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"A Systematic Literature Review on the Effectiveness of Digital Virtual Tour Media in Enhancing Students' Critical Thinking Skills"

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Abstract
Critical thinking skills have become an essential competency in modern education; however, the use of traditional instructional media has proven to be less effective in fostering these skills. This study aims to comprehensively evaluate the effectiveness of digital media in the form of virtual tours in enhancing students' critical thinking abilities through a systematic literature review. Following PRISMA guidelines, this review analyzes 20 selected scholarly articles published between 2019 and 2024. 161 The articles examined include the implementation of virtual tour media such as Virtual Field Trips (VFT) and digital museums across various educational levels. The article selection and data extraction processes were conducted systematically and independently by two reviewers, with both quantitative and qualitative synthesis of results. The findings indicate that digital virtual tour media consistently and effectively enhance students' critical thinking skills, particularly in the areas of analysis, evaluation, and inference. The study found that quasi-experimental and developmental research approaches were the most dominant, with the majority of study subjects at the elementary and secondary education levels. The most frequently used instructional models in combination with virtual tours were Problem-Based Learning (PBL), guided inquiry, and Project-Based Learning. This review offers significant scholarly contributions for educators, researchers, and curriculum developers in implementing effective digital virtual tour media to optimize students' critical thinking abilities.
***Keywords**: Digital Media, Virtual Tour, Virtual Field Trip, Critical Thinking*

Abstrak
Kemampuan berpikir kritis menjadi kompetensi penting dalam era pendidikan modern, namun penggunaan media pembelajaran tradisional terbukti kurang efektif dalam mengembangkan keterampilan ini. Penelitian ini bertujuan untuk mengevaluasi secara komprehensif efektivitas media digital virtual tour dalam meningkatkan kemampuan berpikir kritis peserta didik melalui tinjauan literatur sistematis. Dengan mengikuti panduan PRISMA, kajian ini melakukan analisis terhadap 20 artikel ilmiah terpilih yang dipublikasikan antara tahun 2019 hingga 2024. 161 Artikel yang dianalisis mencakup implementasi media virtual tour seperti Virtual Field Trip (VFT) dan museum digital di berbagai jenjang pendidikan. Proses seleksi artikel dan ekstraksi data dilakukan secara sistematis dan independen oleh dua reviewer, dengan sintesis hasil yang bersifat kuantitatif maupun kualitatif. Hasil penelitian menunjukkan bahwa media digital virtual tour secara konsisten efektif dalam meningkatkan keterampilan berpikir kritis siswa, terutama dalam aspek analisis, evaluasi, dan inferensi. Penelitian ini menemukan bahwa pendekatan kuasi-eksperimen dan pengembangan merupakan jenis penelitian yang paling dominan, dengan subjek penelitian sebagian besar berada di jenjang pendidikan dasar dan menengah. Adapun model pembelajaran yang paling sering dikombinasikan dengan virtual tour adalah Problem-Based Learning (PBL), inkuiri terbimbing, dan Project-Based Learning. Kajian ini memberikan kontribusi ilmiah yang signifikan bagi para pendidik, peneliti, dan pengembang kurikulum dalam penerapan media digital virtual tour yang efektif untuk mengoptimalkan kemampuan berpikir kritis peserta didik.
Kata kunci: *Media Digital, Virtual Tour, Virtual Field Trip, Berpikir Kritis,*

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INTRODUCTION

The digital transformation of education has led to a significant paradigm shift in the learning process, reshaping not only the way teachers deliver content but also how students construct their understanding of concepts. This shift is strongly associated with the Fourth Industrial Revolution, which introduces technologies such as artificial intelligence, virtual reality, and learning analytics into education. Mukul and Büyüközkan (2023) describe this movement as *Education 4.0*, where teaching is increasingly student-centered, collaborative, and competency-based. Similarly, Mhlanga (2024) emphasizes that digital transformation compels schools to redesign their curricula and pedagogical approaches to prepare learners with critical 21st-century competencies. UNESCO (2021) further highlights that digital technologies play a pivotal role in enabling contextual, collaborative, and future-oriented learning strategies. These circumstances underline the urgency for contextual, collaborative, and technology-integrated approaches to ensure students' readiness in a globalized knowledge society.

One of the key competencies in contemporary education is critical thinking. This skill includes the ability to analyze information, evaluate arguments, draw logical conclusions, and make rational, data-based decisions. According to Hopkins (2008), critical thinking is an integral part of meaningful learning, as it involves deep reflection on ideas, problems, or phenomena. It is also considered a fundamental foundation for both academic and professional success in the long term.

However, in practice, teaching and learning in many educational institutions—particularly in Indonesia—still predominantly rely on conventional approaches. Instruction remains teacher-centered, with students often positioned as passive recipients of information. This limits opportunities for students to develop their critical thinking abilities optimally. Kurniawan, Putra, and Mariani (2023) found that one-way teaching models do not provide space for exploration, reflection, or open discussion—components essential for fostering higher-order thinking.

This situation is exacerbated by the low achievement of Indonesian students in international assessments. For instance, the 2018 Programme for International Student Assessment (PISA) ranked Indonesia 72nd out of 78 countries in science and mathematics literacy (OECD, 2019). One of the assessed indicators was students' ability to apply concepts in real-world situations—a key aspect of critical thinking. These results indicate a gap between classroom instruction and global competency demands, especially regarding critical thinking skills. In addition, the 2019 Trends in International Mathematics and Science Study (TIMSS) reported that Indonesian fourth-grade students scored an average of 397 points in mathematics and 397 points in science, both below the international average of 500 (Mullis et al., 2020). Furthermore, the 2022 Indonesian National Assessment (*Asesmen Nasional Berbasis Komputer* / ANBK) revealed that many elementary and secondary students struggled with higher-order reasoning and problem-solving items, showing difficulties in interpreting information, analyzing patterns, and drawing logical conclusions (Kemendikbudristek, 2022). Collectively, these findings confirm that the problem of low reasoning and critical thinking abilities appears consistently across age groups and educational levels.

On the other hand, technological advancements offer new opportunities to address the limitations of conventional approaches. One emerging innovation is the use of simulation-based digital media such as virtual tours, including Virtual Field Trips (VFT) and virtual museums. These media allow students to explore places or objects virtually, as if visiting them in person. This provides an immersive, contextual learning experience that is unattainable through traditional lectures.

Huang et al. (2019) found that simulation-based visual media like augmented reality and virtual reality positively affect learning retention and student engagement. In the context of virtual tours, Sulaiman, Ismail, and Ramli (2020) noted that such media

effectively bridge theory and practice, providing adaptive learning experiences tailored to students' needs. The interactive experience offered by virtual tours allows students not only to absorb information but also to evaluate, compare, and reflect on the knowledge they acquire.

In the Indonesian context, several studies have demonstrated the effectiveness of virtual tour media in enhancing various learning skills. Ramadhani and Syafruddin (2022) reported that implementing inquiry-based Virtual Field Trips in mathematics instruction significantly improved students' analytical thinking. The study highlighted that students became more active in asking questions, connecting concepts, and constructing logical reasoning. Sari (2023), studying virtual museums, concluded that this medium enhances visual literacy and students' ability to critically evaluate historical information. Meanwhile, Fitriani et al. (2023) noted increased learning participation and reflective thinking among elementary students following digital edutourism sessions.

Pedagogically, the use of virtual tours can support the development of critical thinking indicators as outlined by Facione (2015), including interpretation, analysis, evaluation, inference, and explanation. The learning experience provided by virtual tours encourages students to observe objects or events, ask questions, build understanding, and reassess knowledge through dynamic and contextual virtual content. These media are not only visually appealing but also enrich students' cognitive processes through active engagement, both individually and collaboratively.

Despite the promising findings of these studies, the results remain scattered and lack systematic synthesis. For effective implementation of virtual tours in learning, there is a need for a comprehensive understanding of which types of media are most effective, which instructional models are most suitable, the dominant research approaches used, and the characteristics of the learners most frequently involved. The lack of integrated information presents a challenge for educational policy-making and widespread implementation of technology-based learning practices.

Therefore, the purpose of this study is to systematically review and synthesize empirical evidence on the effectiveness of digital virtual tour media in enhancing students' critical thinking skills. Specifically, this study aims to identify the most effective types of virtual tour media, the instructional models with which they are best integrated, the educational levels most frequently involved, and the dominant research approaches used in prior studies. To achieve this, a Systematic Literature Review (SLR) approach guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol is employed, allowing for a structured and transparent synthesis of findings from relevant academic sources. The study is framed by five research questions concerning effectiveness, media types, instructional models, educational levels, and research approaches.

Therefore, this study adopts a Systematic Literature Review (SLR) approach to organize, assess, and synthesize empirical evidence from a range of relevant academic sources. As described by Pati and Lorusso (2018), the SLR method enables researchers to gain a comprehensive, accurate, and accountable overview of a specific topic through the analysis of prior studies. This approach is particularly appropriate for evaluating the effectiveness of virtual tour media in enhancing students' critical thinking skills.

The study focuses on publications from 2019 to 2024 that explicitly examine the use of virtual tours in education and their impact on critical thinking. Article selection was guided by strict inclusion and exclusion criteria, considering research design, educational level, and measured indicators of critical thinking. The collected data were analyzed using thematic analysis and basic quantitative methods to generate an informative synthesis.

This review seeks to answer several key questions: To what extent are digital virtual tours effective in improving students' critical thinking? What types of virtual tours

are most commonly used in education? Which instructional models are most frequently integrated with virtual tours? At which educational levels are virtual tours most often implemented? And what research approaches are most dominant in related studies? By addressing these questions, the study aims to provide a solid literature synthesis on the effectiveness of virtual tour media in developing critical thinking, offering an empirical foundation for teachers, schools, and curriculum developers to design more structured technology-based instruction and identify research gaps for future exploration.

In conclusion, this study not only contributes to academic discourse but also offers practical implications for improving the quality of education in the digital era. If implemented effectively and purposefully, virtual tour media can systematically and sustainably foster students' critical thinking, supporting the realization of adaptive, meaningful, and 21st-century-oriented learning.

METHOD

Research Design

This study adopts a Systematic Literature Review (SLR) approach guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol. The research process consisted of several systematic stages, including formulating research questions, identifying relevant literature through systematic searches in electronic databases, screening the literature based on clearly defined inclusion and exclusion criteria, and independently extracting data by two reviewers to ensure objectivity and reliability. The final stage involved analyzing the data using both quantitative and qualitative synthesis methods. As noted by Kitchenham et al. (2009), the SLR method provides a rigorous framework to collect, evaluate, and interpret all available research relevant to a specific question, while the PRISMA 2020 statement ensures transparent and standardized reporting of the review process (Page et al., 2021).

Research Questions

The study was designed to address five core research questions. First (RQ1), to what extent is digital virtual tour media effective in enhancing students' critical thinking skills? Second (RQ2), what types of virtual tour media are most commonly used in educational settings? Third (RQ3), which instructional models are frequently integrated with virtual tour media? Fourth (RQ4), at what educational levels are virtual tours most frequently implemented? And fifth (RQ5), what research approaches are most commonly used in studies related to this topic?

Inclusion and Exclusion Criteria

To ensure the validity and relevance of the review, specific inclusion and exclusion criteria were applied. The inclusion criteria were as follows: (1) the article was published between 2019 and 2024; (2) it discussed the use of virtual tour media, including virtual field trips or digital museums; (3) it focused on the development or measurement of critical thinking as one of the learning outcomes; (4) the study employed quantitative, qualitative, or mixed-method research designs; and (5) the article was available in full-text and open access. The exclusion criteria included: (1) articles that were not relevant to the virtual tour focus or did not assess critical thinking skills; (2) non-empirical studies such as opinion pieces, essays, or editorials; and (3) duplicate articles or those without full access to the content. The literature search was conducted across several electronic databases, including Scopus, Web of Science (WoS), ERIC, ProQuest, DOAJ, and Google Scholar, to ensure broad coverage of both international and national studies. Following the recommendations of the PRISMA

2020 statement, searching across multiple databases reduces the risk of publication bias and increases the comprehensiveness of the review (Page et al., 2021).

Data Collection Technique

The data collection process involved systematic searching using the Google Scholar academic search engine. Article listings were generated using the Publish or Perish (PoP) software. Keywords used in the search process included: “virtual tour” AND “berpikir kritis”; “virtual field trip” AND “critical thinking”; and “media pembelajaran digital” AND “pembelajaran abad 21.” From the initial search, 161 articles were identified. After screening based on abstracts and full-text availability, 20 articles were deemed to meet the eligibility criteria for further analysis.

Data Analysis Technique

The collected data were analyzed using a thematic and categorical approach. The analysis focused on several key aspects, including: (1) the types of virtual tour media used (e.g., Virtual Field Trips, virtual museums, VR tours); (2) the educational levels and subject areas involved; (3) the instructional models employed alongside virtual tours; (4) the research approaches used; and (5) the reported effectiveness of virtual tours in enhancing critical thinking skills. The findings were presented through frequency tables and thematic narrative descriptions to facilitate a clearer and more comprehensive understanding. Data validity was ensured through source triangulation and interpretive synthesis of the findings from each study.

RESULT AND DISCUSSION

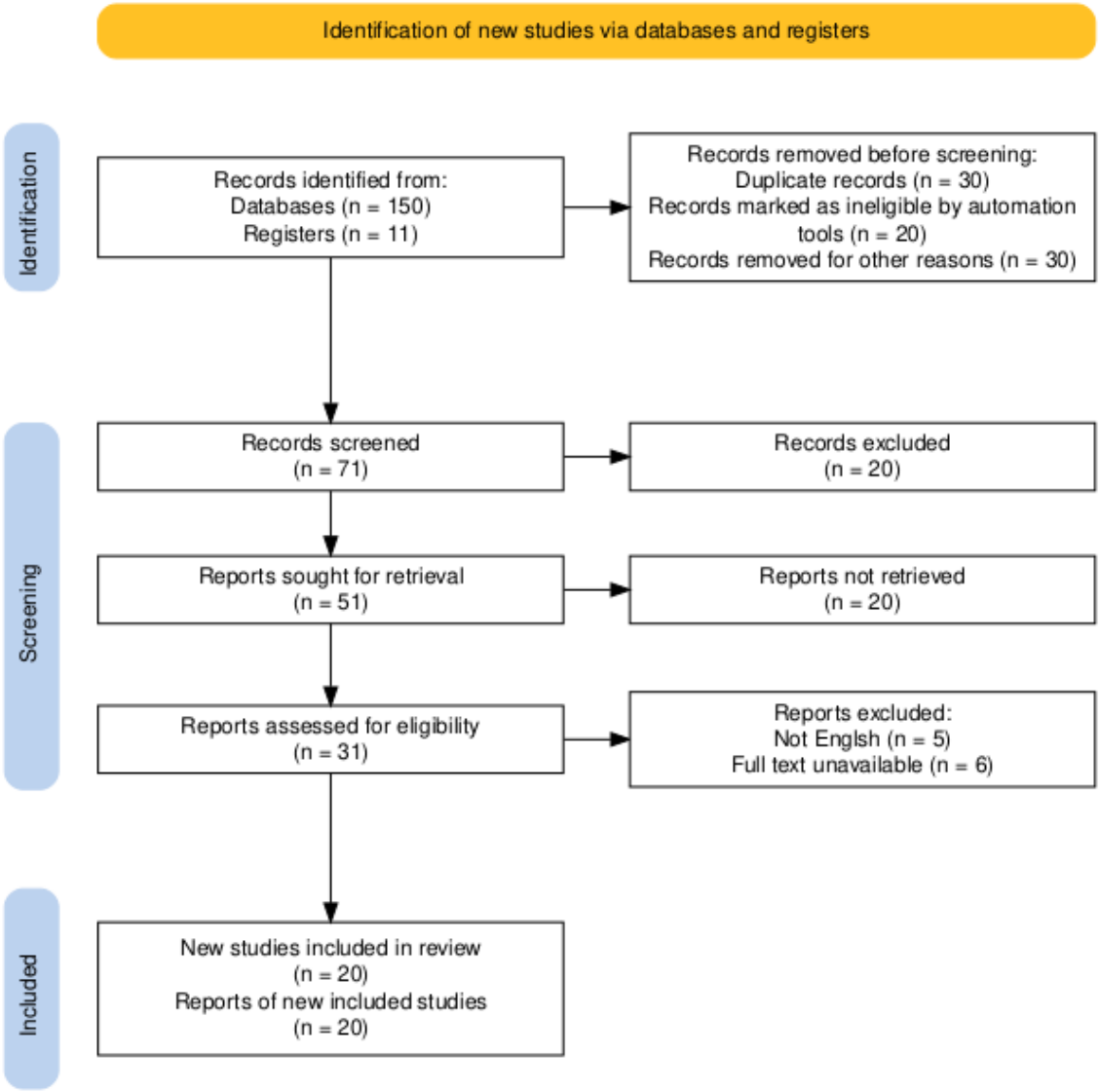

Figure 1. flowchart prisma

The process of identifying, screening, and selecting articles in this review adhered to the PRISMA 2020 workflow, which is designed to ensure systematic and transparent execution of a systematic literature review. The accompanying PRISMA diagram provides a comprehensive overview of each step, from initial identification to final inclusion.

In the Identification phase, a total of 161 documents were retrieved, comprising 150 articles sourced from electronic databases (such as Google Scholar and national journal repositories), and 11 additional articles obtained from reference lists and supplementary registers. Before the screening stage, 80 articles were excluded. Specifically, 30 articles were removed due to duplication, 20 articles were flagged as irrelevant by automated systems for lacking the primary keywords or being contextually unrelated to the topic, and another 30 articles were eliminated for other reasons, such as failing to meet the initial inclusion criteria (e.g., abstracts only or seminar summaries).

As a result, 71 articles proceeded to the Screening phase. During this stage, titles and abstracts were reviewed to assess their relevance to the research focus. 20 articles were deemed irrelevant and excluded. The remaining 51 articles were considered eligible for full-text retrieval and further examination.

However, out of the 51 articles subjected to full-text review, 20 could not be accessed in full due to broken links, restricted access, or content no longer being available online. Consequently, only 31 articles were successfully retrieved and assessed for eligibility in detail.

A rigorous eligibility assessment was then conducted on the 31 full-text articles. In this phase, 11 articles were eliminated. Five were excluded because they were not written in either English or Indonesian, while six others lacked complete manuscripts that could be verified for in-depth analysis. As a result, 20 articles met all inclusion criteria and were included in the final analysis of this systematic review.

The PRISMA flow diagram thus demonstrates that, from the initial 161 documents, only 20 articles were considered sufficiently robust and relevant to serve as primary data sources in this Systematic Literature Review (SLR). This rigorous selection process was critical to maintaining the validity, relevance, and reliability of the review findings, ensuring that each included article had undergone a methodological evaluation consistent with the standards of systematic inquiry.

As an outcome of this selection process, the next section presents a summary table of the 20 selected articles. Each entry in the table includes the article title, author(s), year of publication, research method employed, and key findings. This structured presentation offers an overview of common patterns, methodological approaches, and contributions within the literature related to the effectiveness of virtual tour media in supporting critical thinking-based learning. The table also serves as the foundation for the thematic analysis and discussion that follows in the subsequent section.

Table 1. Previous Research

Article Title	Author(s)	Year	Method	Main Findings	Article Title
The Effect of Virtual Field Trip Media on Critical Thinking Skills	L. M. Putri	2020	Experimental	VFT effectively enhanced students' ability to analyze scientific phenomena and formulate evidence-based conclusions.	The Effect of Virtual Field Trip Media on Critical Thinking Skills
The Impact of VFT on High School Students' Critical Thinking in Ecosystem Topics	R. Aulia	2020	Experimental	Improved logical, analytical, and evaluative thinking related to environmental interactions.	The Impact of VFT on High School Students' Critical Thinking in Ecosystem Topics
The Effect of VFT on Critical Thinking in Geography	A. Rahmawati	2020	Quasi-experimental	Facilitated spatial understanding and critical reasoning in	The Effect of VFT on Critical Thinking in Geography

				geography.	
Critical Thinking in Ecosystem Topics Using PBL and VFT	N. S. Dewi	2023	Experimental	Helped develop problem-solving and reflective thinking skills.	Critical Thinking in Ecosystem Topics Using PBL and VFT
Effect of PBL with VFT on Critical Thinking in Ecosystem Topics	T. Suryani	2022	Quasi-experimental	Enhanced information classification and logical argumentation.	Effect of PBL with VFT on Critical Thinking in Ecosystem Topics
Scientific-Based Virtual Tour Media to Improve Critical Thinking	L. D. Aisyah	2023	Qualitative	Supported contextual exploration and critical thinking.	Scientific-Based Virtual Tour Media to Improve Critical Thinking
Inquiry-Based E-Module with VR Tour for Math Critical Thinking	F. Ramadhani & A. Syafruddin	2022	R&D	Fostered mathematical reasoning and argumentation skills.	Inquiry-Based E-Module with VR Tour for Math Critical Thinking
Validation of Virtual Tour Media for Metacognitive Improvement	R. D. Febrianti & M. Lestari	2021	Quasi-experimental	Improved metacognitive awareness and critical thinking.	Validation of Virtual Tour Media for Metacognitive Improvement
Development of VFT Media for Social Studies	I. Nursamsiah	2021	R&D	Supported analytical learning and fact-based argument development.	Development of VFT Media for Social Studies
Exploring Mangrove Conservation through VFT	A. Aziz	2023	Qualitative	Promoted ecological awareness and evaluative thinking.	Exploring Mangrove Conservation through VFT
VFT on Plantae for Sustainability Literacy and Critical Thinking	R. Herlina	2021	Experimental	Enhanced understanding of sustainability and biological system analysis.	VFT on Plantae for Sustainability Literacy and Critical Thinking
Effectiveness of Virtual Tour Museums in	N. Dewi	2023	Experimental	Increased student engagement and critical	Effectiveness of Virtual Tour Museums in Elementary

Elementary Social Studies				thinking.	Social Studies
Edutourism Digital Lab for Critical Thinking and Local Character	D. Fitriani	2023	Qualitative	Strengthened character and contextual critical thinking.	Edutourism Digital Lab for Critical Thinking and Local Character
Effect of Virtual Museums on Critical Thinking in History	D. Ningsih	2023	Experimental	Encouraged reflective thinking and historical evaluation.	Effect of Virtual Museums on Critical Thinking in History
CTL Model with Temple Virtual Tour for History Learning	F. Astuti	2023	Experimental	Enhanced historical understanding and cultural critical thinking.	CTL Model with Temple Virtual Tour for History Learning
Karst Museum Virtual Tour as History Learning Media	A. Rachmawati	2022	Qualitative	Expanded historical analysis and critical interpretation.	Karst Museum Virtual Tour as History Learning Media
Virtual Tour of Fort Vredeburg Museum for History Learning	I. Nurul	2023	Descriptive	Strengthened historical experience and critical thinking.	Virtual Tour of Fort Vredeburg Museum for History Learning
Public Speaking via Role-Playing as Virtual Museum Guides	L. P. Ayu	2023	CAR	Enabled confident expression of critical ideas.	Public Speaking via Role-Playing as Virtual Museum Guides
Biotourism via VR in Biology Learning	M. Lestari	2023	R&D	Strengthened scientific reasoning and critical thinking.	Biotourism via VR in Biology Learning
Effectiveness of VFT in IPAS for Grade 4	H. Fitriana	2023	Experimental	Improved observation, interpretation, and critical thinking.	Effectiveness of VFT in IPAS for Grade 4

Based on the analysis of 20 selected articles, this review categorizes the findings into five key aspects in accordance with the formulated research questions. Each aspect is discussed specifically to identify the contribution of digital virtual tour media to the

development of students' critical thinking skills, the most effective types of implementation, and the methodological characteristics of the analyzed studies.

The Effectiveness of Digital Virtual Tour Media in Enhancing Students' Critical Thinking Skills

In general, all reviewed articles indicate that virtual tour media has a significant impact on improving students' critical thinking skills. These improvements are both quantitative—such as higher post-test scores compared to control groups—and qualitative, reflected in the emergence of deeper analytical abilities, reflection on information, argument construction, and the evaluation of evidence. For instance, the study by Ramadhani and Syafruddin (2022) demonstrated that the use of a VR tour-based e-module in mathematics learning encouraged students to think systematically and argumentatively when solving contextual problems.

In addition, other studies such as those by Dewi (2023) and Suryani (2022) highlighted that the integration of VFT with the Problem-Based Learning (PBL) model effectively enhanced students' ability to understand cause-and-effect relationships in ecosystem phenomena, make predictions, and evaluate solutions to environmental issues. These findings reinforce the theory that media stimulating active engagement—such as virtual tours—can activate higher-order thinking processes (HOTS), which are the core components of critical thinking (Facione, 2015).

The Most Commonly Used Types of Virtual Tour Media in Education

The most frequently used type of virtual tour media in the analyzed studies is the Virtual Field Trip (VFT), appearing in 12 out of the 20 articles (60%). VFT is commonly applied in subjects such as social studies, science, and geography due to its ability to visually and interactively represent real-world locations. Its use allows students to observe objects or phenomena in greater detail, make comparisons, and reflect on information within real-life contexts. For example, in environmental topics, students can virtually observe mangrove deforestation or biodiversity and then discuss these issues within a scientific framework.

Other types of virtual tour media used include virtual museums, which are typically employed in history education to develop interpretative skills regarding artifacts and historical sources; digital edutourism, which emphasizes local wisdom as a context for critical learning; and virtual reality simulations, enabling interaction in 3D-based spatial environments. This variation suggests that the choice of media type is highly dependent on the learning objectives and content characteristics. Nonetheless, VFT remains the preferred choice due to its flexibility and ease of integration across different subjects.

Table. Analysis of Virtual Tour Media Types and Relevant Theories

Type of Virtual Tour Media	Research Findings	Relevant Theories/Concepts	Analytical Connection
Virtual Field Trip (VFT)	Most frequently used (12/20 studies, 60%); applied in social studies, science, and geography; enables detailed observation, comparison, and reflection.	- *Constructivism* (Piaget & Vygotsky)- *Critical Thinking Indicators* (Facione, 2015)	VFT provides contextual and exploratory learning experiences aligned with constructivism; activities such as observation and reflection foster analysis, evaluation, and inference—core

			aspects of critical thinking.
Virtual Museum	Commonly used in history education; supports interpretation of artifacts and historical sources.	- *Historical Thinking* (Wineburg, 2001)- *Multimedia Learning Theory* (Mayer, 2017)	Virtual museums enhance interpretive skills in analyzing historical sources and optimize visual-verbal integration, consistent with multimedia learning theory.
Digital Edutourism	Links learning with local wisdom; often applied in environmental and cultural contexts.	- *Contextual Teaching and Learning (CTL)*- *21st Century Skills Framework* (Trilling & Fadel, 2009)	Helps students connect global issues with local experiences, making learning more relevant and meaningful.
Virtual Reality (VR) Simulations	Provides immersive experiences in 3D spatial environments; supports interactive exploration.	- *Experiential Learning* (Kolb, 1984)- *Embodied Cognition*	VR offers near-real experiential learning, supporting hands-on exploration, deeper engagement, and problem-solving.

Instructional Models Commonly Integrated with Virtual Tour Media

Most of the reviewed studies did not merely use virtual tours as visualization tools but also integrated them into active learning models to promote deeper cognitive processing. The most frequently used instructional model is Problem-Based Learning (PBL), as observed in studies by Dewi (2023) and Suryani (2022), where students were engaged in solving real-world problems based on virtual content. This model has been shown to facilitate students' abilities in formulating hypotheses, proposing solutions, and constructing logical arguments based on data observed during the virtual tour.

In addition to PBL, other identified models include Guided Inquiry, which provides students with opportunities to formulate questions and seek answers through exploratory learning; Contextual Teaching and Learning (CTL), which connects lesson content to real-life contexts via visual exploration; as well as Project-Based Learning and Team-Based Projects, which emphasize collaboration and the production of creative outputs derived from virtual media-based information.

The integration of these models demonstrates that the effectiveness of virtual tour media can be significantly enhanced when accompanied by learning strategies that emphasize cognitive engagement, social interaction, and personal reflection. These approaches not only enrich the learning experience but also support the development of students' critical thinking in a structured and meaningful way.

Educational Levels Most Frequently Implementing Virtual Tour Media

Virtual tour media is most commonly implemented at the senior high school (SMA) level, appearing in 40% of the analyzed articles. This trend is closely related to the cognitive characteristics of high school students, who are generally capable of abstraction and reflective thinking on complex phenomena. The media is utilized in subjects such as history, geography, ecosystems, and environmental sustainability, all of which require students to analyze inter-variable relationships and draw logic-based

conclusions. For instance, the study by Ningsih (2023) found that high school students using virtual museums were able to critically evaluate historical sources and develop independent interpretations.

Meanwhile, 35% of the studies were conducted at the elementary school (SD) level, particularly in upper grades (grades IV–VI). At this level, virtual tour media primarily serves as an introductory tool for exploration and contextual visualization—for example, introducing students to concepts of cultural diversity, environmental awareness, or historical values. The remaining studies were conducted at the junior high school level or across multiple educational levels. These findings reinforce the assumption that virtual tours are adaptable and applicable across various educational stages, depending on the instructional approach and the depth of content required.

Dominant Research Approaches Used in Related Studies

In terms of research approach, the quantitative approach, particularly experimental and quasi-experimental designs, was the most dominant, found in 50% of the studies. This approach was used to measure the influence or significant differences in critical thinking skills between student groups exposed to virtual tour media and those who were not. This indicates a strong interest among researchers in empirically testing the measurable effectiveness of virtual tour media.

In addition, the Research and Development (R&D) approach was employed for developing learning media such as e-modules and VR-based applications. The qualitative approach was also used, especially to explore student experiences, teacher perceptions, and classroom dynamics in using this media. Several studies utilized Classroom Action Research (CAR) to observe the real-world impact of virtual tour implementation in instructional practice. This diversity of approaches shows that research on virtual tour media has been conducted from a broad range of perspectives—including quantitative evaluation, media development, and reflective practice—providing a more comprehensive understanding of its pedagogical impact.

Conclusion

Based on the findings of this systematic literature review, it can be concluded that virtual tour media—particularly in the form of Virtual Field Trips (VFT)—is effective in enhancing students' critical thinking skills across different educational levels. The reviewed studies consistently show that virtual tours strengthen students' abilities in analysis, evaluation, inference, and reflective reasoning, especially when integrated with active learning models such as Problem-Based Learning (PBL), guided inquiry, and Contextual Teaching and Learning (CTL).

These results imply that virtual tours are not merely technological enhancements but strategic pedagogical tools aligned with the needs of 21st-century learning, offering flexibility across subjects such as history, science, geography, and social studies while bridging classroom learning with real-world application.

To maximize their potential, future efforts should focus on strengthening teacher competence through training, embedding ICT-based approaches into curricula, and improving technological infrastructure. Educators are encouraged to combine virtual tours with active learning strategies to foster higher-order thinking, while researchers should expand investigations into innovative applications across various contexts. At the policy level, systemic support is required to ensure equitable access to digital learning resources, thereby enabling virtual tours to play a greater role in cultivating students' critical thinking and preparing them to meet global challenges

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