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The Use of HOTS-Based Digital Science Mathematics Stories with the Interactive Flat Panel (IFP) Utilization in Elementary School (Literature Review 2020–2025)

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Abstract

This study aims to analyze the use of Higher Order Thinking Skills (HOTS)-based digital science-mathematics storytelling supported by Interactive Flat Panel (IFP) in elementary school learning through a Systematic Literature Review (SLR) approach. The study examined 30 scientific articles published between 2020 and 2025 from national and international sources relevant to digital learning innovation. Data were analyzed through article selection, classification, comparison, and synthesis of key findings. The results indicate that digital storytelling positively contributes to students' motivation, engagement, conceptual understanding, and participation in learning. The integration of science and mathematics concepts in story-based learning helps students understand abstract material in a more concrete, contextual, and enjoyable way. In addition, HOTS-oriented activities encourage students to think critically, creatively, and analytically, and solve problems effectively. The use of IFP further strengthens the learning process through interactive visual displays, collaborative activities, and direct student involvement. However, several challenges remain, including limited technological infrastructure, unequal digital literacy among students, and teachers' readiness to design innovative learning media. Therefore, support through teacher training, adequate facilities, and sustainable educational policies is needed to optimize implementation. In conclusion, HOTS-based digital science-mathematics storytelling with IFP has strong potential as an innovative learning strategy to improve the quality of elementary education in the digital era.

Keywords: Digital Science-Mathematics Storytelling, HOTS, Interactive Flat Panel

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Abstrak

Penelitian ini bertujuan untuk menganalisis penggunaan cerita digital sains-matematika berbasis Keterampilan Berpikir Tingkat Tinggi (HOTS) yang didukung oleh Interactive Flat Panel (IFP) dalam pembelajaran sekolah dasar melalui pendekatan Tinjauan Pustaka Sistematis (SLR). Penelitian ini mengkaji 30 artikel ilmiah yang diterbitkan antara tahun 2020 dan 2025 dari sumber-sumber nasional dan internasional yang relevan dengan inovasi pembelajaran digital. Data dianalisis melalui seleksi artikel, klasifikasi, perbandingan, dan sintesis temuan utama. Hasil penelitian menunjukkan bahwa penceritaan digital berkontribusi positif terhadap peningkatan motivasi, keterlibatan, pemahaman konseptual, dan partisipasi belajar siswa. Integrasi konsep sains dan matematika dalam pembelajaran berbasis cerita membantu siswa memahami materi abstrak secara lebih konkret, kontekstual, dan menyenangkan. Selain itu, kegiatan yang berorientasi pada HOTS mendorong siswa untuk berpikir kritis, kreatif, analitis, dan memecahkan masalah secara efektif. Penggunaan IFP semakin memperkuat proses pembelajaran melalui tampilan visual interaktif, kegiatan kolaboratif, dan keterlibatan langsung siswa. Namun, masih ada beberapa tantangan, termasuk infrastruktur teknologi yang terbatas, kesenjangan literasi digital di antara siswa, serta kesiapan guru dalam merancang media pembelajaran inovatif. Oleh karena itu, dukungan melalui pelatihan guru, fasilitas yang memadai, dan kebijakan pendidikan yang berkelanjutan diperlukan untuk mengoptimalkan implementasi. Kesimpulanya, penceritaan sains dan matematika berbasis HOTS dengan IFP memiliki potensi besar sebagai strategi pembelajaran inovatif untuk meningkatkan kualitas pendidikan dasar di era digital.

Kata Kunci: Penceritaan Sains dan Matematika Digital, HOTS, Layar Datar Interaktif

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INTRODUCTION

The development of digital technology offers significant opportunities to improve the quality of learning in elementary schools. The use of technology enables learning activities to be more interactive, adaptive, and tailored to the needs of 21st-century learners (Niemi & Niu, 2021). In line with this, international institutions emphasize the importance of mastering higher-order thinking skills from elementary school onwards to prepare students for global change (OECD, 2023). These skills include analyzing, evaluating, and creating, which are part of Higher Order Thinking Skills (HOTS) (Harianja et al., 2023). The importance of strengthening HOTS underscores the need for engaging, meaningful learning strategies for elementary school students. Developmentally appropriate learning media can help explain abstract concepts more concretely (Özen & Duran, 2021; Yulianawati et al., 2022). One relevant approach is storytelling, as the material is presented through a storyline that relates to students' experiences (Cahyanti & Nuroh, 2023). The narrative approach is also considered effective in increasing students' attention, engagement, and conceptual understanding (Wu & Chen, 2020).

Storytelling continues to innovate alongside advances in digital technology. Stories previously delivered orally or through text can now be combined with images, audio, animation, and video through digital storytelling (Gürsoy, 2021; Simsek, 2020). The integration of these multimedia elements creates a more engaging and participatory learning experience for students. Recent research also shows that digital storytelling contributes to increased learning motivation, creativity, and student engagement (Ispir & Yıldız, 2023).

Increasing student engagement through digital storytelling is particularly effective when applied to integrated science and mathematics learning. The integration of these two fields is known as sainsmatika, which connects numeracy and science concepts with real-world situations. Through digital Sainsmatika storytelling, students can understand material that was previously considered complex more simply and contextually. This approach also supports gradual growth in creativity and problem-solving skills (Karakuş et al., 2020). The use of digital science and mathematics storytelling will be even more effective with the support of interactive devices such as Interactive Flat Panels (IFPs). These devices enable visual, responsive, and collaborative presentation of material through interactive touchscreens. IFPs help teachers deliver digital stories dynamically while also providing space for active student participation (Permana et al., 2024). The use of interactive media has also been reported to improve learning effectiveness and student learning experiences (Niemi & Niu, 2021).

Based on this description, this study uses a Systematic Literature Review (SLR) approach to analyze the use of HOTS-based digital science and mathematics storytelling using Interactive Flat Panels in elementary schools. This study was conducted to identify research trends, implementation benefits, and supporting factors for its application in elementary learning. The research results are expected to serve as a reference in developing relevant, interactive learning innovations oriented toward improving the quality of student learning. Based on the background that has been described, the problem formulation in this research is:

1. How is HOTS-based digital science and mathematics storytelling implemented in elementary school learning?
2. How effective is the use of digital media in increasing the engagement and learning outcomes of elementary school students?
3. How can the development of IFP in fairy tales improve students' critical thinking and problem-solving skills?

4. What are the supporting factors and obstacles in implementing HOTS-based learning in elementary schools?

METHODS

This study employed the Systematic Literature Review (SLR) method to systematically identify, evaluate, and synthesize relevant research findings using PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses). The SLR method is considered appropriate because it provides a comprehensive overview of the development of research topics from various scientific sources (Page et al., 2021). This approach is also widely used to examine the effectiveness of technology-based learning innovations in elementary education contexts (Barry et al, 2022). This method enables researchers to draw more objective conclusions from previous findings (Wu & Chen, 2020).

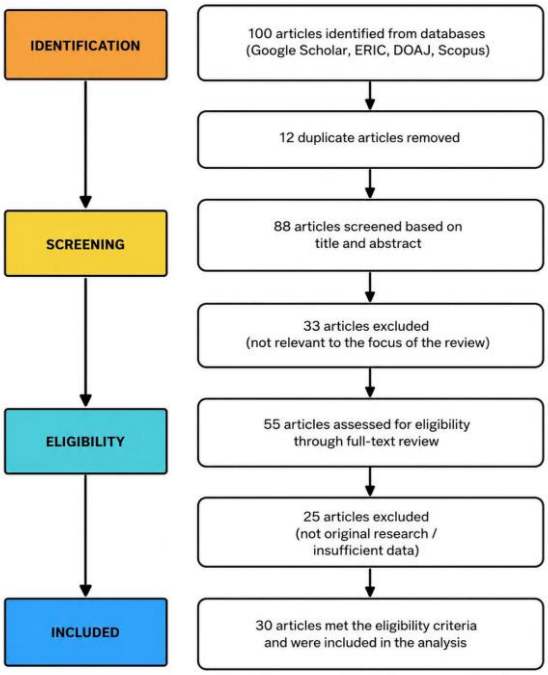

Figure 1. PRISMA Diagram

The article search was conducted across several databases, including Google Scholar, ERIC, and relevant national and international journals. Keywords used included "digital storytelling," "digital fairy tales," "HOTS," "sainsmatika," "Interactive Flat Panel," and "elementary school learning." The use of multiple keywords was intended to broaden the search scope, thereby making the obtained articles more representative (Wu & Chen, 2020). The search was conducted in a structured manner so that the selected sources aligned with the research focus.

The article selection process used predetermined inclusion and exclusion criteria. Inclusion criteria included articles published between 2020 and 2025 that discussed the research topic, were available in full text, and originated from credible scientific sources. Exclusion criteria included articles that were duplicates, irrelevant to the study focus, or did not present adequate data. The screening process was conducted in a stepwise manner, reviewing the titles, abstracts, and content of the articles (Wu & Chen, 2020).

Articles that met the criteria were then analyzed using data extraction techniques. The information collected included the author's name, year of publication, research objectives, methods, instruments, key findings, and limitations. Data extraction techniques helped researchers systematically compile comparisons between articles and easily retrieve them (Page et al., 2021). The extraction results were then grouped based on key themes related to learning effectiveness, HOTS, and technology utilization (Barry et al., 2022).

Data analysis was conducted descriptively and qualitatively through a process of reduction, categorization, and synthesis of findings. Each research result was compared to identify patterns, trends, and remaining research gaps (Xiao & Watson, 2019). This approach enabled researchers to more comprehensively understand the contribution of HOTS-based digital science and mathematics storytelling to elementary school learning. The final analysis results are presented in narrative form and summary tables for easy reader understanding (Page et al., 2021).

RESULT AND DISCUSSION

A literature review indicates that the use of digital science and mathematics storytelling significantly improves learning quality in elementary schools, particularly in students' cognitive, affective, and psychomotor domains (Wu & Chen, 2020). Digital storytelling not only serves as a medium for conveying information but also as a means of building contextual and meaningful learning experiences (Lazareva & Cruz, 2021). By integrating stories with math and science concepts, students can better understand abstract material. These findings align with research indicating that story-based media can increase students' emotional engagement and enhance conceptual understanding (Ispir & Yıldız, 2023). A summary of the results of these studies is shown in Table 1.

Tabel 1. Previous Research Reviewed

No.	Authors (Years)	Title	Method	Result	Cluster
1	Permana et al. (2024)	The Effectiveness of Technology-Based Learning Media in the Digital Era	Literature Review	Technology-based media is effective, flexible, and supports learning activities.	IFP
2	Mansir (2022)	Challenges and Threats for Indonesian Children in the Digital Era	Literature Review	The digital era provides both opportunities and challenges for children's education.	HMS
3	Destari (2023)	Global Education in the Digital Age	Bibliometric Analysis	The trend of digital education research continues to increase globally.	HMS
4	Isa & Rustini (2023)	The Influence of Learning Media on Social Studies Learning	Literature Review	Learning media has a positive influence on student learning outcomes.	HMS
5	Subtianah (2023)	Transforming Learning Through Technology Integration	Literature Review	Technology integration improves the quality of learning.	IFP

No.	Authors (Years)	Title	Method	Result	Cluster
6	Nurhidayah & Wangid (2020)	Development of Sciencematics Fairy Tales	Interview and Test	Storytelling media is appropriate and effective for use in the classroom.	SM
7	Afriyanti et al. (2023)	Comparison of Animated Video and Text Media	Pre-post Test	Animated video media is more effective than text media.	DS
8	Miterianifa et al. (2024)	Environmental Literacy Learning Model	SLR	The learning model increases environmental knowledge and awareness.	HMS
9	Abelia et al. (2025)	Digital Storytelling Media for Elementary School	Observation	Student interest and participation increased significantly.	DS
10	Hayudinna & Muzkiyah, 2024	Critical Reasoning Skills in Science Learning	Literature Review	Students' critical reasoning abilities increase.	HMS
11	Urva et al. (2025)	Digital Comic Learning Media	Observation and Test	Students' reading ability increased significantly.	DS
12	Nurhidayah & Wibowo (2025)	Open Ended Fairy Tale Learning	Experiment	Creative thinking skills increase.	SM
13	Pratiwi et al. (2025)	Video Storytelling in Learning	SLR	Video storytelling increases students' learning motivation.	DS
14	Ariyanto et al. (2025)	Flipbook Mathematics Learning Media for Students' Critical Thinking Skills	RnD	Flipbook-based mathematics learning modules are effective in improving critical thinking skills.	SM
15	Safitri et al. (2024)	Problem Based Learning with Flipbook	Experiment	Learning outcomes improved significantly.	HMS
16	Afriadi & Cahyani (2024)	Integration of Art and Technology	Literature Review	Technology drives dynamic cultural learning.	IFP
17	Silviani (2026)	IFP in Supporting Digitalization of Learning	Case study	Interactive Flat Panel (IFP) assistance has made a significant contribution in accelerating the digitalization of learning in Bojonegoro Regency.	IFP
18	Wibowo et al. (2026)	Digital Literacy in Primary School	(SLR)	Technology has a significant impact on the quality of learning.	IFP

No.	Authors (Years)	Title	Method	Result	Cluster
19	Saifullah et al. (2025)	Numeracy Literacy Development	Descriptive Study	Creativity and numeracy skills increase.	SM
20	Herlistiyanti et al. (2025)	Problem Based Learning and Creativity	Pre-post Test	Problem-Based Learning effectively increases students' creativity.	HMS
21	Ispir & Yıldız (2023)	Digital Storytelling Study in Türkiye	Review Study	Digital storytelling has a positive impact in the classroom.	DS
22	Harianja et al. (2023)	Problem Based Learning towards Critical Thinking	Experiment	PBL improves mathematical critical thinking skills.	HMS
23	Chubko et al. (2020)	Digital Storytelling in EFL Learning	Case study	Student literacy and engagement increased.	DS
24	Susanti et al. (2023)	Video Storytelling Media Development	R&D	Valid and effective media are used in learning.	DS
25	Siregar et al. (2024)	Digital Storytelling with PBL	Conceptual Study	Storytelling connects concepts with problem solving.	DS
26	Almulhim (2025)	Storytelling in Kindergarten Mathematics	Observation	Students' thinking abilities increase.	SM
27	Irmayanti et al. (2025)	Storytelling and Learning Anxiety	Review Study	Storytelling reduces students' learning anxiety.	DS
28	Deslis et al. (2025)	PRISMA Review of Digital Storytelling	SLR	Digital storytelling enhances various aspects of learning.	DS
29	Hapsari & Nugraheni (2024)	HOTS-Based E-comic Media	R&D	E-comic media improves students' HOTS abilities.	HMS
30	Şen (2024)	Digital Storytelling as a Learning Medium	Qualitative Study	Motivation to learn increases even though it takes time to implement.	DS

Cluster Description: Ds = Digital Storytelling; HMS = HOTS and Learning Media in Elementary School; IFP = Interactive flat panel; SM = Sainsmatika (Science-mathematics integration)

Based on the mapping results in Table 1, the distribution of articles shows that the digital storytelling cluster is the largest, followed by the HOTS and learning media cluster in elementary schools, and then the arithmetic cluster. At the same time, the Interactive Flat Panel cluster is still relatively limited. This distribution has two important implications. First, the empirical evidence regarding digital storytelling in elementary education is already quite strong. Second, specific studies that integrate IFP with HOTS-based arithmetic storytelling remain a research gap that needs further development.

Discussions

Implementation of HOTS-Based Digital Mathematics Fairy Tales in Elementary Schools

Analysis of the digital storytelling and science/mathematics clusters shows that presenting material through digital storylines helps students transform abstract concepts into concrete, contextual representations. In the science-mathematics cluster, integrating numeracy and science concepts into stories allows students to build connections between concepts rather than memorize them separately (Nurhidayah & Wangid, 2020). When stories are designed with problem content that requires analysis and evaluation, these activities directly stimulate the HOTS dimension as emphasized in the higher-order thinking taxonomy (Harianja et al., 2023). Thus, the implementation of HOTS-based digital science-mathematics stories is not simply a replacement for media, but rather changes the pattern of learning activities from passive to constructive (Karantalis & Koukopoulos, 2022).

The Effectiveness of Digital Media and IFP on Engagement and Learning Outcomes

Findings across clusters (Permana et al., 2024; Silviani, 2026; Wibowo et al., 2026) confirm that the Interactive Flat Panel (IFP) shifts the role of technology from merely a medium for transmitting digital information (conventional) to a space for collaborative conceptual manipulation. Theoretically, the increase in motivation reported by Abelia et al. (2025) is not caused solely by the visual novelty of the medium, but rather because IFPs facilitate elementary school children's basic psychological need for kinesthetic exploration. Through the multitouch feature on IFPs, digital stories are no longer enjoyed passively through audio-visual means, as found in the study by Afriyanti et al. (2023). However, they are experienced directly through physical activities such as tapping, swiping, and mapping science and math objects on the screen. However, Şen (2024) acknowledges that optimizing this transition in interactive media requires a longer period of pedagogical preparation for teachers. This supports the hypothesis that embodied cognition (cognition developed through the interaction of the body and the environment) accelerates the internalization of abstract concepts in elementary school children.

The Role of Digital Sainsmatika Fairy Tales in Developing Critical Thinking and Problem Solving

An in-depth synthesis of the science-mathematics and HOTS clusters reveals a crucial pattern: high-level cognitive effects do not occur automatically when story texts are transferred to a digital screen. A critical analysis of the development of HOTS-based e-comics by Hapsari and Nugraheni (2024) and of science-math instructional materials by Nurhidayah & Wangid (2020) indicates that digital folktales serve as contextual scaffolding to stimulate critical reasoning skills in elementary school students (in line with the findings of Hayudinna & Muzkiyah, 2024). Science and mathematics are often perceived as daunting subjects at the elementary school level because they are presented through isolated formal symbols. Digital stories bridge this gap by embedding the logical structures of mathematics and scientific phenomena within narrative conflicts. When the storyline is intentionally paused at a specific crisis point, and students are asked to solve the character's problem on the IFP screen using critical reasoning (adopting the Problem-Solving interaction principle from Siregar et al., 2024), that is where abstract concepts can be made concrete. This interactive activity naturally shifts students' reasoning from the recall level (LOTS) to the analysis and evaluation levels (HOTS), thereby confirming the argument by Izzatika et al. (2023) that the stimulation of higher-order thinking skills arises from the quality of the design of thinking activities within the medium, not merely from the physical presence of the technological devices.

This supports the argument by Izzatika et al. (2023) that HOTS stimulation arises from the quality of the design of thinking activities, not merely from the presence of technological devices.

Furthermore, the impact of digital science-math storytelling extends beyond the purely cognitive dimension. This narrative approach has proven capable of deeply engaging students' affective domain. The interactive nature of digital stories has been shown to effectively reduce learning anxiety while boosting students' active engagement in the classroom (Yulianawati et al., 2022). Through the visual examples set by the characters, moral values such as honesty and cooperation can be internalized naturally. This process of internalizing values through active learning experiences aligns with the fundamental principles of constructivism as emphasized by Karantalis & Koukopoulos (2022). It is this combination that ultimately supports the holistic development of elementary school students.

Supporting Factors and Implementation Constraints

Cross-cluster synthesis identified several supporting factors as well as constraints. Key supporting factors include the availability of interactive devices such as IFPs, adequate student digital literacy, and support for technology integration in schools (Andarini & Salim, 2021; Niemi & Niu, 2021; Subtianah, 2023). Conversely, recurring constraints include limited technological infrastructure in some schools, digital literacy gaps among students, and teacher readiness and competence in designing innovative media (Mansir, 2022; Permana et al., 2024). Technology use also requires balanced supervision to prevent distraction or device dependency. Although the literature reflects high optimism regarding IFP integration, a digital implementation paradox was identified through cross-cluster analysis. On the one hand, this technology offers unlimited interactivity (Niemi & Niu, 2021).

On the other hand, teachers' readiness (TPACK) remains the primary obstacle (Mansir, 2022; Permana et al., 2024). This literature review argues that the greatest obstacle is not the procurement of IFP hardware, but rather a deficit in teachers' ability to engage in pedagogical authoring—that is, the ability to design digital storylines that strike a balance between scientific content, mathematical logic, and HOTS triggers. Without structured techno-pedagogical training, costly investments in interactive devices such as IFPs in elementary schools (as depicted by Silviani, 2026) risk underutilization, with advanced interactive panels serving merely as substitutes for chalkboards or one-way projectors.

Based on the study results, it can be concluded that the successful implementation of HOTS-based digital science and mathematics storytelling using technology is influenced by teacher readiness, facility availability, and educational policy support. Therefore, a comprehensive strategy is needed through teacher training, infrastructure provision, and relevant curriculum development. The synergy between schools, educators, and policymakers will determine the sustainability of digital learning innovations in elementary schools (Adiyawati & Nuroh, 2023; Hava, 2021; Nam, 2017).

CONCLUSION

Based on the results of a Systematic Literature Review (SLR), the use of digital science and mathematics storytelling, grounded in Higher Order Thinking Skills (HOTS), using Interactive Flat Panels (IFP), has great potential to improve the quality of learning in elementary schools. This medium can increase motivation to learn, student engagement, and conceptual understanding by presenting engaging, interactive, and contextually relevant materials. The integration of story elements with science and mathematics concepts also helps students understand abstract material in a more concrete and understandable way. Furthermore, the application of HOTS-based digital science and mathematics storytelling can foster the development of critical thinking, creativity, and problem-solving skills, which are essential for

21st-century learning. IFP technology further enhances the learning process through visual, collaborative, and participatory activities, enabling students to be more active during the learning process. This approach demonstrates that digital learning innovation can be an effective alternative for improving the quality of basic education.

However, its implementation still faces several challenges, including limited technological resources, student readiness, and teacher competency in effectively utilizing digital media. Therefore, policy support, ongoing teacher training, and adequate infrastructure are needed to ensure optimal implementation of digital learning. Therefore, HOTS-based digital science and mathematics storytelling has the potential to be a relevant, innovative strategy for improving the quality of learning in elementary schools.

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