



IJE
International Journal of Education

Journal homepage: <https://ejournal.upi.edu/index.php/ije/index>



DIFFERENTIATED PROJECT-BASED LEARNING USING INTERACTIVE MULTIMEDIA TO IMPROVE STUDENTS' CRITICAL THINKING SKILLS

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ABSTRACT

Critical thinking is crucial in facing the challenges of the globalization era, yet traditional memory-oriented learning remains dominant. Learning innovation is needed to develop these skills. This study aims to test the effectiveness of interactive multimedia based on Google Sites and the Project-Based Learning (PjBL) model integrated with differentiated learning on students' critical thinking skills. The study was conducted at SMP Negeri 17 Mataram using a combination of the ADDIE Research and Development (R&D) model and quantitative True-Experimental (One Group Pretest-Posttest Design) experiments. Data were analyzed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) on a sample of 64 ninth-grade students. The results of the SEM-PLS analysis showed that Google Sites media had a significant positive effect on critical thinking skills ($\beta = 0.101$, $p = 0.000$) and on project-based differentiated learning ($\beta = 0.094$, $p = 0.000$). Project-based differentiated learning also had a significant positive effect on critical thinking skills ($\beta = 0.094$, $p = 0.002$). In addition, project-based differentiated learning was proven to significantly mediate the relationship between Google Sites media and critical thinking skills ($\beta = 0.062$, $p = 0.036$). The model showed that 44.7% of the variance in critical thinking skills could be explained by Google Sites media through project-based differentiated learning. This finding strengthens the theory that integrating technology as a digital scaffold with challenging and relevant innovative learning is effective in improving students' critical thinking skills. Practically, teachers are encouraged to utilize Google Sites media in implementing project-based differentiated learning to create a collaborative, innovative learning environment that accommodates the diversity of students' learning styles.

ARTICLE INFO

Article History:

Received 10 Oct 2025

Revised 07 Jan 2026

Accepted 24 Feb 2026

Available online 28 Feb 2026

Keywords:

critical thinking; differentiated learning; interactive multimedia; project-based learning

To cite this paper (in APA style):

Makmun, S., Zubair, M., Alqadri, B., Lestari, N. R. P., & Nur, H. (2026). Differentiated project-based learning using interactive multimedia to improve students' critical thinking skills. *International Journal of Education*, 19(1), 23-38.

<https://doi.org/10.17509/ije.v19i1.82770>

1. INTRODUCTION

In this era of globalization, marked by rapid change, education faces many challenging challenges. One of the most important skills students need is critical thinking, particularly in problem-solving (Alsaleh, 2020; Septiany et al., 2024). Because critical thinking skills enable students to analyze information, evaluate arguments, and solve problems successfully, critical thinking skills are essential for students in many aspects of life (Anvarovna, 2025; Arisoy & Aybek, 2021; Guo & Lee, 2023; O'Reilly et al., 2022). Teachers must be able to supervise classroom activities to help students develop critical thinking skills (Zulyusri et al., 2023). To enable and encourage the development of critical thinking skills, teachers must be able to innovate in their learning activities and foster an active and creative attitude that can trigger the growth of students' critical thinking (Astriawati et al., 2024; Blyznyiuk & Kachak, 2024; Ramadhanti et al., 2023). This is caused by the continued use of traditional learning which places more emphasis on teaching and memory (Ghaleb, 2024). Therefore, an innovative and effective pedagogical approach is needed to bridge the gap between 21st-century skills needs and classroom learning practices. This is because traditional learning is considered less effective in developing students' critical thinking skills (Laghari, 2024).

Traditional learning methods tend to limit student activities (Chen et al., 2021), so that they can weaken students' understanding and in-depth analysis skills, information evaluation, knowledge synthesis, and decision-making skills which are components of critical thinking skills (Indrašienė et al., 2021; Wu, 2024). However, the reality at SMP Negeri 17 Mataram currently shows that some students have critical thinking skills that still need to be improved, because traditional learning is still implemented. Therefore, a creative and innovative learning approach is very important to implement in order to stimulate critical thinking skills in students (Ghozali et al., 2024; Haryani et al., 2021). The critical thinking skills possessed will be a provision for students in the future.

Differentiated learning based on Project-Based Learning (PjBL) is a learning approach that has been proven to improve students' critical thinking skills as evidenced by their collaborative skills, creativity, and learning outcomes (Andriyani et al., 2024; Atmojo et al., 2020; Nestiyarum & Widjajanti, 2023). Differentiated learning recognizes the diversity of students and the implementation of learning is adjusted to the individual needs of students (Smets et al., 2020). Meanwhile, the PjBL model provides an opportunity for all students to be actively involved in completing projects that are very relevant to real life (Hussein, 2021).

The implementation of differentiated learning based on PjBL will be easier to implement if using technology media as a tool to create learning media that suits students' needs (Hakim & Wahyuni, 2024; Putri & Arifin, 2023). One of the media that is quite interactive to use in learning activities is Google Sites (Putri & Pratiwi, 2022; Wulandari et al., 2022). The interactive multimedia platform based on Google Sites is a media that can integrate several other platforms (Febrian & Nasution, 2024), so it greatly supports the implementation of differentiated learning that adapts learning to students' needs and learning styles. The teacher's task as an agent of cognitive growth, of course, the teacher must be responsible for disseminating information to students according to their needs and preferences (Struyven et al., 2019; Tamsah et al., 2021).

Teachers must be able to innovate while keeping in mind the uniqueness of their students, and the learning process must be creatively managed (Pangestu & Karwan, 2021; Ventista & Brown, 2023), because it might encourage pupils to develop their critical thinking abilities (Sari & Prasetyo, 2021). Critical thinking is a very helpful skill for pupils to develop their knowledge (Ramdani et al., 2021). Critical thinking abilities can help students overcome challenges in their everyday lives in addition to increasing their knowledge (Kwangmuang et al., 2021; Sutiani et al., 2021; Zulfikar et al., 2022). Therefore, there is little doubt that the combination of PjBL and individualized learning offers a great deal of potential to develop students' critical thinking abilities.

1.1 Differentiated Learning

Differentiated learning is based on the principle that each individual student has different learning needs (Eikeland & Ohna, 2022; Haelermans, 2022). The differences that each individual student has are very diverse, ranging from interests, talents, preferences, learning styles, to abilities (Gheysens et al., 2022; Hasanah et al., 2022; Qorib, 2024). Differentiated learning offers a learning process that is tailored to the diversity of development profiles of each student in order to meet their needs (Graham et al., 2020). Referring to the application of differentiated learning, teachers are required to adjust the learning approach used to the learning needs of students. The differentiated learning strategy itself is divided into 3 stages, namely, content as input, process, and product (Jong et al., 2022; Karimi & Nazari, 2021; Qorib, 2024). These three elements can be explained as follows:

- 1) Content differentiation (Input): what students will or have learned in learning activities (Kem, 2022; Wormeli, 2023).
- 2) Process differentiation (Method): how students acquire information and create an idea about what has been learned (Ambawani et al., 2024; Chuang, 2021; Ng et al., 2022).
- 3) Product differentiation (Output): how students will demonstrate what they have learned from the information they have received/obtained (Aprilia et al., 2023; Samawati et al., 2023).

The three stages of differentiated learning above are implemented by differentiating students into different learning groups including auditory groups, visual groups, and kinesthetic groups (Aprilia et al., 2023; Arni et al., 2024; Ikawati & Kowiyah, 2021). The three groups are determined according to the learning style of each individual student (Ishartono et al., 2021; Yusnanto & Rahayu, 2022). The practice of implementing differentiated learning requires teachers to pay more attention to students by providing a variety of learning resources and activities that are relevant to their needs as reviewed from their learning styles (Blaz, 2024; Grecu, 2023).

1.2 Project-Based Learning (PjBL)

The Project-Based Learning model is a learning model that integrates learning materials into real and relevant practices (Dean et al., 2023; Rashov, 2024; Saad & Zainudin, 2022). This PjBL model is very suitable for small-scale group learning (Zhang & Ma, 2023). This certainly has a big impact on the development of concrete problem-solving (Fiteriani et al., 2021; Karan & Brown, 2022; Maros et al., 2023). In addition to solving problems, through the PjBL model, students can also hone their teamwork skills, communicate, critical thinking skills, and develop innovative and creative ideas (Maulidah et al., 2023; Owens & Hite, 2020; Sirait & Amnie, 2023). There are 6 PjBL syntaxes according to Lucas including; 1) determining basic questions, 2) creating a project plan design, 3) creating a project plan schedule, 4) monitoring project progress, 5) evaluating project work results, and 6) evaluating learning experiences during project creation (Darussyamsu et al., 2024; Herlita et al., 2023). The syntax will be developed into learning steps that are integrated with differentiated learning.

1.3 Differentiated Learning Based on PjBL Assisted by Multimedia Google Sites

Differentiated learning based on PjBL is learning that aims to foster students' critical thinking skills (Fitri et al., 2024; Tampubolon & Sipahutar, 2024). Learning media is one of the supporters of the success of differentiated learning based on PjBL ((Fadhilah et al., 2021; Prihandini et al., 2023; Sa'diyah et al., 2024). Interactive multimedia based on Google sites is one platform that can be utilized in implementing both approaches. Google sites as interactive multimedia will be very helpful in supporting the implementation of diverse learning, because Google sites can integrate several other relevant platforms in it (Devya et al., 2022; Jendra et al., 2024). In addition, Google sites media can also be used on several devices, from laptops to gadgets (Sevtia et al., 2022), so that it can make it easier for students to access it. The features contained in it can be developed as attractively as possible (Asnidar & Junaid, 2024), and the diverse learning content can also be adjusted in layout. The flexibility of Google Sites will greatly assist teachers in delivering learning materials, either in the form of text, concept maps, images, audio, or relevant videos (Auliana et al., 2023; Nalasari et al., 2021; Nasrullah et al., 2024), so that it can provide challenges for students to analyze, evaluate arguments, and discuss solutions with their groups.

Accordingly, using Google Site as an interactive tool can help implement PjBL-based differentiated learning effectively and motivate students to hone their critical thinking abilities (Gesya et al., 2023; Hidayati et al., 2024). The six components of critical thinking skills are as follows; 1) interpretation, namely the capacity to classify the issues encountered, 2) analysis, which is the capacity to comprehend broad ideas by breaking them down into numerous, intricate components, 3) interaction, specifically the capacity to pose questions, consider potential answers, reach conclusions, resolve issues, and reach decisions, 4) exploration, which includes the capacity to identify arguments, communicate analysis findings, and explain issues, 5) evaluation, which involves assessing the ideas put forth, and 6) self-control, which is carrying out independent research and making corrections to oneself (Maksum et al., 2021; Pursitasari et al., 2020). Students that possess critical thinking abilities might use field practice to enhance their problem-solving abilities more successfully (Afdillah et al., 2024; Kamila et al., 2024). This ability is highly dependent on a set of skills training and dispositions, such as learning interactions that provide motivation to students (Fikriyati et al., 2022; Nieto & Valenzuela, 2012; Sari et al., 2021). Critical thinking skills are very important as provisions for students in this era of globalization.

Previous research has shown the effectiveness of differentiated learning and PjBL by utilizing several platforms as learning media in improving various aspects of learning, including critical thinking skills (Ananda et al., 2022; Makmun et al., 2023; Mckibben & Murphy, 2021; Setyawati et al., 2022). However, to the best of our knowledge and research, there has been no empirical research that integrates differentiated approaches and PjBL by utilizing interactive multimedia based on Google Sites as a learning medium. This indicates a gap in the literature regarding the effectiveness of the synergy of these three innovative elements (differentiated learning, PjBL, and Google Sites) in the context of improving critical thinking skills. Therefore, this study aims to explore differentiated learning based on PjBL assisted by Google Sites multimedia as an innovative solution in developing students' critical thinking skills. This study focuses on the Pancasila and Citizenship Education subjects for Grade IX at SMP Negeri 17 Mataram. This research is expected to contribute to the development of a more effective and relevant learning approach to the needs of students in the 21st century.

1.4 Hypothesis Development

Differentiated learning strategies integrated with the PjBL model are quite complex collaborations and have strong potential to help students acquire the information, skills, and expertise needed in real-world situations (Astriawati et al., 2024; Atmojo et al., 2020; Menggo & Ndiung, 2024), so that they can hone students' critical thinking skills.

According to the findings of an empirical study by Sevtia et al. (2022) on enhancing conceptual understanding and critical thinking through the creation of Google Sites learning materials, students' conceptual and critical thinking abilities could be enhanced by the Google Sites-based learning materials. According to the study on the effect of differentiated learning on critical thinking literacy by Qorib (2024) students can develop their critical thinking abilities by using differentiated learning to better understand themselves and improve their communication, thinking, and self-confidence. Additionally, a study by Hikmah et al. (2023) on the impact of PjBL on critical and creative thinking abilities revealed that students' critical and creative thinking abilities were significantly impacted by the use of the PjBL model. As a result, a research framework was developed, as shown in Figure 1 below.

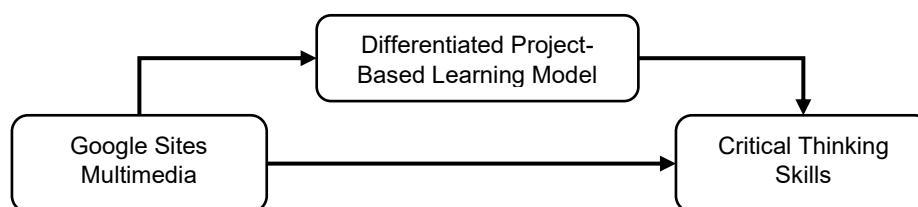


Fig. 1 – Research Framework

Since the integration of the three can meet students' learning needs according to their abilities and learning styles (Setemen et al., 2023), it can be concluded from the foregoing that PjBL-based differentiated learning supported by Google Sites multimedia will give students a more meaningful understanding and learning experience (Aprilia et al., 2023). For this reason, H1, H2, H3, and H4 are proposed.

H1: The use of Google Sites multimedia has a positive and significant influence on students' critical thinking skills.

The hypothesis of this study is supported by the facilities provided by Google Sites, its features are fairly flexible because they are easy to set up and adjust to needs. Through these features, teachers can present learning content that challenges students to analyze, evaluate arguments, and solve problems, so that it can stimulate students' ability to think critically.

H2: The use of Google Sites multimedia has a positive and significant influence on the implementation of differentiated learning based on Project-Based Learning.

In order to adapt learning activities to the specific needs of students in PjBL learning, the research hypothesis is predicated on the claim that Google Sites media is an interactive multimedia platform that can help integrate different learning resources like text, concept maps, images, audio, and video.

H3: Implementation of differentiated learning based on Project-Based Learning has a positive and significant influence on students' critical thinking skills.

The research hypothesis is based on several previous research findings which show that differentiated learning and PjBL are learning methods that are able to adapt to students' needs, so that they can improve collaborative skills, creativity, and synthesis skills which are important components of critical thinking.

H4: The use of Google Sites multimedia has a positive and significant influence on students' critical thinking skills mediated by differentiated learning based on Project-Based Learning.

The research hypothesis is a combination of the three previous hypotheses, which proposes that Google Sites is used as a mediator in implementing PjBL-based differentiated learning, which has an impact on improving students' critical thinking skills.

2. METHOD

This research was conducted at State Junior High School (SMP) 17 Mataram located in Jempong Baru Village, Sekarbela District, Mataram City, NTB Province, Indonesia. As part of the Kemendikbud Ristek program, learning is one of the important elements that must be maximized and made successful in order to produce superior human resources. SMPN 17 Mataram is considered appropriate as a location for conducting experiments, because the learning process that is often applied is traditional learning that is only centered on the teacher.

2.1 Data Collection and Sample Profile

This study uses a combination of research and development methods (R&D) and quantitative research. The research and development method is used to produce interactive multimedia products (Setiyawan et al., 2021), which are then tested for effectiveness through a quantitative approach. (Sardana et al., 2023), by utilizing the Structural Equation Modeling analysis technique based on Partial Least Squares (SEM-PLS). The development model used in this study is the ADDIE model, which consists of five structured processes, namely Analysis, Design, Development, Implementation, and Evaluation (Daryanes et al., 2023). This model is used because it has a series of structured and straightforward steps, making it easier to access, as shown in Figure 2.

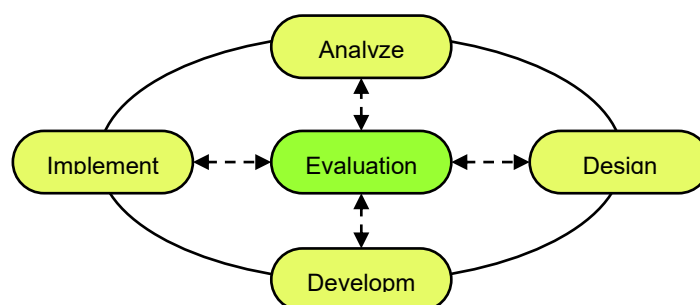


Fig. 2 – Google Sites Multimedia Development Model

The quantitative method used in this study is an experiment with the type of tru-experiments with the aim of manipulating the process of implementing differentiated learning based on PjBL. The design used is One Group

Pretest-Posttest Design, which aims to test the effectiveness of multimedia that has been developed using questionnaires and tests, as illustrated in Figure 3 (Creswell & Creswell, 2018). The questionnaire was used to evaluate how interesting the use of multimedia and the learning model that had been developed was, using a 5-point Likert Scale with criteria of 1 = Strongly Disagree (STS), point 2 = Disagree (TS), point 3 = Neutral (N), point 4 = Agree (S), and point 5 = Strongly Agree (SS).

While the test is used to measure students' critical thinking skills using critical thinking ability components that have been arranged in the form of essay questions. The population in this study was all ninth-grade students at SMP Negeri 17 Mataram, totaling 128 students. To ensure a representative sample of this population, a random sampling technique was used, involving all ninth-grade students randomly, thus providing an equal opportunity for individuals to be included in the study (Creswell, 2009). This approach was used because it aims to minimize sampling bias, so that it can reflect the characteristics of the entire ninth-grade student population at SMP Negeri 17 Mataram. The sample in this study amounted to 64 students. According to Leedy & Ormrod if the population is <100 respondents, all should be used, but if the population is 100-500, the sample is taken 15-50% (Supratiknya, 2015). Data collection was carried out by conducting a pretest in four classes before carrying out the treatment simultaneously and a posttest after the treatment was carried out simultaneously (March 2023 to April 2023).

Respondents in this study were spread fairly evenly based on gender. In terms of age group, there were 34.4% of students aged 14 years, then 60.9% of students aged 15 years, and students aged 16 years were only 4.7%. The respondent's study group consisting of four classes was also dominated by class C with a total of 34.4% of students, followed by classes A and B with the same number of around 20.3% of students, and class D was the least, around 25% of students. The demographic details of this research sample are presented in Table 1.

Table 1. Demographic Information

Aspect	Item	Frequency	Percentage
Gender	Man	29	45,3%
	Woman	35	54,7%
	Total	64	100%
Age	14	22	34,4%
	15	39	60,9%
	16	3	4,7%
	Total	64	100%
Study Group	Class A	13	20,3%
	Class B	13	20,3%
	Class C	22	34,4%
	Class D	16	25%
	Total	64	100%

Source: *Direct Research*

2.2 Media Development

The ADDIE method used in this study is able to minimize errors in the product to be developed. This is because the evaluation stage is prioritized over each stage, as illustrated in Figure 2. The stages carried out in this study using the ADDIE model through five phases include: 1) Analysis is carried out as a preliminary study by conducting needs analysis and curriculum analysis; 2) Design is carried out as a planning stage in developing complex teaching materials according to the results of needs and curriculum analysis, then making a development design paying attention to the storyboard flowchart, then compiling student assessment instruments, designing learning scenarios, and designing multimedia learning navigation; 3) Development is carried out to compile multimedia, starting from compiling the text of the material that will be used in the Google Sites multimedia product, to archiving supporting media. Furthermore, development is carried out on the appearance and layout of the media, such as learning videos, explanatory descriptions in the form of audio or visuals, images, virtual lab links, online LKPD, assignments, and short videos that are relevant to the material; 4) Implementation is carried out as a form of application of multimedia that has been developed in four classes and using the same learning model, namely differentiated learning based on PjBL in the same conditions; 5) Evaluation is carried out as a form of reflection on the multimedia that has been developed by providing an assessment of the products that have been developed. The flow of the five phases is illustrated in Figure 4. Product validation in this case is carried out by media experts, learning design experts, and material experts according to the criteria contained in the instrument. The results of the validation are then used as a basic reference for carrying out the first revision, as contained in Table 2. The product was then tested on several students, who then used it as a basic reference for the final revision as shown in Table 3. After the final revision was carried out, the multimedia product was considered final and complete, so a feasibility test was carried out. After that, the final evaluation was carried out through the pretest-posttest stages to determine the effectiveness of the multimedia that had been developed.

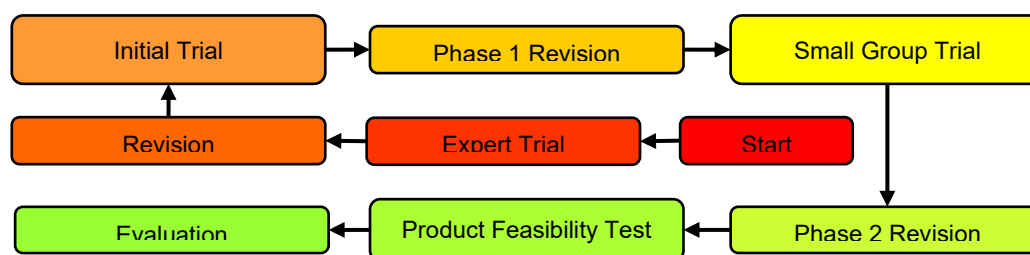


Fig. 3 – Product Trial Flow

The feasibility instrument used in this study was a questionnaire in the form of a statement in the form of a product validation sheet given to the validator to be filled in. The questionnaire aims to obtain quantitative data compiled based on learning multimedia assessment indicators, as shown in Table 3. The data in question is related to the analysis of the product design that has been developed, which is then analyzed as a result of the assessment of the product that has been developed (Daryanes et al., 2023).

In accordance with its purpose, the ADDIE model is used to design and develop valid, effective, efficient, and interactive learning media. The assessment carried out on the validation sheet uses a 5-point Likert Scale score, point 1= Very Bad (STB), point 2 = Not Good (TB), point 3 = Fairly Good (CB), point 4 = Good (B), and point 5 = Very Good (SB). The data validation analysis technique used is quantitative descriptive, by calculating the percentage of data that has been filled in on the product validation sheet, to then be converted into validity criteria for eligibility, as shown in Table 2. The formula used to calculate the percentage.

Table 2. Multimedia Eligibility Percentage

Percentage Criteria	Multimedia Eligibility Criteria	Scorer	Percentage (%) Acquisition	Category
81%–100%	Very Worth It	Media Expert	90,7%	Very Worth It
61%–80%	Worthy	Subject Matter Expert	97,3%	Very Worth It
41%–60%	Quite Decent	PPKn Teacher	93,3%	Very Worth It
0%–40%	Not feasible	Average	93,8%	Very Worth It

Source: *Expert Assessment*

The results of the feasibility test, from the developed Google Sites multimedia as depicted in Figure 5. shows that the developed Google Sites multimedia is very feasible. After the feasibility validation test was carried out, the next step was to test the effectiveness of using Google Sites multimedia on the "National Defense" material based on critical thinking ability indicators that had been developed into questions to be answered by students through a posttest after the implementation of learning, as listed in Table 4. The effectiveness test was carried out simultaneously with the path analysis test that would be used with the SEM-PLS model.

Table 3. Google Sites Based Multimedia Assessment Indicators

No	Assessment Indicators
Display Design (Jendra et al., 2024).	
1.	The display design is in accordance with the characteristics of the use of interactive learning media.
2.	The images on the multimedia display are very clear.
3.	The videos on the multimedia display are very clear and easy to understand.
4.	The sound in the learning videos and audio contained in the multimedia display can be heard clearly.
5.	The menu display of learning multimedia makes it easier for users
6.	The text contained in all parts of the multimedia can be read and is easy to understand.
7.	Buttons on all features found on the media have consistent channel access.
8.	Multimedia background does not interfere with the display.
9.	The colors used in the display are consistent and not flashy.
10.	The buttons on the multimedia menu make it easy for users to access according to their individual learning styles, interests and abilities.
Animation (Asnidar & Junaid, 2024)	
1.	The animations used in each multimedia display are very easy to understand.
2.	Google sites-based multimedia that is developed is interactive and differentiated
3.	The animations used in each multimedia display are adjusted to the characteristics of the user.
User Ease (Sevtia et al., 2022)	
1.	The developed multimedia is easy to use and multi-access.
2.	Instructions on each display are easy for users to understand.
3.	Multimedia contains clear rules and directions for users according to their interests, styles and learning abilities

Based on the assessment indicators of the multimedia, multimedia google sites has quite complex and very interesting components, as can be seen in Figure 4. In addition, in each section, there are also features that direct students to the desired page, of course, must be based on instructions from the teacher. Thus, the

development of multimedia google sites has a complexity that greatly helps teachers and students in delivering material together to students who have different learning styles, interests, and preferences.

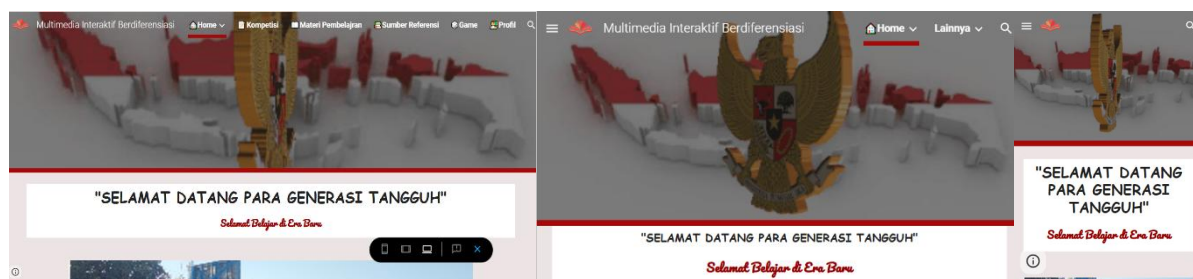


Fig. 4 – Google Sites Multimedia View on Laptop, iPad, and Smartphone

2.3 Measurement Item Development

The measurement items in this study are indicators that will be used as a basis for measuring the role of interactive multimedia based on Google Sites as a mediation between integrated PjBL learning and differentiated learning on students' critical thinking skills. The measurement indicators used in this study are PjBL learning syntax integrated with differentiated learning, Google Sites multimedia elements, and critical thinking skills indicators, which are then developed as tools to measure each research variable, as shown in Table 4. The PjBL learning syntax consisting of 6 elements is taken from Herlita et al. (2023), while the differentiated learning component is taken from Qorib (2024). The multimedia elements developed as measurement items are taken from Nasrullah et al. (2024). Furthermore, the critical thinking skills component is taken from Maksum et al., (2021) and Pursitasari et al. (2020).

Table 4. Measurement Items

Item	Measurement Indicator
PjBL Syntax Integrated Differentiated Learning (Herlita et al., 2023; Qorib, 2024).	
PjBL1	Teachers ask basic questions to create projects that are relevant to the interests and level of understanding that students have
PjBL2	Teachers give freedom to student groups so that students feel more flexible in designing project plans that suit their learning styles and preferences.
PjBL3	Teachers provide sufficient time to complete projects in the most effective manner according to students' learning styles.
PjBL4	The teacher provides feedback that can help each group of students understand the progress of our project and provide the support they need.
PjBL5	Teachers assess projects according to learning objectives and provide students with opportunities to demonstrate their understanding in different ways.
PjBL6	The teacher evaluates the students' learning experiences during the project creation process, focusing on reflection on the learning process.
Google Sites Multimedia Elements (Nasrullah et al., 2024)	
MGS1	The multimedia design of Google Sites is quite attractive, easy to access, and has navigation that directs me to learn according to the learning style I want.
MGS2	The layout of this Google Sites multimedia has clear and easy-to-understand instructions, and the navigation buttons take me to the page I want.
MGS3	The learning content presented in this Google Sites multimedia is quite clear and varied, relevant to the way I want to learn, and directs me to learn according to my level of understanding.
MGS4	The appearance of Google Sites multimedia makes it easy for me to adjust how I should study and what material I should study.
MGS5	After carrying out this lesson using Google Sites multimedia, I have a better understanding of what national defense is and how I apply it in my daily life.
Components of Critical Thinking Skills (Maksum et al., 2021; Pursitasari et al., 2020)	
CTS1	Students are able to identify threats and challenges to countries and group them according to type and the impact.
CTS2	Students are able to understand global issues relevant to national defense and break them down into more specific aspects.
CTS3	Students are able to formulate alternative solutions to overcome threats to a country, make the right decisions, and be responsible.
CTS4	Students are able to explain the importance of defending the country and set an example concretely from the results of the analysis that has been carried out using simple arguments that are easy to understand and convincing.
CTS5	Students are able to assess the validity of information and arguments related to national defense, and distinguish between true and false information.
CTS6	Students are able to learn independently and in groups about national defense and are able to evaluate personal contributions to national defense efforts.

2.4 Common Method Variance

To ensure the validity of the measurement items of each variable used as an analysis of the findings of this study and to overcome potential problems related to common method variances (CMV), we use uone factor (Hair & Alamer, 2022). One factor test was conducted on all questionnaire items involving the implementation of exploratory factor analysis (EFA), as shown in Table 5. Construct validity test was conducted in this study using two methods, namely convergent validity and discriminant validity. The recommended discriminant validity threshold is <0.85 and the recommended convergent validity threshold is above 0.50 (Fornell & Larcker, 2016). Construct reliability testing was also carried out in this study as part of measuring the internal consistency of the variables, the threshold of 0.70 is acceptable (Hair et al., 2017), including the Composite Reliability and Cronbach's alpha measurements.

3. RESULTS AND DISCUSSION

This study uses Structural Equation Modeling (SEM) as a modeling method which is analyzed using Partial Least Squares (PLS) statistical techniques to test the research hypothesis. This is because PLS-SEM shows very good work in terms of statistics. (Hair et al., 2017), thus allowing researchers to obtain more accurate results. In addition, the technique used SEM-PLS is also a concern for researchers, because it can handle small sample sizes and non-normally distributed data (Cassel et al., 1999). In this section, the researcher details the results of the data analysis carried out using the SEM-PLS technique. The research framework and its results are as depicted in Figure 1. in this study consists of three constructs including, Multimedia Google Sites, Differentiated Learning and Project Based Learning (PjBL), and Critical Thinking Skills.

3.1 External Model Validation and Scale

The construct quality was evaluated using the outer model evaluation, comprising reliability, convergent validity, and discriminant validity tests. The loading factors exceeded the 0.70 threshold recommended by Hair et al. (2011), indicating acceptable indicators. Construct reliability was confirmed as all Composite Reliability and Cronbach's alpha values were above 0.70. Additionally, no multicollinearity issues were found since all Variance Inflation Factor (VIF) values remained below 3 (Hair et al., 2011). The complete results are presented in Table 5.

For construct validity, convergent validity was satisfied with Average Variance Extracted (AVE) values exceeding the 0.50 threshold (Hair & Alamer, 2022), demonstrating a solid construct basis (Fornell & Larcker, 2016). Discriminant validity was also established, as the square root of the AVE for each construct was greater than its correlations with other constructs (Fornell & Larcker, 2016). This was further supported by the heterotrait-monotrait (HTMT) ratios, which safely fell below the <0.85 benchmark (Hair & Alamer, 2022), as detailed in Table 6.

Table 5. Loading Factor, Construct Reliability, and Convergent Validity

Item	Loading Factor	Cronbach Alpha	Composite Reliability	AVE	VIF
CTS1	0,830	0,898	0,921	0,659	1,248
CTS2	0,820				
CTS3	0,840				
CTS4	0,806				
CTS5	0,761				
CTS6	0,813				
MGS1	0,828	0,852	0,895	0,630	1,000
MGS2	0,818				
MGS3	0,767				
MGS4	0,825				
MGS5	0,724				
PjBL1	0,786	0,882	0,910	0,629	1,248
PjBL2	0,837				
PjBL3	0,705				
PjBL4	0,855				
PjBL5	0,708				
PjBL6	0,852				

Note 1 : CTS = Critical Thinking Skill; MGS = Multimedia Google Sites; PjBL = Differentiated Project Based Learning;

Based on the results of the analysis conducted on the loading factor analysis, it shows that all items strongly measure their respective constructs. Furthermore, the reliability of the construct, first seen from the Composite Reliability value obtained by the CTS construct of 0.921, MGS of 0.895, and DPjBL of 0.910. Furthermore, it is also seen from the Cronbach's alpha value, obtained in the CTS construct of 0.898, MGS of 0.852, and DPjBL of 0.882. This means that the indicators in each construct consistently measure the construct that should be measured. While the convergent validity seen from the AVE value, first in the CTS construct obtained 0.659, MGS 0.630, and DPjBL 0.629, so it is said that all constructs are valid and reliable. The results of the examination of multicollinearity problems that were also carried out were indicated by the VIF value with the acquisition of the CTS construct of 1.248, MGS 1.000, and DPjBL 1.248. These results reveal that there is no multicollinearity problem among the variables in the model, so that it can support further testing.

Table 6. Discriminant Validity of HTMT, Fornier, and Larcker

	CTS	MGS	PjBL	HTMT		
				CTS	MGS	PjBL
CTS	0,812			-	-	-
MGS	0,615	0,794		0,675		
PjBL	0,509	0,446	0,793	0,544	0,486	-

Note 1 : CTS = Critical Thinking Skill; MGS = Multimedia Google Sites; PjBL = Differentiated Project Based Learning;

Note 2 : The numbers in bold indicate the square root of AVE;

Note 3 : The numbers at the bottom of the CTS, MGS and PjBL shows the HTMT ratio.

The discriminant validity test confirms that each construct in the research model is distinct and does not overlap with others. As shown in Table 6, the square root of the AVE for each construct is greater than its correlations with the remaining variables. Furthermore, the HTMT ratios are entirely below the 0.85 threshold, indicating that discriminant validity requirements are fully met.

3.2 Inner Model

Structural equation modeling, often known as internal modeling, evaluates the postulated relationships in verifying the proposed hypothesis. By using bootstrapping, the weight of each path coefficient can be determined. This technique is used in conducting hypothesis testing by determining the significance of the correlation between variables. Table 7. and Figure 6. present the results of the analysis of the hypotheses proposed in this study.

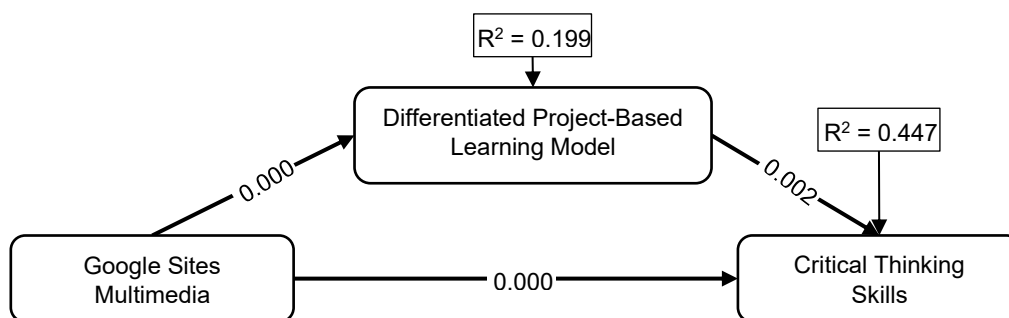
Table 7. Summary of Hypothesis Test Results

Hipotesis	Path	Standardized Path Coefficient	t-value	p-value	Kesimpulan
H1	MGS -> CTS	0,101***	4,793	0,000	Supported
H2	MGS -> PjBL	0,094***	4,721	0,000	Supported
H3	PjBL -> CTS	0,094**	3,114	0,002	Supported

Note 1 : CTS = Critical Thinking Skill; MGS = Multimedia Google Sites; PjBL = Differentiated Project Based Learning;

Note 2 : *** = p-value < 0.001; ** = p-value < 0.010; * = p-value < 0.50.

Based on the results of hypothesis 1 testing, Multimedia Google Sites (MGS) has a significant influence on Critical Thinking Skills (CTS). This is indicated by a positive and significant standardized path coefficient value ($\beta = 0.101$, t value = 4.793, p value = 0.000). The path coefficient of $\beta = 0.101$ indicates that there is a positive relationship between MGS and CBT. Thus, hypothesis 1 is supported. Multimedia Google Sites (MGS) also has a significant influence on Differentiated Learning & PjBL (DPjBL), as seen from the positive and significant standardized path coefficient, ($\beta = 0.094$, t-value = 4.721, p-value = 0.000), indicates a positive relationship between MGS and DPjBL. Thus, hypothesis 2 is supported. Furthermore, hypothesis 3, Differentiated Learning and PjBL (DPjBL) have a significant influence on Critical Thinking Skills (CTS), seen from the positive and significant standardized path coefficient, ($\beta = 0.094$, t-value = 3.114, p-value = 0.002), The value of $\beta = 0.094$ indicates a positive relationship between DPjBL and CTS.

**Fig. 5 – Path Coefficient Standardized and the Significance of the Inner Model**

The evaluation of the internal model used in this study aims to estimate R^2 and path coefficients. Based on Figure 5, the R^2 value and the structural path coefficient value used in this study, which can show how much the independent variable can explain changes in the dependent variable. Based on this, the R^2 value in this study was obtained for the differentiated learning and PjBL variables of 0.199, which means that 19.9% of the integrated Differentiated learning variables of the PjBL model are explained by the Multimedia Google Sites variable. While for the Critical Thinking Ability variable, the R^2 value obtained was 0.447, which means that 44.7% of the Critical

Thinking Ability variable can be explained by the Multimedia Google Sites variable through the integrated Differentiated learning variables of the PjBL model.

3.3 Mediation Test

Mediation analysis as one of the hypotheses in this study was carried out to determine whether the model used in this study works well statistically. This mediation analysis allows for a path investigation process to see the causal relationship between variables through indirect effects (Rasoolimanesh et al., 2021).

Table 8. Mediation Test Results

Hypothesis	Path	Standardized Path Coefficient	t-value	p-value	Conclusion
H4	MGS -> PjBL -> CTS	0,062*	2,094	0,036	Supported

Note 1 : CTS = Critical Thinking Skill; MGS = Multimedia Google Sites; PjBL = Differentiated Project Based Learning;

Note 2 : *** = p-value < 0.001; ** = p-value < 0.010; * = p-value < 0.50.

According to the analysis results in Table 8, which are included in hypothesis 4, it shows that Differentiated Integrated Learning (PjBL) has a significant mediation effect on the relationship between Multimedia Google Sites (MGS) and Critical Thinking Skills (CTS). This is indicated by the standardized beta value obtained ($\beta = 0.062$, t -value = 2.094, p -value = 0.036), which means that PjBL contributes significantly as a mediator in the relationship between Multimedia Google Sites and Critical Thinking Skills. This path coefficient (β) indicates the strength and positive direction of the mediation effect.

The success of the educational process in a school is part of achieving national education goals, of course through an effective and efficient teaching and learning process. Through effective and efficient learning, with the use of technology, and adjusting the learning process to the needs and learning styles of students, it will have a significant impact on the development of student knowledge and the success of the learning process according to educational goals. This discussion judges the research hypothesis based on the data collected and its wider implementation.

This study confirms that Differentiated Project-Based Learning (PjBL) drives junior high school students' critical thinking skills (CTS). The integration of Google Sites multimedia (MGS) enables teachers to deliver diverse and challenging materials that support this model. Critical thinking is highly influenced by motivation and mental habits (Nieto & Valenzuela, 2012), meaning that structured environments focusing on active questioning, analysis, and argument evaluation effectively stimulate these skills (Darussyamsu et al., 2024; Tampubolon & Sipahutar, 2024). Furthermore, effective inquiry-based learning devices can prompt critical development via challenging problem-solving activities (Sutiani et al., 2021) while accommodating students' individual preferences and needs (Nestiyarum & Widjajanti, 2023; Struyven et al., 2019).

A robust learning medium ensures clear communication and effective goal achievement. Implementing media or modules that engage students directly in problem-solving yields a significant effect on their CTS (Tampubolon & Sipahutar, 2024), a trend mirrored by the positive impact of MGS found in this study (Hidayati et al., 2024). Using digital media creates meaningful learning experiences that cultivate higher-order capabilities (Geszy et al., 2023). Conversely, relying solely on technology without an integrated pedagogical model restricts critical growth, as these skills require complex, challenging problems to properly develop (Ananda et al., 2022; Fadhilah et al., 2021).

Combining differentiated learning with PjBL alongside MGS establishes a comprehensive framework for activating student competencies. Differentiated instruction guarantees that contents align with unique learning styles (Grecu, 2023; Qorib, 2024), while PjBL bridges knowledge application with practical problem-solving (Zulyusri et al., 2023). Concurrently, MGS serves as a flexible, interactive platform to deliver material, foster collaboration, and provide feedback (Devya et al., 2022; Febrian & Nasution, 2024; Nalasari et al., 2021; Putri & Pratiwi, 2022; Sevtia et al., 2022). This alignment reflects Vygotsky's scaffolding theory, where structured digital intervention regulates information flow to minimize working memory cognitive load (Nooijen et al., 2024). Ultimately, utilizing technology alongside innovative pedagogy nurtures the independent, critical, and creative capabilities crucial for addressing 21st-century educational challenges.

3.4 Implications of the results

The results of this study provide quite significant implications for learning theory, especially in the context of technology integration with innovative learning in implementing learning activities. Based on the research findings that reveal the application of differentiated learning integrated with the PjBL model and assisted by Google Sites multimedia has a good impact on improving students' critical thinking skills, strengthening the concept of scaffolding (Karimi & Nazari, 2021; Nooijen et al., 2024). Based on this, the findings of this study reveal that Google Sites multimedia has an effective function as a digital scaffolding that provides various supports in implementing structured and gradual learning, thus enabling students to achieve a higher level of understanding.

In addition, the findings of this study support that a learning environment that is challenging and relevant to students' needs, then implemented through real practices, triggered by real questions and problems, is able to stimulate students' critical thinking skills (Alsaleh, 2020; Geszy et al., 2023; Kamila et al., 2024; Saad & Zainudin, 2022). The findings of this study also underline the importance of considering the motivation and mental habits of students who are trained through the implementation of learning by facing challenges. Through the challenges

given, students become more trained and accustomed to facing challenges, so that they are able to train their mental habits and know how to respond to the challenges they are facing. (Nieto & Valenzuela, 2012).

Based on this, the findings of this study can enrich the understanding of the importance of building active interactions in learning activities. Furthermore, the use of technology in the world of education cannot be avoided, because technology has become an integral part of everyday life that offers various opportunities to improve the quality and effectiveness of learning. (Asnidar & Junaid, 2024; Qorib, 2024). Thus, understanding how technology plays a crucial role in education, especially in the development of interactive multimedia is very important for teachers in carrying out their profession. Technology-based multimedia integrated with a learning model that emphasizes the learning process on problem solving, will certainly be very innovative and help students improve their critical thinking skills.

The practical implications of this study are very relevant for teachers in implementing learning practices and curriculum development. Judging from the findings of this study, Google Sites multimedia is one of the alternative tools that is quite effective in supporting the implementation of differentiated learning integrated with PjBL. The results of this study also show that the integration of the three provides flexibility in delivering learning materials, because using Google Sites multimedia is able to facilitate student collaboration. (Febrian & Nasution, 2024; Nestiyarum & Widjajanti, 2023; Qorib, 2024). Therefore, teachers are encouraged to utilize this Google Sites multimedia platform in carrying out their profession as educators. The implementation of learning by creating a conducive and challenging learning environment for students also stimulates their critical thinking skills. This can be implemented through the application of the PjBL learning model which has elements of real practice in its implementation, and involves students in problem solving. (Sari & Prasetyo, 2021; Tampubolon & Sipahutar, 2024). Furthermore, this study emphasizes the importance of differentiated learning, by paying attention to student diversity. (Graham et al., 2020; Haelermans, 2022).

Through differentiated learning, teachers can ensure that each student gains a complex understanding of the material. In addition, teachers also ensure that each student receives support that suits their needs and learning styles. This certainly has an impact on students' mastery of the material, which triggers the growth and development of their critical thinking skills. (Arisoy & Aybek, 2021; Herlita et al., 2023). Thus, it can be said that teachers as facilitators and motivators must be able to provide constructive feedback. (Blyznyuk & Kachak, 2024), thus creating a meaningful learning experience for students. In addition, continuous evaluation and reflection are essential in the implementation of learning, to ensure that the learning process is carried out effectively and is relevant to students' needs.

Based on this, this study provides practical guidance for teachers in implementing learning activities that can accommodate student diversity. Through the application of differentiated learning integrated with the PjBL model and assisted by multimedia-based technology media Google Sites, it provides a complex learning experience for students. (Asnidar & Junaid, 2024; Febrian & Nasution, 2024; Zulyusri et al., 2023). This is certainly the basis for the growth and development of students' critical thinking skills. (Arisoy & Aybek, 2021; Hidayati et al., 2024; Saad & Zainudin, 2022), because the learning process is carried out according to the individual needs of students using Google Sites multimedia and field practice through the application of problem-based learning. This kind of learning practice is certainly very collaborative and innovative, so that its implementation can have a significant impact on students' critical thinking skills.

4. CONCLUSION

Learning that involves students in various practices and problem-solving allows them to gain a deep and complex understanding of the material, build collaboration and communication skills, which triggers the development of their critical thinking skills. This study focuses on the development of Google Sites multimedia that supports the implementation of integrated differentiation learning using the PjBL model through experiments to test the effectiveness of the developed Google Sites multimedia which further supports integrated differentiation learning using the PjBL model in growing and developing students' critical thinking skills. This finding offers the use of technology media, especially Google Sites multimedia, as an alternative effective learning medium and the application of an integrated differentiation learning model using PjBL that can help students develop their critical thinking skills, thus becoming provisions for students in facing the challenges of the 21st century, and students also gain meaningful learning experiences. However, this study has limitations because it focuses on model analysis using PLS-SEM that highlights the relationships between constructs (Multimedia Google Sites, Differentiated Learning and PjBL, and Critical Thinking Skills), and may not fully capture the in-depth qualitative aspects of classroom implementation. Theoretical implications suggest that this integration strengthens the concept of scaffolding as a digital scaffold and supports the theory that challenging and relevant learning environments can stimulate critical thinking skills. Practically, this study suggests that teachers utilize Google Sites as a flexible medium to facilitate differentiated learning and PjBL, emphasizing the role of teachers as facilitators and the importance of continuous evaluation and reflection to ensure the relevance and effectiveness of the learning process.

5. ACKNOWLEDGEMENT

We would like to express our deepest gratitude to the media experts who have contributed their time and expertise to provide validation of the case method-based interactive learning media Articulate Storyline. Constructive feedback and suggestions from experts have been very helpful in improving the quality and effectiveness of this learning media. We also thank all parties who have supported and contributed to this research.

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