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Integrating *Canva*-supported project-based learning in disaster mitigation education

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ABSTRACT

This study aims to analyze the effectiveness of the Project Based Learning (PJBL) model supported by Canva in improving visual creativity and disaster understanding among grade XI students at Ma'arif NU Solokuro High School. The research employed a quantitative approach using a quasi-experimental design with two groups: an experimental group receiving PJBL-Canva-based instruction and a control group receiving conventional learning. Data were collected using pretest-posttest instruments to measure disaster comprehension and rubrics to assess visual creativity. The findings revealed that the experimental group experienced a highly significant improvement, indicated by a Sig. value of 0.000 on the Paired Sample t-test and a greater increase in mean scores compared to the control group. In contrast, the control group did not demonstrate significant improvement, as shown by a Sig. value of 0.755. The Independent Sample t-test also confirmed a significant difference between the groups with a Sig. value of 0.000. Furthermore, ANCOVA results indicated that the learning model significantly affected posttest outcomes ($F = 92.363$; $p < 0.05$), demonstrating that PJBL integrated with Canva contributed substantially to student achievement even after controlling for initial ability. Overall, this study concludes that Canva-based PJBL is highly effective in enhancing students' visual creativity and disaster-related conceptual understanding. This learning model also supports engaging, contextual, and digital-literacy-oriented instruction. Therefore, Canva-based PJBL is recommended as an innovative learning alternative, particularly for geography or subjects requiring visual creativity and deeper conceptual mastery.

INTRODUCTION

Globally, Project-Based Learning (PBL) has been widely recognised as an effective instructional approach that enhances students' engagement, higher-order thinking skills, and creativity. Extensive reviews and meta-analyses indicate that PjBL outperforms conventional instructional methods by promoting active knowledge construction, collaboration, and real-world problem solving (Kokotsaki et al., 2016; Mandouit & Hattie, 2023). Recent international studies have further confirmed that PjBL positively contributes to creative thinking and conceptual understanding across various disciplines (Kwon & Lee, 2025). However, most global research focuses on general creativity outcomes and higher education contexts, with limited attention to the integration of specific digital visual design tools within PjBL environments (Yurchenko, 2025).

In the Asian context, the adoption of technology-enhanced learning has increased significantly, particularly in geography, environmental education, and disaster-related learning. Studies conducted in Asian educational settings highlight that digital media can enhance students' engagement, spatial understanding, and affective responses toward disaster issues (Satchwell et al., 2024). Nevertheless, many of these studies remain conceptual or descriptive, emphasising pedagogical frameworks rather than empirically measuring learning outcomes or students' visual creative products through experimental designs (Nurramadhani et al., 2024b; Pramashela et al., 2023a). As a result, empirical evidence demonstrating the concrete role of digital visual tools in supporting learning within PjBL-based disaster education remains relatively limited in the Asian region.

Indonesia is among the countries with the highest levels of disaster vulnerability worldwide. This is due to its geographical position at the intersection of three major tectonic plates, Indo-Australian, Eurasian, and Pacific, as well as its location within the Pacific Ring of Fire, which has extremely high volcanic and seismic activity (Syuryansyah & Sukendar, 2023; Husyain Rifai, 2023; Evie et al., 2022). These conditions make Indonesia highly prone to various types of disasters, including earthquakes, tsunamis, volcanic eruptions, floods, landslides, tornadoes, and droughts (Monalia & D., 2024). The high intensity of disasters requires increased awareness, mitigation skills, and disaster knowledge among communities, including students, who must be prepared to face future disaster risks (Syuryansyah & Sukendar, 2023; Mahardhika & Risa Dwita Hardianti, 2025).

In Indonesia, Project-Based Learning has been widely implemented in response to curriculum demands emphasising creativity, critical thinking, and digital literacy. Several national studies report that integrating Canva into PjBL positively influences students' motivation, creativity, and learning outcomes across subjects, particularly in language and vocational education (Ulyani & Jayanti, 2025). In the context of disaster education, however, instructional practices still tend to prioritise cognitive understanding delivered through conventional methods, with limited use of digital visual media to support students' communication and creativity (Jalil et al., 2019). Consequently, existing Indonesian literature indicates a growing interest in PjBL and digital tools. At the same time, their application within disaster mitigation education and visual learning contexts remains an emerging area of pedagogical development.

Schools, as formal educational institutions, have a strategic role in building disaster literacy. Through disaster education, students can understand concepts of hazards, vulnerability, risk, and appropriate mitigation actions in emergencies. Disaster education is closely related to Sustainable Development Goal (SDG) 13, which focuses on climate action and disaster risk reduction. Implementation at the school level should be practical, experience-based, and contextual to the local environment (Suryadi et al., 2024).

Aligned with 21st-century learning paradigms, education demands integration of technology, creativity, collaboration, problem-solving, and critical thinking. The Merdeka Curriculum emphasises student-centred, project-based learning and competency development (Aulina & Nurdiana, 2024; Hidayani, 2024; Putri & Cahaya, 2024; Ulyani & Jayanti, 2025; Kwon & Lee, 2025). One of the most relevant models is Project-Based Learning (PBL), which positions students as active learners solving real problems and producing applicable products (Rahmawati & Nurlim, 2025; Husni Mubarak, 2024; Lia Januarsih et al., 2023; Putri & Cahaya, 2024).

In the context of disaster mitigation learning, PJBL provides meaningful learning experiences. Through relevant projects, students can identify disaster risks, analyse causes, and design educational products such as posters, infographics, simulation videos, or disaster education modules (Ardianto & Sumarmi, 2023). Digital technology development also supports the quality of project-based learning, including the use of Canva as a cloud-based visual design platform with creative features that enable students to produce professional visual outputs (Oktaviani et al., 2023; Zulhandayani, 2023; Fau et al., 2025; Nasution, 2024).

Visual creativity is an essential skill in modern education, involving the ability to process data, communicate messages visually, and integrate aesthetics with information. In disaster mitigation education, visual products function as communication tools to raise awareness and disseminate mitigation actions (Irfan & Jalil, 2019). Meanwhile, disaster understanding must also be strengthened through innovative learning, as conventional teaching remains theoretical and lacks experiential engagement (Nuraini et al., 2024)

However, research on the effectiveness of Canva-integrated PJBL in disaster mitigation learning remains limited, especially at the senior high school level and within religious-based schools such as Senior High School Ma'arif. Therefore, this study is essential for filling the research gap and for contributing to innovative learning models that enhance visual creativity and understanding of disasters.

This research aims to analyse the impact of Canva-based PJBL integration on visual creativity and understanding of disasters among grade XI students at Senior High School Ma'arif. The results are expected to serve as a reference for educators in designing creative, effective, and technology-oriented instructional strategies and to support schools in building a culture of disaster awareness and student involvement in school-based disaster mitigation efforts.

PjBL and constructivist learning theory

Project-Based Learning (PBL) is a learning approach that positions students as the main actors in the learning process by directly involving them in completing meaningful, authentic project tasks. This approach is rooted in constructivist learning theory, which posits that students actively construct knowledge through experience and social interaction rather than passively receiving information (Benardi, 2023). Within a constructivist learning context, PjBL stimulates students to identify real-world problems, conduct investigations, and subsequently produce products as evidence of their individual understanding of the subject matter.

PjBL has been widely recognised as effective in enhancing 21st-century skills such as critical thinking, collaboration, and creativity, as the process requires students to explore ideas and reflect on the outcomes of their own work (Voronchenko et al., 2015). Meta-analytic studies indicate that PjBL has a positive impact on students' creative thinking skills compared to conventional learning, particularly when implemented in settings that support student voice and choice (Li & Tu, 2024). The integration of digital tools within PjBL has also been reported to enrich the learning process by increasing access to resources, facilitating collaboration, and supporting the production of students' creative outputs (Voronchenko et al., 2015).

Visual Creativity as a Learning Outcome

In contemporary learning, particularly in the digital era, visual creativity has become an essential competency, as it shapes how students communicate ideas and information effectively through visual design. Visual creativity encompasses the ability to select design elements, combine colours, and organise information communicatively and aesthetically, all of which are crucial for conveying hazard mitigation messages or disaster education clearly.

Empirical studies indicate that the use of visual media in learning contexts can strengthen student engagement and support the understanding of abstract concepts. For example, digital platforms such as Canva offer students opportunities to express ideas and concepts through visual design projects, thereby expanding the possibilities for project-based learning and enhancing students' creativity in visualising scientific or social content (Ulyani & Jayanti, 2025).

Technology-Based Disaster Education

Effective disaster mitigation learning requires not only cognitive understanding of mitigation strategies but also students' capacity to communicate hazard messages visually and communicatively. Digital technology offers tools to support this process, as platforms such as Canva enable students to integrate textual content with visual graphics, thereby enhancing memory retention and individual risk communication skills.

Although many studies have examined the use of digital tools in general learning contexts, research on their specific use in disaster education remains relatively limited. Some literature emphasises the importance of integrating technology that fosters empathy and social engagement among students in geography and disaster education contexts; however, much of this research remains confined to non-technological content development or remains largely theoretical (Satchwell et al., 2024).

Research Gap and Novelty

Although numerous studies have confirmed the effectiveness of Project-Based Learning (PjBL) in enhancing students' engagement, higher-order thinking skills, and creativity, the integration of PjBL with specific digital visual design tools remains underexplored, particularly within the context of disaster mitigation education. International research by Kokotsaki et al. (2016) demonstrated that PjBL significantly improves creative thinking skills in higher education settings; however, their study focused on general creativity outcomes and did not incorporate digital design platforms such as Canva, nor did it address disaster-related learning contexts. As a result, the potential of digitally supported PjBL to enhance visual creativity and domain-specific understanding, such as in disaster mitigation, remains insufficiently examined.

Similarly, Satchwell et al. (2024) emphasised the importance of technology-enhanced learning environments in strengthening students' engagement and empathy in geography and disaster-related education. Nevertheless, their study primarily discussed digital systems at a conceptual and pedagogical level, without empirically measuring students' creative visual outputs or assessing learning outcomes through experimental designs. This indicates a gap in quantitative evidence regarding how digital tools concretely support students' visual communication skills and conceptual understanding in disaster education.

In the Indonesian context, research by Ulyani and Jayanti (2025) found that using Canva within a Project-Based Learning framework positively influenced students' writing skills and learning motivation. Despite these promising findings, the study was limited to language learning in vocational education. It did not examine visual creativity as an explicit learning outcome, nor did it address disaster mitigation as a learning domain. Consequently, there is limited national-level empirical research that investigates the role of Canva-assisted PjBL in enhancing both creative and cognitive outcomes simultaneously, especially at the senior high school level.

Furthermore, existing disaster education studies in Indonesia tend to prioritise cognitive understanding and preparedness knowledge, often employing conventional instructional methods or descriptive approaches. Few studies have systematically integrated constructivist learning models with digital visual media to support students in transforming disaster knowledge into communicative visual products. This indicates a lack of research that positions visual creativity not merely as a supplementary skill, but as a central learning outcome in disaster mitigation education.

Based on this synthesis, the key research gap lies in the absence of empirical studies that integrate Canva-supported Project-Based Learning, disaster mitigation education, and dual learning outcomes, namely disaster understanding and visual creativity, within a single quasi-experimental framework. The novelty of the present study resides in its attempt to bridge this gap by examining the effectiveness of Canva-assisted PjBL in a senior high school setting, focusing on both cognitive mastery and creative visual production. By situating digital design tools within a constructivist PjBL framework, this study contributes new empirical evidence to disaster education literature. It extends the application of multimedia-enhanced learning models in secondary education.

METHOD

This study uses a quantitative, quasi-experimental design, a Non-Equivalent Control Group Design, involving two groups: the experimental and control classes. This design was chosen because it does

not allow for perfect randomisation, but it still provides an opportunity to test the causal relationship between the Canva-based Project-Based Learning (PJBL) learning model and the increased visual creativity and understanding of students' disasters (Febriana, 2016; Kuo & Chuang, 2020). Both groups received a pretest before treatment and a posttest after the learning process was completed, allowing the change in ability to be analysed comparatively.

Table 1. Quasi-experimental design

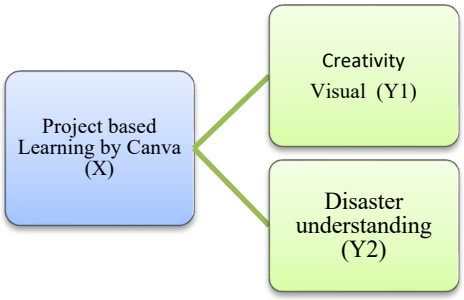
Class	Pretest	Treatment	Posstest
Experiment	O1	X	O2
Control	O1	-	O2

Information:

X : Treatment (Canva-Based PJBL Learning Model)
-: Treatment (Conventional-Based PJBL Learning Model)
O1: Pretest on experimental and control classes
O2: Posttest in experimental and control classes.

This research was carried out at Ma'arif NU Solokuro High School, focusing on grade XI students in the Geography subject. All grade XI students served as the research population, and the sample was selected using a convenience sampling technique because the class selection was adjusted to school conditions (Amin et al., 2023). The sample consisted of two classes of 30 students each. The experimental class received the Canva-based PJBL treatment, while the control class learned using conventional methods without digital media support.
The research variables included the independent variable, namely the Canva-based PJBL learning model, and two dependent variables: visual creativity and understanding of disasters. Visual creativity is measured through rubric assessments that include aspects of material suitability, design composition, visual quality, and innovation (Irfan, Jalil, 2019). Understanding of disasters is measured through objective tests and essays prepared based on competency indicators and disaster mitigation concepts set by BNPB.

Figure 1. Research variables



Data collection is carried out through tests and non-tests. Pretest and posttest measures are used to assess changes in understanding of disasters before and after interventions. A non-test instrument, in the form of an analytical rubric, is used to evaluate the visual products students produce during the Canva-based learning process. In addition, documentation of activities and observations of learning implementation are also carried out as supporting data to assess student involvement during the learning process (Remmen & Frøyland, 2014).
Before use, the research instrument has been tested for validity and reliability. The validity of the items was assessed using Pearson's correlation, and the instrument's reliability was calculated using Cronbach's alpha to assess internal consistency. All research procedures are carried out in three stages, namely the preparation stage, the experimental implementation stage, and the final stage. At the implementation stage, the experiment class follows a project-based learning (PJBL) flow that includes the formulation of essential questions, project planning, investigation, creation of visual

products using Canva, and presentation of results. Meanwhile, the control class followed conventional learning in the form of lectures, discussions, and exercises without digital media.
The data was analysed using parametric statistical tests. Prerequisite tests, including the Kolmogorov–Smirnov normality test and the Levene homogeneity test, were used to assess the suitability of parametric analysis. Furthermore, the Paired Sample t-test was used to assess improvements in learning outcomes within each group, the Independent Sample t-test to compare differences between groups, and the Covariance Analysis (ANCOVA) to assess the effectiveness of the learning model while controlling for early ability. Descriptive analysis is also used to provide an overview of the quality of visual products and students' responses to the use of Canva media (Zulhandayani, 2023). The selection of this analysis technique aligns with educational research standards that integrate PJBL models and digital technology (Nuraini et al., 2024a).
Prior to hypothesis testing, data were analysed using prerequisite tests, including the Kolmogorov–Smirnov normality test and Levene's homogeneity test. Inferential analyses included paired-sample t-tests to examine within-group improvements, independent-sample t-tests to compare posttest differences between groups, and Analysis of Covariance (ANCOVA) to control for pretest scores. In addition to statistical significance testing, effect sizes were calculated to determine the magnitude of the instructional impact. Cohen's d was used to assess the effect size of group differences, while partial eta squared (η^2) was reported for the ANCOVA results. These effect size measures provide meaningful interpretation of the practical significance of the Canva-supported PjBL intervention beyond p-values (Valentine et al., 2019). This study was conducted in accordance with ethical research principles. Permission to conduct the research was obtained from the school authorities. Students participated voluntarily, and informed consent was obtained prior to data collection. Participants' identities were kept confidential, and the data were used solely for research purposes.

RESULT AND DISCUSSION

RESULTS

The data collected from the experimental class and the control class of results before and after the test were analysed using a parametric statistical approach to determine the integration of the Canva-based Project-Based Learning (PJBL) learning model in disaster mitigation learning: its impact on visual activity and disaster understanding of grade XI students at SMA Ma'arif NU. A prerequisite for performing parametric statistical tests is that the data are normally distributed and the data variance is homogeneous.
The normality test of this study is used as a prerequisite for the t-test. In this study, the data must be normally distributed; if they are not, the t-test cannot proceed. The data can be said to be normally distributed if the significance level is > 0.05, then the data is said to be not normally distributed if the significance level is < 0.05. To perform the normality test obtained using the Kolmogorov-Smirnov test with the help of SPSS 25, the results of the normality test can be seen from the following table:

Table 2. Normality test results with *Kolmogorov-Smirnov*

		Kolmogorov-Smirnova			Shapiro-Wilk		
	Class	Statistics	Df	Sig.	Statistics	Df	Sig.
Result	Pretest A (Control)	.138	30	.150	.942	30	.104
	Postest A (Control)	.147	30	.097	.939	30	.084

	Pretest B (Experiment)	.153	30	.072	.939	30	.085
	Postest B (Experiment)	.155	30	.064	.958	30	.271

Based on the results of normality testing using two statistical approaches, the Kolmogorov-Smirnov and Shapiro-Wilk tests, it was found that all research data groups, including pretest and posttest values in both the control and experimental classes, showed a significance value (Sig.) < 0.05. This condition indicates that the empirical distribution is not significantly different from the normal distribution, so it can be concluded that all variables in this study are normally distributed.

Table 3. Homogeneity Test Results

		Living Statistic	df1	df2	Sig.
Result	Based on Mean	1.732	3	116	.164
	Based on Median	1.620	3	116	.189
	Based on Median and with adjusted df	1.620	3	114.021	.189
	Based on trimmed mean	1.747	3	116	.161

Based on the results of Levene's Test across four calculation approaches (mean, median, median with df adjustment, and trimmed mean), the overall p-value was above 0.05. These findings show that there was no significant difference in variance between the data groups. Thus, the variance of the whole group can be declared homogeneous, so that the homogeneity assumption is fulfilled and parametric statistical analysis can be followed appropriately.

Table 4. Paired Sample t-test *results (Control Class)*

					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig (2 tailed)
Pair 1	Pretest - Postest	.667	11.577	2.114	-3.656	4.990	.135	29	.755

Based on the results of the Paired Sample t-test on the pretest and posttest values in the control class, the value of Sig. (2-tailed) = 0.755 > 0.05 was obtained. Thus, there was no significant difference between the pretest and posttest scores in the control class.

Table 5. Paired Sample t-test *results (Experimental Class)*

					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig (2 tailed)
Pair 1	Pretest - Postest	-16.667	6.989	1.276	-19.277	-14.057	-13.061	29	.000

Based on the results of the Paired Sample t-test between the pretest and posttest values in the experimental class, a Sig. (2-tailed) A value of 0.000 < 0.05 was obtained, indicating a very significant difference between the pretest and posttest values in the experimental class.
Thus, it can be concluded that the learning treatment applied to the experimental class had a noticeable positive impact. In contrast, the conventional learning in the control class did not provide a significant improvement.

Table 6. Independent Sample t-test results

								95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Value	Equal variances assumed	2.726	.104	-9.127	58	.000	-19.333	2.118	-23.573	-15.093
	Equal variances not assumed			-9.127	54.627	.000	-19.333	2.118	-23.579	-15.088

Based on the results of the Independent Sample t-test, the value of Sig. (2-tailed) = 0.000 < 0.05, and the value of t = -9.127 was obtained, indicating a significant difference. Thus, H0 was rejected, and H1 accepted, indicating that the learning method applied to the experimental class was more effective than that in the control class.

Table 7. ANCOVA Test Results

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	6345.076a	2	3172.538	57.137	.000
Intercept	3063.128	1	3063.128	55.167	.000
Pretest	738.409	1	738.409	13.299	.001
Class	5128.447	1	5128.447	92.363	.000
Error	3164.924	57	55.525		
Total	286950.000	60			
Corrected Total	9510.000	59			

Based on the ANCOVA results, the class variable significantly influenced posttest scores after controlling for pretest scores (F = 92,363, p = 0.000 < 0.05). This shows that the learning method in the experimental class is significantly more effective than that in the control class at improving student learning outcomes. In addition, the pretest covariate also had a significant effect on the posttest with a value of F = 13,299 and p = 0.001 < 0.05, which means that students' initial ability also affects the final learning outcome.

DISCUSSION

The results of this study show that integrating the Project-Based Learning (PJBL) model using Canva in disaster mitigation learning significantly increases visual creativity and understanding of disasters among grade XI students at SMA Ma'arif NU Solokuro. The pretest results showed that the basic abilities of students in the experimental and control classes were almost the same. This is evident from the normality and homogeneity tests, which show a p-value above 0.05, indicating that the data are normally distributed and that the variances of the two groups are equal. This condition shows that the two classes have equal initial abilities, making it worth comparing in this study.

Beyond statistical significance, the magnitude of the effect observed in this study provides strong evidence of the educational value of Canva-based Project-Based Learning (PJBL). The ANCOVA results indicate an R^2 value of 0.667, meaning that the learning model explains 66.7% of the variance in students' posttest scores after controlling for initial ability. In educational research, this proportion represents a large effect size, suggesting that the intervention does not merely produce marginal gains but leads to substantial learning improvements. Such a high explanatory power reinforces the view that the observed differences are educationally meaningful and not merely statistically detectable. From a pedagogical perspective, a large effect size implies that Canva-based PJBL meaningfully transforms the learning experience. Students not only score higher on tests but also demonstrate deeper understanding and improved visual creativity. This finding strengthens the argument that integrating digital visual tools into project-based learning environments can significantly enhance conceptual comprehension, particularly in abstract and contextual topics such as disaster mitigation.

In the class that followed conventional learning, the Paired Sample t-test results showed no significant improvement between the initial and final test scores (p=0.755). These findings suggest that teaching methods that rely solely on lectures and simple assignments are less effective at improving students' understanding of how to reduce the impact of disasters. Conventional learning makes students more passive, only receiving information without actively participating, which makes it difficult for them to understand abstract concepts and relate them to everyday conditions. These findings are in line with the opinion (Upi Supriatna, 2023) that low participation and a lack of hands-on experience are the main causes of limited improvements in learning outcomes in traditional learning methods. In addition, education about disasters in schools is still only theoretical and does not use visual media, so it is difficult for students to understand mitigation measures as a whole(N. Nuraini et al., 2025).

In the experimental class that received Canva-based PJBL learning, posttest scores increased by a very significant amount. From the Paired Sample t-test, a Sig. A value of 0.000 was obtained, with an average score increase of 16,667 points. This improvement shows that Canva-based PJBL learning can provide a more meaningful, interactive, and contextual learning experience. This PJBL model allows students to be directly involved in completing projects, from compiling key questions and conducting research to creating visual products such as posters, infographics, and videos about disaster mitigation. This active engagement helps students understand the material through real-life experiences and teamwork. (Benardi, 2023a) He said that project-based learning (PJBL) is effective in improving critical thinking skills and conceptual understanding because it focuses on independent investigation and problem-solving.

Canva's integration in learning plays an important role in enhancing students' visual creativity. Canva as a digital design platform helps students turn information into visuals that are engaging, informative, and easy to understand. Students can choose from a variety of appropriate templates, icons, colours, and fonts to convey the message more effectively. By visualising information, students not only learn the material but also turn it into designs they create themselves, thereby strengthening their understanding (Hazarika, 2025; Zulhandayani, 2023). Similar research explains that Canva can help improve digital capabilities and design creativity because its interface is easy to use and allows users to explore visual ideas freely and creatively (Yurchenko, 2025).

The significant difference between the experimental class and the control class became more pronounced after being tested with the Independent Sample t-test. The results showed a Sig. value of 0.000 and a difference in the average score of 19.333 points. This means that students in the experimental class understand the material better than those in the control class after completing the learning process. These findings align with research (Fau et al., 2025) showing that learning with creative digital media can improve memory, enthusiasm for learning, and understanding of the material compared to previous learning methods.

An ANCOVA analysis reveals that the learning model has a significant influence on student learning outcomes, even after controlling for pretest scores. The class variable showed $F = 92.363$ and $p = 0.000$, indicating that the type of learning used is the main factor driving increases in student learning outcomes. From the R^2 value of 0.667, it can be concluded that 66.7% of the change in posttest scores was explained by the learning model, which is a very large effect size in the context of educational research. These findings align with the opinion (Nuraini et al., 2024a) that contextual learning using digital technology can significantly improve students' abilities.

In addition to improving academic skills, project-based learning with Canva also has a big impact on students' visual creativity. They can create works with neater designs, attractive colour choices, and clearer mitigation messages. The use of posters, infographics, and videos helps improve students' ability to communicate visually. As explained by Irfan and Jalil (2019), effective visual media can simplify complex messages and help people more easily understand how to reduce the impact of disasters. In addition, the process of creating this visual project helps develop twenty-first-century skills such as cooperation, creativity, communication, and the ability to use digital technology, in accordance with the needs of the Independent Curriculum (Aulina & Nurdiana, 2024a).

In general, the results of this study show that the Canva-based PJBL model is an effective, relevant, and appropriate way to learn, aligned with current educational needs. This model not only improves students' understanding of disaster concepts in real life but also encourages their creativity in conveying mitigation information in an engaging, easy-to-understand way. Therefore, the Canva-based PJBL model is highly recommended for learning geography or other subjects that require greater digital literacy, creativity, and context-based understanding.

The findings of this study align closely with constructivist learning theory, which emphasises that knowledge is actively constructed by learners through interaction with their environment rather than passively received. Canva-based PJBL allows students to engage directly with disaster mitigation concepts by designing visual products, collaborating with peers, and connecting learning materials to real-life disaster contexts. This process supports meaningful learning, as students actively interpret, reorganise, and represent information based on their prior knowledge and experiences (Ulfi Andrian Sari et al., 2024; Susilawati & Fahrozi, 2020).

Furthermore, integrating multimedia elements via Canva supports Mayer's multimedia learning theory, which posits that learners understand information more effectively when it is presented through a combination of verbal and visual representations. By transforming textual disaster information into infographics, posters, and videos, students process information through multiple cognitive channels, leading to stronger memory retention and conceptual clarity. This explains why students in the experimental class achieved significantly higher posttest scores than those in conventional learning settings.

The improvement in students' learning outcomes can also be explained through the lens of cognitive load theory. Disaster mitigation concepts often involve complex processes, abstract risks, and multi-step procedures, which may overwhelm students when delivered solely through lectures. Canva-based visual learning helps reduce extraneous cognitive load by organising information into structured, visually coherent formats. Well-designed visuals guide students' attention to essential information, allowing them to focus on understanding rather than decoding dense textual explanations.

At the same time, PJBL increases germane cognitive load by encouraging students to actively process information, make design decisions, and reflect on how best to communicate mitigation messages. This balance between reducing unnecessary cognitive burden and promoting productive mental effort contributes to deeper learning. Thus, the use of visual projects not only enhances creativity but also supports efficient cognitive processing in disaster education.

Cultural and local contextual factors also influence the effectiveness of Canva-based PJBL in this study. Disaster mitigation learning in Indonesia is highly relevant, as students often live in disaster-prone areas and are familiar with floods, earthquakes, or other natural hazards. By incorporating local disaster contexts into visual projects, learning becomes more authentic and personally meaningful. Students are not merely learning abstract concepts; they are visualising mitigation strategies directly applicable to their own environments.

Additionally, the collaborative nature of PJBL aligns well with collectivist cultural values commonly found in Indonesian educational settings, where cooperation and group responsibility are emphasised. Working together on visual projects fosters social interaction, shared responsibility, and peer learning, which further strengthens students' engagement and understanding. This cultural compatibility may partly explain the strong impact of the learning model observed in this study.

The novelty of this study becomes clearer when compared with previous international and national research on Project-Based Learning and digital media integration. Although numerous studies have confirmed the effectiveness of Project-Based Learning (PjBL) in enhancing students' engagement, higher-order thinking skills, and creativity, the integration of PjBL with specific digital visual design tools remains underexplored, particularly within the context of disaster mitigation education. For instance, Winaryati et al. (2025) demonstrated that PjBL significantly improves creative thinking skills in higher education settings; however, their study focused on general creativity outcomes and did not incorporate digital design platforms such as Canva. Moreover, disaster mitigation was not used as a domain-specific learning context, leaving the potential of digitally supported PjBL for visual creativity and contextual understanding of disasters insufficiently examined.

In addition, Satchwell et al. (2024) emphasised the importance of technology-enhanced learning environments in geography and disaster-related education, particularly in fostering student engagement and empathy. Nevertheless, their research was largely conceptual and pedagogical, without employing experimental designs or quantitatively measuring students' learning outcomes. Importantly, their study did not assess students' creative visual products or evaluate how digital tools concretely support visual communication skills in disaster mitigation learning. This highlights a gap in empirical evidence regarding the measurable impact of digital visual tools within project-based disaster education.

From a national perspective, research by (Ulyani & Jayanti, 2025) reported positive effects of Canva-assisted PjBL on students' writing skills and learning motivation in vocational education. While these findings support the pedagogical value of Canva in project-based learning, the study was limited to language-learning contexts. It did not explicitly examine visual creativity as a learning outcome. Furthermore, disaster mitigation was not addressed as a learning domain, and the study did not

involve senior high school students. As a result, empirical evidence on the effectiveness of Canva-supported PjBL for enhancing both creative and cognitive outcomes in disaster education at the secondary school level remains limited in the Indonesian context.

Unlike previous studies, the present research integrates Canva-supported Project-Based Learning within disaster mitigation education. It simultaneously examines dual learning outcomes, namely disaster understanding and visual creativity, using a quasi-experimental design. This study not only extends prior findings by situating digital design tools within a constructivist PjBL framework but also provides quantitative evidence of their effectiveness, as indicated by the large effect size obtained after controlling for students' initial abilities. By positioning visual creativity as a central learning outcome rather than a supplementary skill, this study offers new empirical insights into the disaster education literature. It strengthens the application of multimedia-enhanced, constructivist learning models in senior high school education.

Despite its strong findings, this study has several limitations that should be acknowledged. First, the sample size was limited to two classes within a single school, which may restrict the generalizability of the results to broader educational contexts. Differences in school facilities, teacher competencies, and student digital literacy levels could influence the effectiveness of Canva-based PJBL in other settings. Second, the study focused on short-term learning outcomes measured through pretest and posttest scores. Long-term retention of disaster mitigation knowledge and sustained development of visual creativity were not examined. Future research is encouraged to involve larger, more diverse samples and longitudinal designs to explore the long-term impact and broader applicability of this learning model.

CONCLUSION

This study demonstrates that integrating Canva-based Project-Based Learning (PJBL) into disaster mitigation learning is highly effective in enhancing both visual creativity and understanding of disasters among grade XI students at SMA Ma'arif NU Solokuro. Students who participated in Canva-assisted PJBL showed substantial improvements in learning outcomes compared to those who experienced conventional instructional methods. In contrast, the control class, which relied primarily on lectures and routine assignments, did not show meaningful improvement, indicating that traditional approaches are less effective in fostering deep understanding and active engagement in disaster mitigation education. Beyond its empirical findings, this study offers an important theoretical contribution to the field of educational research, particularly in constructivist and multimedia learning perspectives. By integrating a digital visual design platform within a Project-Based Learning framework, this research extends constructivist learning theory by demonstrating how students actively construct disaster-related knowledge through visual representation and collaborative project work. Furthermore, the findings support multimedia learning and cognitive load theories by showing that visual-based project outputs help students organise complex disaster information more effectively, thereby enhancing conceptual understanding and creative expression. This study positions visual creativity not merely as a supplementary skill, but as a core learning outcome in disaster education.

In terms of educational policy implications, this study's results suggest that disaster mitigation education should move beyond theoretical instruction toward more interactive, technology-supported learning models. The integration of Canva-based PJBL aligns with the Indonesian curriculum's goals of emphasizing digital literacy, creativity, and contextual learning. Therefore, policymakers and curriculum developers are encouraged to incorporate project-based digital learning strategies into disaster education programs, particularly at the secondary school level. Such an approach can strengthen students' disaster literacy, improve their ability to communicate mitigation messages effectively, and better prepare them to respond to real disasters in their local environments. Despite its contributions, this study has several limitations that open opportunities for future research. The sample size was limited to a single school, which may restrict the generalizability of the findings. Future studies are recommended to involve larger and more diverse samples across different regions

and school types. In addition, longitudinal research designs could be employed to examine the long-term retention of disaster mitigation knowledge and the sustainability of students' visual creativity skills. Further research may also explore integrating additional digital design tools or comparing different multimedia platforms to identify the most effective strategies for enhancing disaster education outcomes.

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