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Meta-Analysis and Bibliometric Review: Comparison of Digital and Non-Digital Innovation Media in Contextual Learning for Enhancing Critical Thinking in Scopus-Indexed Science Publications (2020-2024)

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ABSTRACT

The development of a curriculum through a contextual approach is widely recognized as an effective way to enhance students' critical thinking skills. Therefore, to improve critical thinking the contextual approach employs two main types of innovations: digital media (including augmented reality, virtual classes, and digital games, etc) and non-digital innovations (SSCS, PBL, and Thinking Empowerment, etc). However, debate exists on whether digital media's immersive engagement or non-digital methods' personalized, hands-on experience is more effective for delivering contextual learning and enhancing critical thinking.This study performs a meta-analysis and bibliometric analysis to assess the effectiveness of contextual learning using both digital and non-digital media in boosting critical thinking skills. Adhering to PRISMA guidelines, a literature search identified 16 studies published between 2020 and 2024 that met the inclusion criteria. These studies were analyzed using VOS-viewer to visualize research trends and SPSS for statistical tests, including ANCOVA with effect size. The Kolmogorov-Smirnov test result was 0.081 > α 0.05, Levene's test result was 0.29 > α 0.05, ANCOVA significance was 0.927 > α 0.05, and the effect size was 0.01. The findings indicate that both digital and non-digital media effectively enhance critical thinking skills, with no significant difference in their effectiveness. This implies that the choice between digital and non-digital methods should depend on factors such as accessibility, cost, and personal preference, as both approaches are equally effective for fostering critical thinking in a contextual learning environment.

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INTRODUCTION

Development of a curriculum with a contextual approach has long been recognized as an effective method for developing critical thinking skills among students. This approach allows students to connect lesson materials with real-world situations, making learning more relevant and meaningful (Budiman et

al., 2021). The development of a curriculum with a contextual approach is a process of designing a curriculum that emphasizes the importance of linking lesson materials with real-life situations, thus making learning more relevant and meaningful for students.

This approach is based on the theory of constructivism, which posits that students build their own knowledge based on their experiences and interactions with their environment (Angelico, 2022). However, there is still debate about the relative effectiveness of digital versus non-digital media in the context of contextual learning. Some studies show that digital media can have a more significant impact on students' critical thinking skills, while others find that non-digital media innovation remain effective, particularly in situations that require direct interaction and group discussion (Mentari & Syarifuddin, 2020).

This research aims to conduct a meta-analysis and bibliometric analysis of published studies on the effectiveness of contextual learning with digital and non-digital media. The interconnection between various subjects is also a focus in contextual curriculum development. By demonstrating the relationships between different discipline students can understand how concepts from various subjects are interrelated and support a more holistic understanding of the world around them. Authentic assessment is another essential principle in the contextual approach. Instead of relying on traditional written tests, assessment in this approach focuses more on students' ability to apply their knowledge in real-life situations(Nasrah et al., 2024). This assessment can take the form of projects, presentations, or portfolios, providing a clearer picture of students' practical abilities and understanding. The application of these principles makes the contextual approach in curriculum development not only more engaging and relevant but also helps students develop the skills necessary to succeed in real life(Sevinc, 2022). Along with technological advancements, various learning media, both digital and non-digital innovation, have been integrated into the contextual learning process to enhance its effectiveness. Digital media, such as e-learning, educational applications, and educational games, offer high interactivity and accessibility. These media enable students to learn independently with instant feedback, which can accelerate the learning process and increase motivatio(Ssenyonga, 2022)n. On the other hand, non-digital media, such as textbooks, communication approaches, printed modules, and physical teaching aids, remain important learning resources, especially in environments with limited access to technology(Kolar & Hodnik, 2021).

The contextual approach in education has various manifestations designed to connect lesson materials with real-world situations, making learning more relevant and meaningful for students. One popular manifestation is the STEM (Science, Technology, Engineering, and Mathematics) approach, which emphasizes the integration of these four disciplines to solve real-world problems. In the STEM approach, students are encouraged to apply scientific and technical concepts in practical projects, helping them understand how science and technology play a role in everyday life(Roehrig et al., 2021). Besides STEM, there is also the Problem-Based Learning (PBL) approach. PBL is a student-centered learning method where students learn about a subject through an open-ended and complex problem-solving process. Students work in groups to identify what they know, what they need to learn, and how they can solve the given problem. This process not only enhances critical and analytical thinking skills but also develops collaborative and communication abilities (Djou et al., 2023).

The contextual approach can also manifest in other forms, such as Project-Based Learning (PJBL), where students work on long-term projects that require in-depth research and the application of knowledge to produce a final product or presentation. PJBL encourages students to develop time management, research, and presentation skills while deeply learning the subject matter through hands-on experience(Firdani & Al, 2023). Contextual Teaching and Learning (CTL) is also a significant manifestation of the contextual approach. In CTL, learning is designed to help students understand concepts by connecting them to real-life contexts (B. Yasin et al., 2023). This can be done through various strategies such as experiential learning, cooperative learning, and inquiry-based learning, all of which aim to make learning more meaningful and applicable. These

approaches demonstrate that contextual learning is not a one-dimensional method but a spectrum of methods that can be tailored to the needs and contexts of students. These various manifestations bring us, to the primary goal is to make learning more engaging and relevant as well as to develop the skills students need to face real-world challenges(DUDE, 2020).

Critical thinking skills play a very important role in education and everyday life. This ability allows individuals to deeply analyze information, evaluate evidence, and make rational decisions based on logical thinking(Meneses, 2020). In an increasingly complex world full of diverse information, critical thinking skills help individuals filter relevant and valid information and avoid being influenced by misleading or inaccurate information. Moreover, critical thinking encourages individuals to question assumptions, identify biases, and understand various perspectives, all of which contribute to the development of a more holistic and profound understanding of the issues at hand. The selection of critical thinking skills as a variable in this study is based on the importance of these skills in the context of contextual learning. The contextual learning approach strives to connect lesson materials with real-world situations, and to do this effectively, students need to develop critical thinking skills. With these skills, students can link theoretical concepts with practical applications, analyze real situations, and formulate creative and effective solutions.(Goodsett, 2020) Additionally, measuring critical thinking skills can provide a clearer picture of the effectiveness of various learning media (both digital and non-digital) in enhancing the quality of learning and student understanding. Therefore, critical thinking skills were chosen as the main variable in this study to assess the extent to which contextual learning approaches with various media can influence students' ability to think critically and face real-world challenges(Surapaneni, 2024).

METHOD

Research Method

Research Design

This research aims to evaluate the effectiveness of contextual learning using digital and non-digital media in enhancing critical thinking skills. The study employs a meta-analysis and bibliometric analysis approach to provide a comprehensive and systematic overview. A literature search was conducted to identify relevant studies on the effectiveness of contextual learning with digital and non-digital media in improving critical thinking skills. The primary database used is ERIC (Education Resources Information Cente). Meta-analysis presented in this study, given that the selection of work has been done on the basis of clearly defined and explained criteria for inclusion(Sánchez-Serrano et al., 2022). In addition, the selection process was designed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Declaration)(Urrútia & Bonfill, 2010).

Criteria of Inclussion

Meta analisis is presented in this study, given that the selection of work has been done on the basis of clearly defined and explained criteria for inclusion. In addition, the selection process was designed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-AnalysesDeclaration). The search was conducted with Eric during the first week of July 2024. The search was restricted to the decade 2020–2024. The search terms were “contextual curriculum critical thinking”, Then, the following criteria for inclusion were applied to the search results:

1. The data was published in the 2020-2024 Timeframe
2. “Contextual” or “Critical thinking” appear in the title, abstract or keywords and related to science education
3. The are journal article with method experimental or RnD (research and development)
4. Subject or sample on journal article was on secondary level (grade 8-12)
5. They evaluate Contextual learning or with contextual approach or its manifestation impact on critical thinking
6. Journal articles indexed by Scopus Q1, Q2, or Q3

Instrument

The instruments required for this research include several key tools to ensure a comprehensive and systematic analysis. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework is used for screening and selecting

relevant articles, ensuring that only studies meeting the inclusion criteria are considered. VOS-viewer is employed to visualize and analyze research trends, allowing for the identification of key clusters and patterns in the literature. SPSS (Statistical Package for the Social Sciences) is utilized to conduct statistical tests, specifically the ANCOVA test with effect size, to evaluate the effectiveness of digital media compare with non-digital media in enhancing critical thinking skills.

Data Analysis Techniques

The flowchart summarizes the process of identifying, screening, and including studies for a systematic review based on specified inclusion criteria. Initially, a search in the ERIC database yielded 5,352 records. Before screening, 4,584 records were removed because they did not comply with criterion 1, which specified the document type and required that the data be published between 2020 and 2024. This left 768 records to be screened further. During the screening process, 361 records were excluded because they did not meet criterion 2, which required that "contextual" or "critical thinking" appear in the title, abstract, or keywords, and that the study be related to education. Additionally, 59 records were excluded for not meeting criterion 3, which required the studies to be journal articles with experimental or research and development (RnD) methods. Furthermore, 307 records were excluded for not meeting criterion 4, which specified that the subject or sample be at the secondary education level (grades 8-12).

Following this screening, 41 reports were sought for retrieval. However, 8 reports could not be retrieved, leaving 33 reports to be assessed for eligibility. Of these, 10 reports were excluded because they did not comply with criterion 5, which involved evaluating contextual learning or its impact on critical thinking. Another 7 reports were excluded for not meeting criterion 6, which required that the journal articles be indexed by Scopus in Q1, Q2, or Q3. Ultimately, 16 studies met all the criteria and were included in the bibliometric analysis and for meta-analysis. After obtaining the articles that meet the inclusion criteria, data extraction is conducted. Following this, VOS-viewer is used to analyze research trends in contextual learning approaches. Subsequently, an ANCOVA test with effect size is employed using SPSS to assess the effectiveness of utilizing digital media.

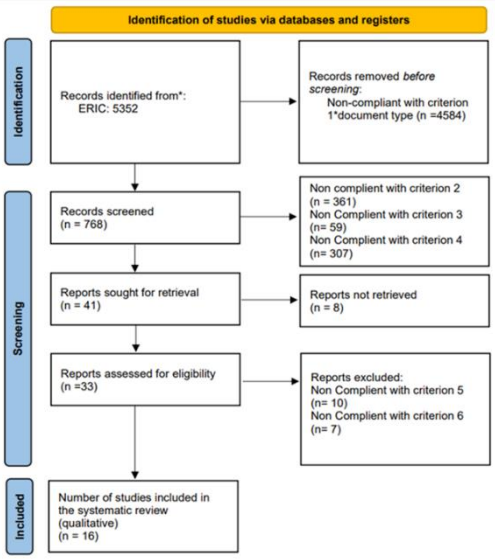


Figure 1 PRISMA Workflow

Trend of contextual learning approach enhance critical thinking

After conducting a literature search with specific criteria through the PRISMA workflow, 16 journal articles were found to be suitable and indexed by Scopus at the Q1, Q2, or Q3 levels. A bibliometric analysis and meta-analysis were performed on these 16 articles to compare the effectiveness of contextual approaches using digital media versus non-digital media. The image below is a bibliometric visualization that shows the relationship between various research topics related to "contextual learning." This visualization was created using VOS-viewer and illustrates how these topics are interconnected based on the co-occurrence of keywords in publications indexed by Scopus from 2020 to 2024.

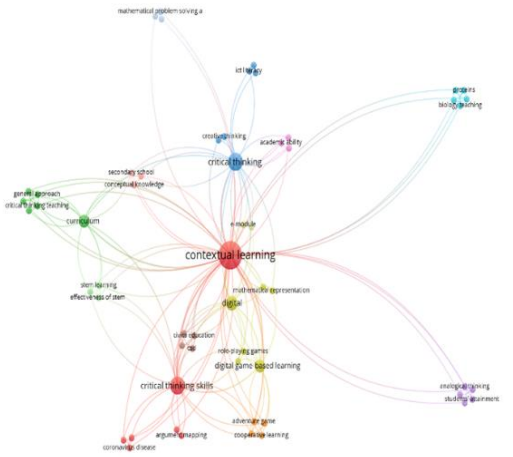


Figure 2. VOS-viewer (Network Visualization) display for Interactive Contextual Learning and Critical thinking based on database

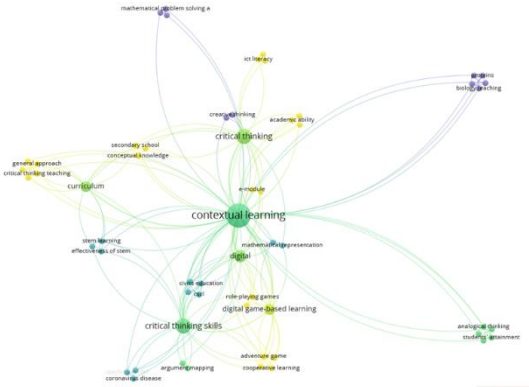


Figure 3. VOS-viewer (Overlay Visualization) display for Interactive Contextual Learning and Critical thinking based on database

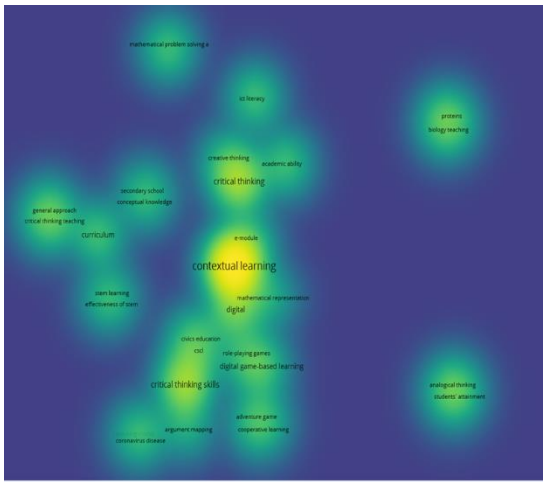


Figure 4. VOS-viewer (Density Visualization) display for Interactive Contextual Learning and Critical thinking based on database

The image is a bibliometric visualization depicting the relationships between various research topics related to contextual learning. Each point in the image represents a topic or keyword, such as "contextual learning," "critical thinking," and "digital game-based learning." The size of each point indicates the frequency of appearance of that topic in publications—larger points represent more frequent appearances. Connecting lines between points indicate relationships or co-occurrences between two topics. Thicker lines indicate more frequent co-occurrences between the two topics. Different colors in the image represent closely related topic clusters, with each color cluster representing a research area or major theme. For example, the red cluster centers on "contextual learning," with connections to topics such as "digital game-based learning" and "critical thinking skills." The blue cluster focuses on "critical thinking," with topics like "academic ability" and "secondary schools." The green cluster encompasses topics such as "curriculum," "STEM learning," and "effectiveness of learning," while the purple cluster relates to "analogical thinking" and "student engagement."

The main theme in this image is "contextual learning," which is central to many connections with other topics, indicating that contextual learning is a focus of much related research. "Critical thinking" is also a significant theme with many sub-themes, such as academic abilities and learning in secondary schools. Topics related to digital media, like "digital game-based learning" and "web exploration," underscore the importance of digital media in this research. Although non-digital media is not directly depicted in the image, it can be inferred through related topics connected to contextual learning. This visualization helps understand how various topics in contextual learning research are interconnected and how frequently they appear together in scholarly literature. Based on Vos-viewer density visualization, the more yellow and larger the circle, the higher the intensity and frequency of research on that topic or term. Yellow areas indicate regions

with high density of publications or terms, while green and blue areas indicate lower densities. Therefore, areas that are yellow and have large circles represent the topics that are

most researched and considered most significant in the analyzed literature(Raihan & Azad, 2023). The graph above displays the distribution of articles based on publication year, the country where the research was conducted, and Scopus index indicating the article's credibility level. According to the graph, the highest number of research articles were published in the year 2020, total 5 articles. In terms of Scopus index qualification, the majority of research articles were categorized as Q2, total 12 articles. Additionally, Indonesia was the most frequently studied country, with 11 research articles, followed by Taiwan, Turkey, and the United Arab Emirat.

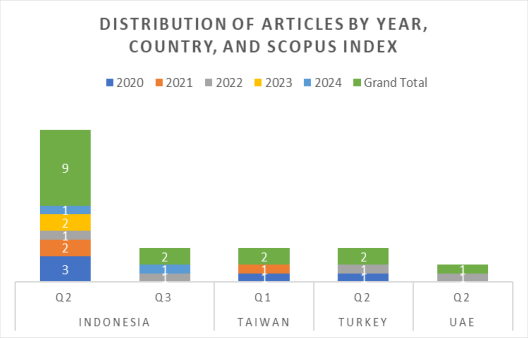


Figure 5, Figure 5. Distribution of Articles by Year, Country, and Scopus Index

Meta Analysis

The meta-analysis in this study aims to collect, evaluate, and synthesize the results from various studies related to the effectiveness of digital and non-digital learning media. In the context of this research, the primary focus is to determine whether the use of digital learning media is more effective than non-digital learning media in improving student learning outcomes. The initial step in this meta-analysis involves collecting data from various relevant research articles. The collected data includes information about the sample size, pretest scores, and posttest scores of groups using digital and non-digital learning media. Additionally, the category of learning media used in each study is recorded to facilitate further analysis To assess whether there is a significant difference between the two media in enhancing critical thinking skills, the table above performed an ANCOVA assumption test using SPSS 27 software. ANCOVA (Analysis of Covariance) aims to test the mean differences between two or more groups by controlling for covariate variables that might affect the outcome. In this case, the pre-test scores serve as a control for initial differences between groups, as the score ranges vary across different countries. This test is chosen because it allows researchers to control for additional variables that could influence the dependent variable, providing moreaccurate results regarding the effect of the independent variable. There are several requirement to perform the ANCOVA test, the data must meet the following requirements: (a) the first requirement before conducting the ANCOVA test is the normality of residuals from the media used for the contextual approach (digital or non-digital). The normality test is conducted using the Kolmogorov-Smirnov test.

Table 1. Normality Test Result

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Residual for Pos_Test	.202	16	.081	.878	16	.036

a. Lilliefors Significance Correction

Based on the table above, it is known that the significance value is 0.081, while α is 0.05. This indicates that the significance value (sig.) > α, meaning that H0 is accepted. This can be interpreted to mean that the data is normally distributed, thus meeting the first requirement. The statistical test then proceeds with (b) the second requirement, which is that the data variance is homogeneous. To assess this, Levene's test is used.

Table 2. Homogenity Test Results

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Pos_Test

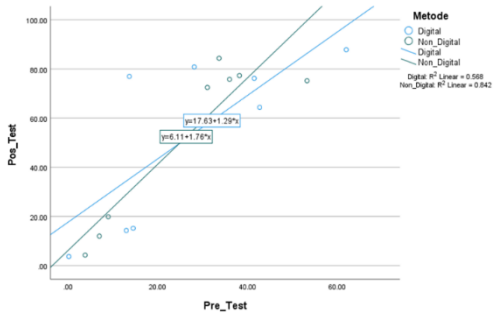
F	df1	df2	Sig.
1.385	1	14	.259

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Pre_Test + Metode

Based on the table above, it is known that the significance value is 0.259, while α is 0.05. This indicates that the significance value (sig.) > α, meaning that H0 is accepted. This can be interpreted to mean that the data variance is homogeneous, thus meeting the second requirement. The statistical test then proceeds with (c) the third requirement, which is the linearity of covariance with the dependent variable. To assess this, a scatter plot is used to examine the distribution of values and the regression line equation.

Table 3. Regression Scatter Plots



Both lines above have linear regression, as can be seen from the lines produced by the data and the regression equations displayed on the graph. For the "Digital" method, the regression line equation is y=17.63+1.29x, while for the "Non-Digital" method, the regression line equation is y=6.11+1.76x. Based on this, it can be concluded that the third requirement is met. The statistical test then proceeds with (d) the final requirement, which is the test of homogeneity of regression coefficients.

Table 4. Homogeneity of Regression Coefficients

Tests of Between-Subjects Effects

Dependent Variable: Pos_Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11720.329[a]	3	3906.776	9.397	.002
Intercept	690.779	1	690.779	1.661	.222
Metode	162.815	1	162.815	.392	.543
Pre_Test	11717.654	1	11717.654	28.184	.000
Metode * Pre_Test	274.744	1	274.744	.661	.432
Error	4989.095	12	415.758		
Total	60897.669	16			
Corrected Total	16709.425	15			

Based on the table above, it is known that the significance value is 0.927, while α is 0.05. This indicates that the significance value (sig.) > α, meaning that H0 is accepted. This can be interpreted to mean that the regression coefficients of the data are homogeneous. Based on the table above, it can be seen that the differences between all media groups are homogeneous, or there are no significant differences. This can be confirmed through effect size testing.

Table 5. Effect Size Standarization

Measure	Small Effect	Medium Effect	Large Effect
Cohen's	0.2	0.5	0.8
Pearson's	0.1	0.3	0.5
Partial Eta Squared	0.01	0.06	0.14

Table 5, which presents the standardization of effect sizes, will help in this regard. By evaluating the effect sizes, we can determine the practical significance of the differences between the groups, if any. In cases where the effect size is small, it reinforces the conclusion that the groups are homogeneous, and any observed differences are minimal and not meaningful in practical terms.

In summary, the ANCOVA (Analysis of Covariance) test, combined with the effect size analysis, supports the conclusion that there are no significant differences between the media groups being studied. The homogeneity of regression coefficients and the small effect sizes both indicate that the groups exhibit similar patterns, and any variations are likely due to random chance rather than inherent differences in the data.

Table 6. Result of Effect Size

Tests of Between-Subjects Effects

Dependent Variable: Pos_Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	11445.586[a]	2	5722.793	14.133	.001	.685
Intercept	797.796	1	797.796	1.970	.184	.132
Pre_Test	11445.360	1	11445.360	28.266	.000	.685
Media	3.538	1	3.538	.009	.927	.001
Error	5263.839	13	404.911			
Total	60897.669	16				
Corrected Total	16709.425	15				

Based on the table above, it can be observed that the effect size is only 0.001, which, when matched with the effect size criteria table, indicates a small effect. Therefore, in the contextual approach that utilizes digital media innovation or digital innovation, there is no significant difference. The ability of digital media innovation or non-digital innovation to enhance critical thinking has been tested in the articles analyzed in the meta-analysis and proven to be significant. However, when trying to determine which of the two methods is more significant, it turns out there is no significant difference.

This suggests that while both digital and non-digital innovations are effective in improving critical thinking skills, one does not significantly outperform the other. This finding emphasizes that the choice between digital and non-digital methods may depend

more on factors such as accessibility, cost, or personal preference rather than on the effectiveness of enhancing critical thinking. The key takeaway is that educators and curriculum developers can confidently use either approach knowing that both are valid options for fostering critical thinking in a contextual learning environment.

Comparison of the Effectiveness of Contextual Learning with Digital and Non-Digital Media Innovations.

Based on the analysis of 16 articles, it has been proven that contextual learning approach both using digital media innovation or non-digital media innovation, can effectively enhance critical thinking skills compared to conventional methods(Rizki et al., 2024; Shana & El Shareef, 2022). This study aimed to investigate whether there are differences in improving critical thinking skills between various media innovations, both digital (such as online interactive modules, educational apps, and digital storytelling games, etc) and non-digital (such as hands-on activities, PBL, SSCS, or guided discovery learning, etc). After conducting ANCOVA tests and calculating effect sizes, the results indicated no significant differences between digital and non-digital media innovations in enhancing critical thinking skills. This means that both types of media innovations are equally effective in fostering critical thinking. This is a positive outcome because educators have the freedom to choose between digital and non-digital media based on resources, availability, and student preferences, without compromising on the quality of critical thinking enhancement. Schools or institutions with limited access to digital technologies can still achieve similar improvements in critical thinking through non-digital means, ensuring equitable educational opportunities. Both digital and non-digital media can be integrated into diverse learning environments, accommodating different teaching styles and classroom settings, which can lead to more inclusive education. Additionally, institutions can make cost-effective decisions regarding the procurement of educational materials, knowing that non-digital methods can be just as effective as digital ones. Catering to different student preferences and learning styles can enhance engagement and motivation, as some students might respond better to digital media while others might prefer non-digital approaches(Gurr et al., 2021).

The opportunity here lies in the potential for creating hybrid learning environments that leverage the strengths of both digital and non-digital media(Li, 2022). By combining these approaches, educators can design more versatile and engaging curricula that can adapt to various educational contexts and student needs. This opens up possibilities for personalized learning experiences, where the choice of media can be tailored to optimize individual student outcomes. Additionally, this flexibility can encourage more innovative teaching practices and the development of new educational tools that blend digital and non-digital elements, further enriching the learning experience and potentially leading to even greater enhancements in critical thinking skills(Lundberg & Stigmar, 2023).

Even though the study found no significant difference between digital and non-digital media in enhancing critical thinking, the analysis of the 16 articles reveals that digital media approaches offer additional benefits. For instance, digital media can also improve other variables such as ICT literacy and learning motivation(Chen & Wu, 2023; Negoro et al., 2023b). Several studies illustrate these advantages: one study on Scratch-assisted waves teaching materials demonstrates how digital media can enhance both ICT literacy and critical thinking skills. ICT literacy, or Information and Communication Technology literacy, refers to the ability to effectively navigate, evaluate, and utilize digital tools and information technologies. In the contemporary landscape, ICT literacy is pivotal as it underpins several essential 21st-century skills(Asrizal et al., 2022). These skills include critical thinking, problem-solving, creativity, collaboration, and digital citizenship. ICT literacy empowers individuals to access a vast array of information resources, enabling continuous learning and informed decision-making(van Laar et al., 2020). Moreover, it fosters adaptability to technological advancements and enhances productivity in professional environments. As technology continues to permeate every aspect of society, from education to business and beyond, proficiency in ICT literacy becomes increasingly indispensable. It not only prepares individuals to thrive in digital economies but also

cultivates responsible digital behavior and ethical use of information, thereby contributing to a globally interconnected society's sustainable development and progress(Jayaprakash & Radhakrishna Pillai, 2022). Thus, nurturing ICT literacy is essential for equipping individuals with the competencies needed to succeed and innovate in the modern world. Another study on digital role-playing games highlights their dual benefit of improving critical thinking and boosting learning motivation. Similarly, research on digital storytelling games shows that these tools engage students in creative processes that enhance critical thinking while maintaining high levels of motivation and engagement. Additionally, studies on cooperative models, digital games, and augmented reality-based learning emphasize how these digital tools create immersive learning environments that significantly increase both critical thinking and learning motivation. In summary, while both digital and non-digital media are effective in fostering critical thinking, digital media offer the added advantage of improving ICT literacy, learning motivation, and engagement, broadening the potential impact on overall educational outcomes and providing a more holistic approach to student development(Park et al., 2021). Digital media can enhance motivation in learning through several key mechanisms:

a. Engagement and Interactivity: Digital media often incorporates interactive elements such as videos, simulations, and gamified content that actively engage learners. This interactivity provides immediate feedback and a sense of accomplishment, which can increase motivation(Safitri et al., 2022)

b. Personalization: Digital media allows for personalized learning experiences tailored to individual preferences and learning styles. This customization can enhance motivation by making learning more relevant and enjoyable for each learner(Sarwinda et al., 2020).

c. Accessibility and Convenience: Digital media provides anytime, anywhere access to learning materials, which can accommodate diverse learning schedules and preferences. This accessibility reduces barriers to learning and encourages consistent engagement(Rafiola et al., 2020).

d. Visual and Multimedia Learning: Visual and multimedia elements in digital media (such as graphics, animations, and audio) can enhance understanding and retention of complex concepts. These elements make learning more dynamic and appealing, thereby increasing motivation to engage with the content(Lin et al., 2017).

e. Collaboration and Social Learning: Digital media platforms often facilitate collaboration and social learning through features like discussion forums, online communities, and collaborative projects. Interacting with peers and experts can foster a sense of community and shared learning goals, boosting motivation(Rizki et al., 2024).

f. Real-World Application: Digital media can connect learning to real-world contexts and applications, demonstrating the practical relevance of knowledge. When learners see how their learning can be applied in meaningful ways, it can increase motivation by highlighting the value and impact of their efforts.(Chen & Wu, 2023)

CONCLUSSION

Based on the meta-analysis and bibliometric analysis conducted on the effectiveness of contextual learning with digital and non-digital media in enhancing critical thinking skills among secondary education students from 2020 to 2024, several key findings have emerged. The systematic review indicates that both digital and non-digital media significantly contribute to improving critical thinking abilities among students. However, despite initial indications of a potentially higher efficacy for digital media interventions based on pre-test and post-test score differences, ANCOVA tests conducted in SPSS revealed no significant difference between the effectiveness of digital and non-digital media. These results suggest that while both types of media can enhance critical thinking skills, their practical effectiveness in educational settings may not vary significantly. This underscores the importance of considering a balanced approach to instructional media selection in fostering critical thinking skills among secondary education students. Trends identified through VOS-viewer highlighted clusters in research focusing on specific contextual learning approaches and their impacts. These findings underscore the potential of integrating digital tools in educational practices to foster deeper critical thinking among secondary school

students. Moving forward, these insights can inform curriculum developers and educators aiming to optimize instructional strategies for enhancing critical thinking in diverse educational settings.

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