module-assisted Project Based Blended Learning model is relevant to be carried out in an effort to develop students' creative thinking skills and social attitudes. Furthermore, no studies have been found that combine the influence of this model assisted by e-modules and consider the level of students' digital literacy. Therefore, this study aims to examine the influence of the project-based blended learning model assisted by e-modules on students' creative thinking skills and social attitudes moderated by digital literacy in the Human-Computer Interaction course.

Method

Research Design

This quantitative experimental study was conducted to examine the effect of the project-based blended learning model and e-modules on students' creative thinking skills and social attitudes, with digital literacy as a moderator, in the Human-Computer Interaction course at ITB STIKOM Bali. This study used a quasi-experimental design of the one-way non-equivalent pre-test post-test control group design with variable analysis following a factorial pattern or design (Santyasa, 2023). This design was chosen considering that the subject groups had already been formed in the field, making it impossible for the researcher to conduct a completely random sampling. This resulted in the groups that had been previously formed by the institution being retained and involved as research subjects. The complete research design can be seen in Figure 1.
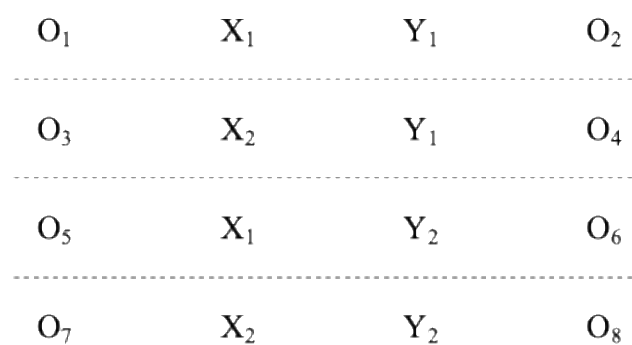
$$O_1 \qquad X_1 \qquad Y_1 \qquad O_2$$

$$O_3 \qquad X_2 \qquad Y_1 \qquad O_4$$

$$O_5 \qquad X_1 \qquad Y_2 \qquad O_6$$

$$O_7 \qquad X_2 \qquad Y_2 \qquad O_8$$

Figure 1. One way non equivalent pre-test post-test control group design

In Figure 1, symbols O_1, O_3, O_5, O_7 represent *pre-test* observations, O_2, O_4, O_6, O_8 represent *post-test* observations, then X_1 = E-assisted PJBBL Learning Model -Module X_2 is the Direct Instruction Learning Model, Y_1 is High Digital Literacy, Y_2 is Low Digital Literacy, with the dotted line indicating that *Simple Random Sampling* cannot be performed.

Population and Sample/ Study Group/Participants

This study used the entire population of ITB STIKOM Bali students who took the Human and Computer Interaction course, namely all students in the Information Systems undergraduate program. Given that conditions at ITB STIKOM Bali did not allow for simple random sampling of individuals, the study involved two study groups (intake classes) with a total of 104 students who had already been formed as the research sample. To accommodate the 2×2 factorial model without rearranging the conditions and integrity of the student classes, which could cause ethical and administrative problems in the field, the treatment allocation was carried out at the group level. First, digital literacy as a moderator variable of all research samples was measured through a *pre-test*. The four classes as samples were then classified into two groups, namely high digital literacy (Y_1) and low digital literacy (Y_2), based on the composition of the majority of students whose scores were above or below the combined mean or median. Second, the E-Module-Assisted PJBBL Learning Model (X_1) and Direct Instruction (X_2) were randomly assigned to each factor group, resulting in four treatment groups and specific analyses (X_1Y_1, X_1Y_2, X_2Y_1, and X_2Y_2). This design allows for the necessary interaction tests while still using pre-test scores as covariates to control for initial bias between student groups.

Data Collection Tools

This study did not involve cognitive tests for respondents who were ITB STIKOM Bali students. In this case, the researcher measured the level of digital literacy as a moderating variable with a five-point Likert scale questionnaire, where a score of 1 meant strongly disagree and a score of 5 meant strongly agree. The students' creative thinking skills and social attitudes were measured with a situational judgment test. In this case, the evaluators or students answered the options that they thought were most appropriate from the four options in each item of the instrument and a score range from 1 to 4 for each answer option,

with no answers considered wrong or not scoring. This technique is efficient if the researcher understands the variables being measured and understands that the respondents can provide the expected data (Sugiyono, 2015). The aspects measured by the creative thinking ability measurement instrument can be seen in Table 1. Then, students' social attitudes are measured by aspects that are relevant and support positive interactions among students to create quality individuals (Ningrum et al., 2023). The aspects of the student social attitude measurement instrument can be seen in Table 2. Meanwhile, the level of student digital literacy is measured with an instrument developed with two main components of digital literacy, namely heuristics and exploration (Reddy et al., 2023). The aspects derived from these two main components can be seen in Table 3.

Table 1. Indicators and Aspects of Students' Creative Thinking Skills

Aspects	Indicator
Fluency	Able to generate many ideas or relevant answers to a problem.
Flexibility	Able to generate ideas from various perspectives or in different ways.
Originality	Able to come up with unique, unusual ideas that others rarely think of.
Elaboration	Able to explain ideas in more detail, thoroughly, and systematically.

Table 2. Indicators and Aspects of Students' Social Attitudes

Aspect	Indicator
Honesty	Demonstrate honest behavior in academics and daily life.
Discipline	Obey rules, arrive on time, and complete tasks on schedule.
Responsibility	Carry out duties sincerely and reliably.
Tolerance	Respect differences in opinion, culture, and religion.
Mutual cooperation	Work together and help each other in various activities.
Self-confidence	Demonstrate self-confidence in academics and organizations.
Politeness and courtesy	Demonstrate politeness in communication and interaction.

Table 3. Indicators and Aspects of Student Digital Literacy

Aspect	Indicator
Appearance	First impressions when using a digital application.
Content	Ease of use of a digital application.
Navigation	Ease of exploring an application.
Student attitude	Student behavior as users of digital literacy tools.
Perceived usefulness	The feeling of acceptance of the benefits for students from using digital literacy tools.
Perceived ease of use	The usefulness of digital literacy tools that are increasingly easy to obtain.

Data Collection

Each learning model (e-module-assisted PjBBL and direct instruction) was applied to two classes of students taking the Human-Computer Interaction course for approximately nine weeks, which included five offline meetings and four online meetings. The researchers determined a duration of nine weeks to ensure optimal treatment and strengthen the internal validity of the experimental research conducted. The initial treatment was given to both the experimental and control classes with the socialization of the learning program implemented by conducting a pre-test of students' creative thinking abilities and social attitudes. During this initial offline meeting, the students' digital literacy levels were also measured to identify high and low digital literacy groups. Then, the Project Based Blended Learning learning model treatment was carried out with the help of e-modules, with steps ranging from problem orientation to project evaluation, with project monitoring carried out online in accordance with the blended strategy. Then, direct instruction was carried out, starting from the delivery of class objectives to the provision of independent exercises, which were conducted entirely offline. The learning syntax for both learning models in the experimental and control groups can be seen in Table 4. In the last meeting, a post-test was conducted to measure the creative thinking abilities and social attitudes of students in all classes involved.

Table 4. Syntax Project Based Blended Learning and Direct Instruction Learning

No	Project-Based Learning with a Blended Learning Approach Supported by Electronic Modules	Direct Instruction
1	Orientation on project topics with the help of e-modules	Communicating objectives and class preparation
2	Offline project planning	Demonstrating concepts and skills
3	Online schedule preparation and project guidance	Providing guided practice
4	Online project monitoring	Evaluating understanding
5	Offline presentation of project results	Providing independent practice
6	Online and offline evaluation and reflection	The usefulness of digital literacy tools that are increasingly easy to obtain.

Data Analysis

This study guarantees the quality of the data obtained with instruments that have been tested for validity and reliability beforehand. The content validity of each item in the questionnaire and situational judgment test was measured through testing with experts and analyzed using the V-Aiken technique. Then, empirical validity was tested using the Pearson product moment technique and followed by confirmatory analysis. The reliability of the test was measured using Cronbach's alpha and supplemented by calculating the CR/Omega reliability test. The results of testing this instrument show that, overall, the instrument is valid and reliable for use in collecting data. The data collection results were tested using descriptive and inferential statistical techniques following the MANCOVA procedure. Data analysis using the MANCOVA procedure reduces bias during the experiment by separating the variation originating from the variables from the error variation (Hair et al., 2019). This results in a more convincing test of differences between independent variable groups. The purpose of covariates is to eliminate bias factors caused by treatment group inequality (Ekayana et al., 2024). Preliminary tests were conducted before evaluating the research

hypothesis, such as tests of normality and data homogeneity, linearity tests, multicollinearity tests, and regression suitability.

Findings

The results of descriptive statistical analysis show an overview of students' digital literacy levels, which then divide subject classes into high and low digital literacy categories. The level of digital literacy measured by the questionnaire at the beginning of this study descriptively contains the mean, standard deviation, median, minimum and maximum values as shown in Table 5. Then, an overview of the data on students' creative thinking abilities and social attitudes before and after the learning intervention obtained through the pre-test and post-test activities can be seen in Table 6 and supported by the illustration in Figure 2.

Table 5. Student's Digital Literacy Profile

Group	Digital Literacy					Category	
	$\overline{x}$	σ	Min	Max	Median	High	Low
Experiment (PjBBL E-Module)	163,47	9,10	145	184	163,5	30	30
Control (DI)	164,18	9,00	140	181	163,5	22	22

Table 6. Recapitulation of Research Variable Measurement Results

| Variable	Digital Literacy	PjBBL E-Module				Direct Instruction			
		$\overline{x}$	σ	Min	Max	$\overline{x}$	σ	Min	Max
Pre-Test creative	High	111,3	12,9	85	135	108,5	10,4	85	133
thinking skills	Low	108,3	11,4	85	127	105	11,3	84	125
Post-Test Creative	High	129	10,7	106	150	116,1	9,5	95	141
Thinking Skills	Low	126,8	10	109	144	109	10,1	92	125
Pre-Test Social Attitude	High	109,2	4,4	99	117	107,7	4,6	98	115
	Low	107	5,7	96	117	101	4	92	107
Post-Test Social Attitude	High	128,5	4,1	118	135	127,2	3,8	119	133
	Low	124,5	4,9	115	133	120	4,6	112	127
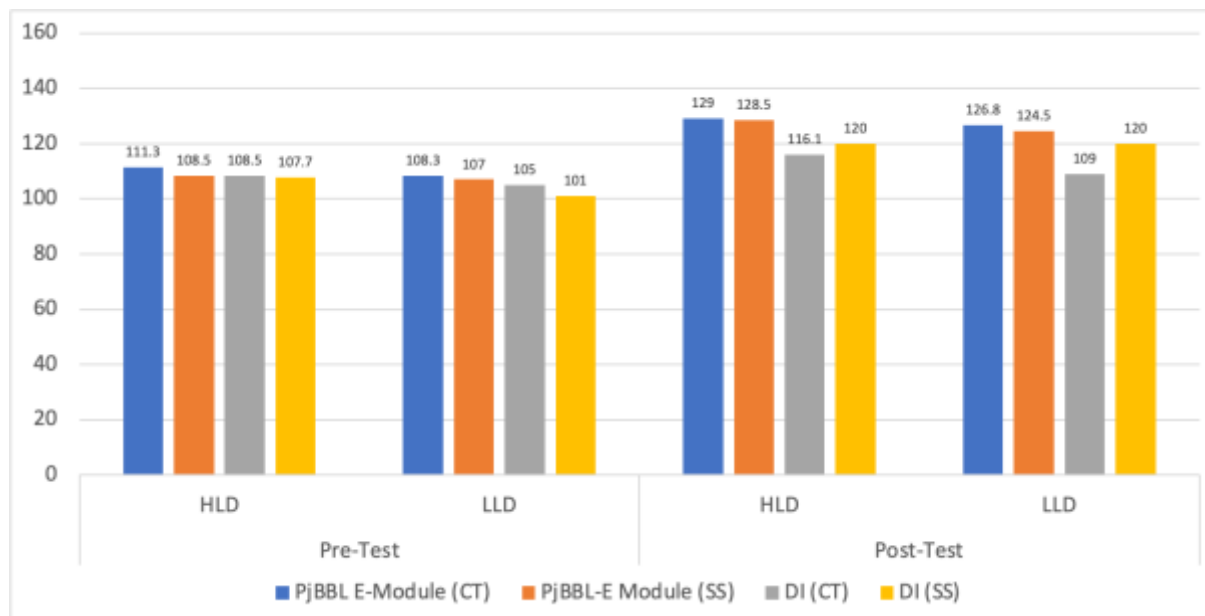
Figure 2. Pre-Test and Post-Test Results

The data in Figure 2 shows the average difference between students' creative thinking abilities and social attitudes as measured in the *pre-test* and *post-test*, grouped according to digital literacy level and learning model group. In terms of creative thinking abilities, students who participated in PjBBL e-module learning experienced an average increase before and after the intervention, which also applied to each digital literacy level. An increase was also seen in the group of students who attended *direct instruction* learning, with differences in the increase that may also be related to the students' digital literacy levels. These descriptive findings provide a starting point for subsequent inferential analysis, while also showing that differences between groups are not only apparent in statistical tests but also in the general distribution of data.

Table 7. MANCOVA Results

Source	Dependent Variable	Type III Sum of Square	F	Sig.
Learning Model	CT	3304.943	886,016	<,001
	SA	6.721	2.954	0,089
Digital Literacy	CT	39.877	10,691	0,001

	SA	49.713	21,851	<,001
Learning Model * Digital	CT	90.318	24,213	<,001
Literacy	SA	4.139	1,819	0,181

The MANCOVA prerequisite test was conducted using SPSS, producing normality, homogeneity, linearity, multicollinearity, and regression suitability that were valid and suitable for proceeding to the hypothesis testing stage. In general, the hypothesis testing results rejected H0 if a value in the sig or p-value column was found to be < 0.05. According to the MANCOVA test results shown in Table 7, there were various findings as follows. First, there was a significant difference in creative thinking skills between students who participated in e-module-assisted Project Based Blended Learning (PjBBL) and students who learned through the conventional model in the field, namely Direct Instruction (DI) (F=886.016 and p <0.001). These results confirm that students who learn through a project-based approach in a blended learning environment assisted by e-modules experience a higher increase in creative thinking skills compared to students who learn with the direct instruction model. The second research result states that there is a significant difference in creative thinking skills between students with high digital literacy and students with low digital literacy. MANCOVA analysis shows that digital literacy has a significant effect on creative thinking skills with an F value of 10.691 and a significance of p = 0.001. These results indicate that the ability to utilize digital technology affects creative thinking skills. The third research result shows that there is a significant interaction effect between the e-module-assisted Project Based Blended Learning (PjBBL) learning model and the level of digital literacy on students' creative thinking abilities (F=24.213 and p<0.001). This research result indicates that the effectiveness of the learning model on creative thinking abilities is not uniform but depends on the students' level of digital literacy. The fourth research result shows that there is no significant difference in students' social attitudes between the group that participated in Project Based Blended Learning (PjBBL) and the group that participated in Direct Instruction (DI). Statistically, the value of F=2.954 and the value of p of 0.089> 0.05 confirm that the learning model does not contribute differently to the development of students' social attitudes. Thus, both PjBBL and DI produced relatively equivalent levels of

social attitudes, even though they had different learning process characteristics. The fifth research result shows that there is a difference in social attitudes between students with high digital literacy and students with low digital literacy (F=21.851 and p<0.001). This finding indicates that digital literacy is not only related to technical skills in using technology but also related to students' social skills in interacting, collaborating, communicating, and adapting to the learning environment. The sixth research result shows that there is no significant interaction between the learning model and the level of digital literacy on students' social attitudes. Based on the SPSS output in the Test of Between Subjects Effects table, the significance value in the Learning Model*Digital Literacy interaction component is F=1.819 and p=0.181 > 0.05, so the hypothesis stating that there is an interaction is rejected. In other words, both the e-module-assisted PjBBL learning model and Direct Instruction did not have a significant effect on social attitudes when combined with students' digital literacy levels. This condition indicates that changes or differences in social attitudes are not influenced by the combination of learning treatments and digital literacy categories, so that the two variables work independently in the context of social attitudes.

Discussion

The effectiveness of implementing learning models with various strategies or media used in them can be closely related to the theoretical foundations of learning that underlie the learning process that occurs as a result of these learning activities. The results of this study indicate that the PjBBL e-module learning model has a significant effect on improving students' creative thinking skills. Theoretically, these findings are in line with the views of constructivism experts such as Vygotsky and Bruner, who emphasize that creativity develops when students are given the opportunity to explore, interact, and build understanding through authentic experiences such as project-based learning (Harrison & Laco, 2022). Meanwhile, direct instruction learning tends to prioritize the transfer of knowledge from lecturers to students in a structured manner, so that the space for students to create, evaluate, and modify ideas is relatively limited. However, DI learning is said to help students understand basic concepts, but it does not provide enough opportunities for students to develop their potential according to their characteristics, such as creative processes like

experimenting and innovating (Herlambang et al., 2024) Therefore, PjBBL learning assisted by e-modules is relevant to learning theory and can develop students' creative thinking skills. The findings of this study are also reinforced by previous studies that show the effectiveness of project-based learning in developing 21st-century skills, including student creativity (Fadli et al., 2022; E. D. P. Sari et al., 2023). PjBBL learning assisted by e-modules in this study is also relevant to other learning implementations that integrate digital technology to develop student creativity (Cui et al., 2025; Khoso et al., 2025).

The next finding explains that digital literacy levels influence the improvement of students' creative thinking abilities. Based on the constructivist theory perspective, the difference in creative thinking abilities between students with high and low digital literacy can be understood as a result of different abilities in constructing knowledge through interaction with the learning environment. Constructivism emphasizes that knowledge is actively constructed through a process of exploration, reflection, and integration of experiences (Göncü & Main, 2023). In the context of project-based learning and e-modules, students with high digital literacy are better able to explore information independently, utilize various digital sources, and integrate their findings into the projects being developed (Jamil et al., 2025). This ability allows them to construct richer and more complex representations of knowledge, which directly contributes to the improvement of creative thinking skills. Conversely, students with low digital literacy experience limitations in utilizing digital sources, resulting in a narrower and less varied knowledge construction process. In addition, the findings of this study are also relevant to connectivism theory, which views learning in the digital era as occurring through an individual's ability to access, manage, and connect various information nodes in a digital knowledge network (Corbett & Spinello, 2020). Theoretically, digital literacy is seen as an important part of 21st-century learning competencies, which include the ability to access, process, evaluate, and utilize digital information (Arimbawa et al., 2024). Students with high digital literacy are not only able to use technological devices efficiently, but also able to navigate complex information, compare sources, and integrate various knowledge from the digital environment. The findings of this study indicate that students with high digital literacy have better creative

thinking skills than students with low digital literacy. This difference indicates that digital literacy is an individual competency that does not develop automatically. This is in line with the view that an increase in academic level is not always directly proportional to an increase in digital literacy, as stated by (Nalaila & Elia, 2024). Digital literacy provides a broader cognitive space for students to develop new perspectives, seek alternative solutions to problems, and develop more innovative concepts, especially in online learning (Zheng et al., 2025). Conversely, students with low digital literacy in this study tend to face obstacles in understanding digital instructions, finding valid sources, or making optimal use of technology in the task completion process.

The third research result explains that there is an interaction between the learning model and digital literacy on the differences in students' creative thinking abilities in the Human and Computer Interaction course. This interaction can be explained through the characteristics of the PjBBL model, which emphasizes exploration, collaboration, problem solving, and systematic project creation activities. Educators can apply this model to learning to achieve better learning outcomes because this model trains students' social skills and persistence in learning, thereby increasing their creative thinking skills (Sulastri et al., 2023). In this case, for students with low or high digital literacy, project-based learning structures provide a clearer workflow, focus on concrete tasks, and provide learning opportunities through hands-on practice. Furthermore, the e-modules used in PjBBL also provide step-by-step instructions and technical guidance that help students who are less skilled in digital navigation (Nasution et al., 2025). This supports their ease of learning so that they can focus on learning activities and efforts to develop creative thinking skills. Conversely, in the Direct Instruction model, students with high or low digital literacy do not have sufficient exploratory opportunities to practice their creative abilities, so their performance remains low. The results found in this study are also in line with connectivism theory, which asserts that learning in the digital age is largely determined by an individual's ability to access and connect information (Cleary, 2021). Interaction with e-modules and collaborative activities carried out by students in this study were able to help them expand their sources of information and improve their creative thinking skills. In addition, e-modules, when used

consistently, are also considered to strengthen students' desire to learn (Wijayanto et al., 2023). Meanwhile, constructivism theory explains that students with low digital literacy can build new understanding more effectively when supported by structured authentic activities, as occurs in PjBBL e-module (Ugwuozor, 2020) Therefore, the interaction between the PjBBL e-module learning model and digital literacy is relevant in influencing the level of students' creative thinking skills in the Human and Computer Interaction course.

In contrast to previous findings, the absence of significant differences in students' social attitudes based on the application of the PjBBL model assisted by e-modules can be understood through the nature of social attitudes themselves. Social attitudes are affective competencies that tend to develop gradually, are stable, and are influenced by a broader social context rather than short-term learning interventions (Achban et al., 2023). In addition, Kerlinger defines social attitudes as relatively stable views of a social situation involving certain feelings. This also supports the notion that social attitudes are affective competencies that are more influenced by the feelings or dispositions of the students themselves than by the learning model provided. Activities in PjBBL provide opportunities for collaboration, discussion, and group work, which theoretically can foster social attitudes such as responsibility, empathy, and cooperation (Laksono & Waluyati, 2025). However, the duration of the learning process, the intensity of interaction, and the readiness of students may not be strong enough to produce significant changes within the research period. Meanwhile, *DirectInstruction*, although more teacher-centered, still allows for moderate social interaction, so there are no striking differences between groups. Basically, students' social attitudes, which include honesty, discipline, responsibility, tolerance, cooperation, self-confidence, and politeness, fall within the realm of social emotional learning (SEL) (Sethi & Jain, 2024). Social emotional learning, which seeks to develop social attitudes, takes into account the competence of educators and their ability to strengthen their relationships with students (Gimbert et al., 2023). The development of social attitudes is considered to be a slow process, as it requires the internalization of consistent values (Kim et al., 2024). Therefore, this study did not find a significant difference between the e-module-assisted PjBBL group and the DI group, because the learning time was relatively limited and the main

focus of the activities was more directed at achieving cognitive competencies rather than directly shaping social character.

Research findings showing that there is a significant difference in the social attitudes of students with high digital literacy levels and those with low digital literacy levels are supported by various previous studies on the role of digital literacy in learning in the digital age. In this case, the significant difference in social attitudes between students with high and low digital literacy confirms that in the modern learning ecosystem, digital competence is not just a technical skill, but can be assessed as a basic concept in effective digital interaction. This finding is in line with the DigComp framework which classifies collaboration and interaction through digital technology as core competencies (Vuorikari Riina et al., 2022). Students with high digital literacy have better abilities in navigating digital communication ethics, understanding information sharing norms, and managing their digital identities responsibly. These abilities are considered important for the development of higher education institutions undergoing a paradigm shift, requiring students to be equipped with digital skills to face the complexities of the job market (Hina Amin et al., 2022). Digital literacy also directly facilitates more positive social attitudes, such as empathy, tolerance for ambiguity in text communication, and willingness to share resources with peers. Therefore, digital literacy can act as a competency that transforms technical interactions into positive social interactions. This is supported by studies finding that high digital literacy is closely related to self-control and emotions of individuals, thus enabling high digital literacy to have a significant impact on the high social attitudes of students (Arias López et al., 2023). Thus, high digital literacy can be said to encourage more positive social attitudes among students, because students are not only able to use technology, but also understand ethics, empathy, and how to collaborate well in the digital world.

The next research results reveal that the insignificant relationship between the learning model interaction and digital literacy level in this study can be explained through social attitude characteristics that are theoretically more long-term and not easily changed only through project-based learning interventions or the use of technology. Aspects such as honesty, discipline, responsibility, tolerance, cooperation, self-confidence, and politeness

are part of social-emotional learning that develops through positive interactions and a supportive environment (Weems, 2024). The limited duration of the learning intervention in this study, despite involving collaborative activities, was not always able to produce significant changes in students' social attitudes in the IMK course. High digital literacy resulted in students exhibiting better social attitudes, as digital skills are more related to technical and cognitive abilities than social character. This is supported by a literature review which shows that digital literacy is narrower in scope and includes technical skills for using digital devices and services (Vercruyssen et al., 2023). The study found that the project-based learning model is not related to students' affective abilities, including social-affective abilities, creativity, and initiative to learn (Evcimik & Oruc, 2023). Previous studies have also found that technology-based project-based learning affects students' cognitive abilities but does not always have a significant impact on affective aspects such as students' social attitudes (Degeng et al., 2021). In addition, the integration of technology that supports independent learning is significantly assessed to improve learning performance and teamwork among students, but the increase in motivation and affective domain is not clearly seen due to the homogeneous learning process among students (Kumar, 2021). This is relevant to the research conducted with the integration of project-based learning and e-modules, with results explaining that there is no significant relationship between the interaction of these variables and students' social attitudes in IMK courses. Thus, the results of this study are relevant to previous findings which concluded that learning factors and digital capabilities do not have an interactive impact on students' social attitudes.

Conclusion

This study aims to examine the effect of the *Project Based Blended Learning* model assisted by e-modules on students' creative thinking skills and social attitudes in the Human-Computer Interaction course. The researcher provided interventions using the PjBBL model assisted by e-modules and *direct instruction* to each group in accordance with the syntax of the learning model. The results of multivariate and univariate tests explain that there are differences in creative thinking abilities between students who participated in the e-module-assisted PjBBL learning model and the direct instruction model. The interaction between this

model and digital literacy also shows that digital literacy has an influence on the relationship between the learning model and creative thinking abilities. Students with high digital literacy consistently demonstrated better creative thinking skills and social attitudes than students with low digital literacy. Conversely, the learning model did not significantly affect students' social attitudes, and the interaction between the learning model and digital literacy also did not affect social attitude outcomes. Overall, this study confirms that the effectiveness of technology-based learning is greatly influenced by students' level of digital literacy.

Suggestion

This study provides recommendations based on its findings, which highlight the importance of strengthening students' creative thinking skills and social attitudes in higher education. The results of the study confirm that technology-based learning is greatly influenced by students' ability to use and manage technological devices, which is referred to as digital literacy. Therefore, educators are expected to understand and apply innovative learning models that integrate technology and are relevant to students' needs and the context of the material. In implementing technology-based learning, educators are expected to consider students' level of digital literacy so that they can understand the best efforts to improve student competence with the help of technology-based learning. This study shows that the project-based learning model with a *blended* mode has proven to be effective in strengthening creative thinking skills and that digital literacy influences students' creative thinking skills and social attitudes. However, the social attitudes assessed were not directly correlated with the learning model, and the interaction of digital literacy with the learning model showed the need for learning interventions using other methods or approaches to develop students' social attitude competencies. The application of project-based learning in a blended mode assisted by e-modules is expected to create an innovative learning environment and inspire educators to support the development of student learning achievement in higher education.

Limitation

Research limited by field conditions shows that the implementation of e-module-assisted project-based blended learning requires more intervention time, especially in offline

mode. Although e-module-assisted PjBBL is capable of improving creative thinking skills, this study shows that this learning model does not significantly affect students' social attitudes. This condition indicates that the development of social attitudes requires other interventions that are more oriented towards direct interaction. Face-to-face activities such as group discussions, collaborative work in real contexts, role-playing, or field activities can enrich students' social experiences compared to online activities or considering digital literacy alone. This indicates that further research can improve the quality of project-based learning implementation in a blended mode and integrate technology while still providing a greater proportion of online and offline learning interventions so as to develop students' social competencies.

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