



Effectiveness of Digital Media-Based Contextual Learning on Critical and Creative Thinking Skills in Photosynthesis for Elementary Students

Gumgum Gumilar^{*1}, Harsono¹, Murfiah Dewi Wulandari¹, Choiriyah Widyasari¹

¹Universitas Muhammadiyah Surakarta, Indonesia

This study aims to examine the effectiveness of contextual strategies based on digital media in improving critical and creative thinking skills on photosynthesis material in elementary schools. This study was conducted at SDN Sukasenang, Singaparna, Tasikmalaya, West Java. The population and sample of this study were fourth-grade students, with a total of 116 students. The sampling technique used was availability sampling or area sampling using a quantitative experimental control group pretest-posttest research method. Data were collected through pretest and posttest tests, and analyzed using the t statistical test and one way ANOVA. The results showed that contextual learning strategies based on digital media were effective in improving students' critical and creative thinking skills, with a significant increase in posttest scores compared to pretests. The average contextual score on critical thinking skills increased from 80.93 on the pretest to 87.52 on the posttest, and the average contextual score on creative thinking skills increased from 74.86 on the pretest to 81.40 on the posttest. This study confirms that digital media-based contextual strategies have a positive impact on the development of critical and creative thinking skills of grade 4 students of Sukasenang Tasikmalaya public elementary school, with digital media-based contextual strategies on critical thinking skills showing superior results. Based on these findings, researchers hope to make a meaningful contribution to the development of the world of education.

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*Correspondence

Gumgum Gumilar

ggumgumilar@gmail.com

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INTRODUCTION

Education in Indonesia continues to evolve along with the need to face global challenges. In this digital era, technology has become an integral part of everyday life, including in education. Education that focuses on skill development can help students to better solve problems, innovate, and adapt to rapid changes. Quality improvement towards better understanding of learning materials especially for students at the elementary level is influenced by technological advancements. Learning processes that use digital technology as a tool or medium to deliver learning materials, interact between teachers and students, and facilitate online or computer-based teaching and learning processes (Alojaiman, 2021; Brod et al., 2023; Tyerman-Marsh, 2024). In addition, digital learning can also facilitate collaboration between students and provide a more interactive learning experience through technologies such as videos, simulations, and learning games (An & Oliver, 2021; Marshall et al., 2022).

Digital media-based learning refers to any form of learning that uses information and communication technology (ICT) to deliver, support, and enrich education. Digital learning is a learning process that uses digital technology as a tool or medium to deliver learning materials, interact between teachers and students, and facilitate online or computer-based teaching and learning processes (Alojaiman, 2021). This approach includes the use of educational software, applications, internet, and multimedia to support learning. (Brod et al., 2023; Tyerman-Marsh, 2024). In addition, digital learning can also facilitate collaboration between students and provide a more interactive learning experience through technologies such as videos, simulations, and learning games (Marshall et al., 2022). It includes the use of digital technologies to support the learning process inside and outside the classroom. Digital-based learning can increase student engagement, enrich learning materials, and provide flexibility in time and place of learning (Daniel, 2019). Digital learning enables student engagement, as well as the provision of more varied materials, and flexibility in the teaching and learning process.

Learning strategy is one of the references in delivering messages in the teaching and learning process. Contextual is an approach that aims to connect teaching materials with real experiences and situations that students face every day. This approach aims to make learning more relevant and meaningful, thus increasing student engagement and understanding. According to (Markwick & Reiss, 2024), Contextual learning strategy is an approach that emphasizes the connection between teaching materials and real experiences and situations that students face every day. (Markwick & Reiss, 2024) added that, contextual learning can

encourage students to relate new knowledge to students' daily experiences and seek creative solutions to problems faced. (Markwick & Reiss, 2024) argued that, Contextual learning strategies can increase student motivation because teaching materials that are relevant to students' real lives can make the learning process more interesting and meaningful. In addition, (Markwick & Reiss, 2024) explained that, The implementation of contextual learning strategies in the classroom involves organizing activities that facilitate students in applying students' knowledge and abilities in a real-world context.

The integration of contextual learning strategies and the use of digital media is an approach that aims to create relevant, actual and meaningful learning experiences for students. This strategy links learning materials with real-life contexts and utilizes digital technology that is familiar to students as a means of exploration and self-expression. Thus, the learning process becomes more dynamic, interactive and adaptive to the times. This approach encourages active student involvement, strengthens critical and creative thinking skills, and challenges students to connect new knowledge with concrete experiences, solve real problems, and innovate through various available digital resources. Contextual strategies based on digital media also emphasize the importance of connections between subject matter and life experiences, the surrounding environment, and the social and cultural context of students (Habibi, 2016; Fiorella & Zhang, 2018), so it is expected to create a more meaningful learning environment and have a positive impact on the development of students' overall competencies. This allows students to improve their critical and creative thinking skills in the learning process.

Critical and creative thinking skills are important competencies in 21st century learning. Critical and creative thinking skills through contextual strategies can be developed by linking learning to real-life situations, encouraging students to think critically, and providing varied stimuli to spark creativity. This strategy also encourages students to understand the material more deeply, develop initiative, and make their own decisions. (Saad et al., 2024) reveal that critical thinking is a thinking process used to formulate rational decisions based on the evaluation of arguments and available evidence. Critical thinking skills are the ability to think logically, rationally, systematically, and thoroughly through problem identification, information gathering, evidence evaluation, argument development, and decision making (Ding et al., 2022; Dobozy & Cameron 2018). Meanwhile, creative thinking is intelligence, imagination, insight, ideas, and hypotheses for solving problems (Bascandziev, et al., 2018; Brod et al., 2020). Essentially, the definition of creative thinking is related to undergoing a process to produce something that has never existed before, is original, and is meaningful (Brod. G & Breitwieser., 2020). Creative thinking basically involves the

process of creating ideas or solutions that have never existed before, are original, and have meaning and relevance in the context of solving learning problems.

Natural and Social Sciences is one of the subjects taught in elementary school with the aim of introducing and developing students' basic knowledge and skills in understanding nature and their surroundings. Natural and Social Sciences is a subject that integrates basic concepts from natural and social sciences ([Damsa et al., 2019](#)). The teaching of natural and social sciences involves various topics, including biology, physics, chemistry, and geography, which are adapted to the cognitive development level of students at the elementary education level ([Jayawardana, 2017](#)). According to Ministry of Education and Culture Regulation No. 21 of 2016, the teaching of natural and social sciences must be conducted in an integrated, contextual, and problem-based manner to improve the quality of education. The integration of natural and social sciences refers to the relationship between natural phenomena and social changes, as well as how their interaction affects human life and the surrounding environment ([Rocha-Bravo & Golovátina-Mora., 2024](#); [Wedyawati & Lisa., 2019](#)). Topics such as photosynthesis in natural and social sciences are important subjects to introduce at an early age. Through a contextual approach using digital media, students can understand the photosynthesis process in a more concrete and enjoyable way, for example through visual simulations or interactive videos.

The Ministry of Education and Culture shows that many students in Indonesia have not yet achieved the expected level of critical and creative thinking skills. According to the (Kemendikbud report, 2020), "most students still show difficulties in developing higher-order thinking skills, including critical and creative thinking" ([Kemendikbud, 2020](#)). As previous research studies have indicated, teachers still tend to explain material in a verbalistic manner ([Khoiriyah, 2014](#); [Pertiwi & Putra., 2023](#)). This poses a significant challenge for the education sector in Indonesia. The lack of these skills can be attributed to various factors, including learning strategies that are not varied and irrelevant to the students' life contexts. This is why the researcher conducted this study at Sukasenang State Elementary School in Tasikmalaya.

[Table 1 about here.]

Sukasenang Tasikmalaya public elementary school was chosen as the research location based on several considerations. First, this location has good access to digital technology, which is important for the implementation of digital media-based learning strategies. Second, this location has a fairly representative diversity of students, so the research

results are expected to provide a more comprehensive picture. Third, this location has strong support from the school and local education authorities, enabling the research to be conducted smoothly and effectively.

This study has several novelties and new contributions compared to previous studies. First, this study examines contextual strategies based on digital media in the context of developing critical and creative thinking skills. Second, this study was conducted at the elementary school level, which is still rare. Third, this study uses data from the Ministry of Education and Culture that shows the level of critical and creative thinking skills of students in Indonesia, providing a relevant and actual context. As in previous studies, ([Suhandi & Kurniasri, 2019](#)) found that the contextual learning model can enhance students' learning independence. Additionally, research by ([Anjarsari et al., 2022](#)) found that contextual-based instructional materials are effective in improving students' critical thinking skills. ([Hamzah et al., 2024](#)) found that the use of technology in learning can enhance interactivity, collaboration, and access to broader information, all of which contribute to the development of critical and creative thinking skills. The approach and problem-solving strategies in this study involve mapping and projecting digital media-based contextual strategies to enhance students' critical and creative thinking skills.

Based on this background, this study aims to test the effectiveness of contextual strategies based on digital media in improving critical and creative thinking skills in photosynthesis material in elementary schools. The results of this study are expected to contribute significantly to the development of future learning strategies.

METHOD

Research Design

This type of research is experimental research using quantitative research methods. Quantitative research is a method of processing numerical data and analysis using statistics ([Privitera., 2022](#); [Sutama et al., 2022](#)). Experimental research is a systematic, logical, and thorough form of research conducted to control conditions. Experimental research is conducted to determine the effect of a particular treatment on another under controlled conditions ([Sutama et al., 2022](#)). This quantitative research method uses a control group pretest-posttest research model. The control group pretest-posttest experimental research model or approach is an experimental study without random sampling. ([Sutama et al., 2022](#)). The following is the research flow presented in the Table 2.

[Table 2 about here.]

Based on the above explanation, this research design consists of two classes. The purpose of this research is to determine the differences between digital-based contextual learning strategies and critical and creative thinking skills.

Participants of the Study

The research was conducted at Sukasenang Public Elementary School, Singaparna, Tasikmalaya, West Java, 46417. The research was conducted in May. The population and sample of this study were fourth-grade students, with a total of 116 students. Consisting of 4 classes (4A, 4B, 4C, 4D) with 29 students each. The sampling technique used in this study was availability sampling or area sampling. Availability Sampling or Area Sampling is a method where samples are selected from all available subjects ([Sutama et al., 2022](#)). This technique involves selecting samples from the available subjects.

Instruments

Questionnaires are a data collection technique that involves providing respondents with a set of written questions and statements to be answered using a Likert scale. Questionnaire/question sheet to measure critical thinking and creative thinking skills (pre-test and post-test). Modules/teaching materials and learning media for both strategies (textual and digital-based contextual) as part of the treatment (see Appendix on modules & media). Research instruments are validated through a questionnaire validation process. The validity and reliability of the instrument or questionnaire are assessed before the research is conducted to ensure that the questions are valid and consistent ([Leavy., 2022](#)). Validity and reliability tests are conducted to assess the validity or suitability of the instrument used.

This experimental study used a pretest-posttest design. Pretest scores were used to measure students' abilities before the treatment. Meanwhile, posttest scores were used to measure students' abilities after the treatment. In line with what was stated by ([Rogers & Revesz, 2020](#)), the pretest aimed to ensure class comparisons before the treatment. Meanwhile, the posttest allows researchers to determine the direct impact of the treatment on the outcome variable. This is in line with the statement by ([Privitera, 2022](#)) that pretest scores are used to measure students' abilities before the treatment, while posttest scores are used to measure students' abilities after the treatment. Furthermore, according to Pretest aims to ensure class comparison before treatment, while posttest allows researchers to determine the direct impact of treatment on outcome variables ([Privitera., 2022](#); [Rogers & Revesz, 2020](#); [Sutama et al., 2022](#); [Gravetter & Forzano, 2018](#)). Thus, the pretest serves as a basis to ensure that the classes being compared have equivalent abilities before the

treatment is administered. After the treatment, the posttest allows researchers to evaluate the direct impact of the treatment on the outcome variable.

Data Analysis Techniques

Data analysis techniques used include normality tests, homogeneity tests, t-tests, one-way ANOVA tests, and descriptions of pretest-posttest scores. In ANOVA (Analysis of Variances), significance values are used in practice; variance analysis can serve as a hypothesis test ([Leavy., 2022](#); [Daniel., 2019](#)). The analysis of variance (ANOVA) obtained through data collection from this study uses statistical methods with the assistance of SPSS 25 for Windows software. Additionally, if the data is normal using the Independent Sample t-test, then to determine the t-value, the t-test formula below can be used.

$$t = \frac{M1 - M2}{SDBM}$$

Description:

t	= R-Ratio / t-Test / t Calculated Analysis
M1	= Average in Group 1
M2	= Average in Group 2
SDBM	= Standard Error of Mean Difference

RESULT AND DISCUSSION

Results

This study was conducted in Grade 4 of Sukasenang Public Elementary School (Tasikmalaya) to test the effectiveness of digital media-based contextual learning strategies on elementary school students' critical thinking and creative thinking skills in Natural and Social Sciences, specifically on the topic of photosynthesis. Based on a sample of 116 students, the effectiveness was assessed using statistical analysis with t-tests and one-way ANOVA to compare the average scores in each class. The results of the class analysis are explained in the table 3.

Normality Test

[\[Table 3 about here.\]](#)

Based on the table above, the Kolmogorov-Smirnov value is greater than 0.05 for critical and creative thinking abilities, so it can be concluded that the data is normally distributed.

Homogeneity Test

[\[Table 4 about here.\]](#)

Based on the table 4, the test of homogeneity of variance shows a significance value greater than 0.05 in critical and creative thinking abilities, so it can be concluded that the data is homogeneous.

Paired Sample Correlation Test

[\[Table 5 about here.\]](#)

Based on the table 5, paired samples correlations show that the significance value of critical thinking and creative thinking abilities is greater than 0.05, namely 0.684, so it can be concluded that there is no correlation or relationship between critical and creative thinking abilities.

Paired Samples T Test

[\[Table 6 about here.\]](#)

Based on the table 6, the paired samples t-test shows that the t-value is 84.58 and the sig. (2-tailed) value is less than 0.05, so it can be concluded that there is a difference between critical thinking and creative thinking abilities.

One-Way Anova Test

[\[Table 7 about here.\]](#)

Based on the table 7, it shows that the significance value of 0.000 is smaller than 0.05 in critical and creative thinking abilities, so it can be concluded that there is a difference.

Data Description

[\[Table 8 about here.\]](#)

Based on the table 8, it shows that the highest mean is the contextual class for critical thinking skills with a score of 87.52 and the contextual class for creative thinking skills with a score of 81.40.

Discussions

[\[Figure 1 about here.\]](#)

The results of the study indicate that digital media-based contextual learning strategies are more effective in improving students' critical and creative thinking skills. Digital media-based contextual strategies in photosynthesis material are able to stimulate imagination and curiosity about real experiences in the students' environment and help them to more easily understand

concepts and develop them through analytical and imaginative activities.

Critical Thinking Skills

[\[Figure 2 about here.\]](#)

Critical Thinking Skills, improving students' critical thinking skills by emphasizing the connection between material and real-life contexts, such as students' daily experiences. This makes it easier for students to analyze, evaluate, and make logical decisions related to the concept of photosynthesis. This finding is consistent with research by (Suhandi & Kurniasri, 2019; Nareswari et al., 2024; Anjarsari et al., 2022), which shows that contextual learning tools improve understanding and critical thinking.

Creative Thinking Skills

[\[Figure 3 about here.\]](#)

Creative Thinking Skills, improving students' creative thinking skills by emphasizing the connection between material and real-life contexts triggers the exploration of new ideas and innovative solutions, especially when students connect photosynthesis with real life (e.g., plants around the school). These results are consistent with the findings of (Gu et al., 2024; Hamzah et al., 2024; Yustina et al., 2021), which show that the use of learning technology with a contextual approach can encourage students' creativity in problem solving.

Contextual Implications for Critical & Creative Thinking

[\[Figure 4 about here.\]](#)

Contextual Implications for Critical & Creative Thinking, this strategy not only enhances students' abilities but also creates a more meaningful learning environment. Students become more motivated, active, and engaged in the learning process. This supports 21st-century learning, which emphasizes critical thinking, creativity, collaboration, and communication. These findings are reinforced by research from (Harsono et al., 2022), which found that the use of educational media can boost students' enthusiasm. (Febriansyah et al., 2023) found that digital technology-based media is highly effective in the learning process. Additionally, (Wahyuningtyas & Sulasmono, 2020) found that the use of educational media significantly influences students' learning outcomes in science education content. Based on the results of this study and other similar studies, the researchers can demonstrate that this study not only aligns with previous findings but also adds novelty and new evidence that strengthens the argument that digital-based contextual strategies are effective in enhancing elementary school students' critical and creative thinking skills.

[\[Table 9 about here.\]](#)

The correlation between the level of student engagement in classroom learning can improve student understanding. This study proposes an approach that integrates contextual learning strategies in a digital context. This approach offers advantages in utilizing digital technology to enrich the learning experience, create an interactive learning environment, and facilitate active learning that directly involves students between learning strategies, critical thinking, and creative abilities.

CONCLUSION

Digital-based contextual learning strategies have been proven effective in improving the critical and creative thinking skills of elementary school students in the subject of photosynthesis. This is demonstrated by a significant increase in post-test scores compared to pre-test scores. Critical thinking skills have improved significantly because contextual strategies present learning situations that are real and relevant to students' daily lives. Students' creative thinking skills improved thanks to their active involvement in exploring contextual problems and devising innovative solutions.

The results of this study provide insight that the use of digital-based contextual strategies can be a more effective approach to developing students' critical and creative thinking skills, especially in science and social studies learning. For curriculum developers, these findings serve as a foundation for designing instructional materials that are not only content-oriented but also promote higher-order thinking skills by leveraging digital media. For the education sector, the implementation of digital-based contextual strategies underscores the importance of transforming learning from conventional patterns toward active, collaborative, and meaningful learning.

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LIST OF TABLES

1.	Table Gap Analysis	143
2.	Table Research Process.....	144
3.	Table Normality Test	145
4.	Table Homogeneity Test.....	146
5.	Table Paired Sample Correlation Test	147
6.	Table Paired Samples T Test	148
7.	Table One-Way ANOVA Test.....	149
8.	Table Data Description	150
9.	Table Relevant Previous Research Studies	151

TABLE 1 / Table Gap Analysis

No	Study (researcher, year)	Main focus	Sample / Context	Key findings	Identified gaps
1	Suhandi & Kurniasri (2019).	Contextual learning model (general)	Fourth Grade Elementary School (local studies)	Enhancing student learning independence	Lacks focus on digital media integration and does not specifically address the topic of photosynthesis; the completeness of higher-order thinking instruments is limited.
2	Anjarsari, Rochmiyati & Distrik (2022).	Development of contextual teaching materials for critical thinking	Thematic teaching materials (elementary school)	Contextual teaching materials effectively improve critical thinking	Has not yet tested the combination of local context + interactive digital media; focus is more on printed/thematic teaching materials rather than complete digital packages.
3	Gu, Ritter, & Dijksterhuis (2023).	Online creativity training (media context)	Online program (general, not elementary school)	Learning media can enhance creativity	The context is not elementary school and not a basic science topic (photosynthesis); transfer to an elementary school setting (attention limitations, children's digital literacy) needs to be tested.
4	Hamzah, Abdullah & Ma (2024).	Integration of technology and innovative pedagogy (systematic review)	Extensive literature review	Technology drives creativity and interactivity	Theoretical review — lack of field studies in elementary schools specifically on the topic of photosynthesis using a combination of PBL + local context + digital assets.

TABLE 2 / Table Research Process

Stage	Description
Research Design	Quasi-experiment with pretest-posttest control group model
Instruments	Critical and creative thinking tests (pretest-posttest), digital modules and media
Procedures	Pretest – Treatment (digital contextual strategy) – posttest

TABLE 3 / Table Normality Test

Tests of Normality				
		Kolmogorov-Smirnova		Description
		Statistic	Sig.	
Critical Thinking Skills	Contextual Learning	0.158	0.061	Normally Distributed
Creative Thinking Skills	Contextual Learning	0.161	0.054	Normally Distributed
a. Lilliefors Significance Correction				

TABLE 4 / Table Homogeneity Test

Test of Homogeneity of Variance		
	Sig.	Description
Critical Thinking Skills	0.142	Homogeneous
Creative Thinking Skills	0.199	Homogeneous

TABLE 5 / Table Paired Sample Correlation Test

Paired Samples Correlations			
	Correlation	Sig.	Description
Critical Thinking Skills & Creative Thinking Skills	0.055	0.684	No Connection

TABLE 6 / Table Paired Samples T Test

Paired Samples Test					
	Mean	Std. Error Mean	t	Sig. (2-tailed)	Description
Critical Thinking Skills	28.3621	0.55448	84.58	0.000	There are differences
Creative Thinking Skills	23.6724				

TABLE 7 / Table Normality Test

Tests of Normality				
		Kolmogorov-Smirnova		Description
		Statistic	Sig.	
Critical Thinking Skills	Contextual Learning	0.158	0.061	Normally Distributed
Creative Thinking Skills	Contextual Learning	0.161	0.054	Normally Distributed
a. Lilliefors Significance Correction				

TABLE 8 / Table One-Way ANOVA Test

ANOVA		
	Sig.	Description
Critical Thinking Skills	0.000	There are differences
Creative Thinking Skills	0.002	There are differences

TABLE 9 / Table Data Description

Descriptives				
Class	Descriptive Statistics	Mean	Minimum	Maximum
Contextual - Critical Thinking	Pretest	80.93	71	94
	Posttest	87.52	71	97
Contextual - Creative Thinking	Pretest	74.86	60	87
	Posttest	81.40	73	90

LIST OF FIGURES

1.	Learning Materials and Resources	153
2.	Critical Thinking Skills Learning Activities	154
3.	Creative Thinking Skills Learning Activities	155
4.	Contextual Learning Activities for Critical and Creative Thinking	156

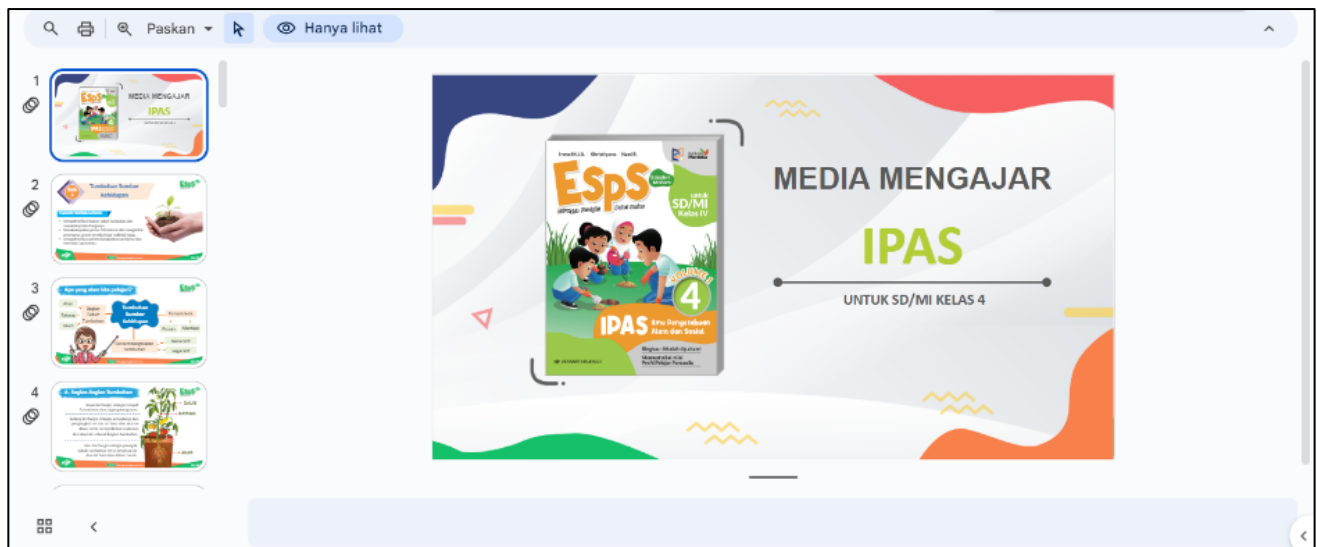


FIGURE 1 / Learning Materials and Resources



FIGURE 2 / Critical Thinking Skills Learning Activities



FIGURE 3 / Creative Thinking Skills Learning Activities



FIGURE 4 / Contextual Learning Activities for Critical and Creative Thinking