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Development of digital storytelling video media to improve students' critical thinking and communication skills on environmental change material

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ABSTRACT

This research is a research and development study of learning media based on Digital Storytelling (DS) on environmental change material to improve students' critical thinking and communication skills. Using the 4-D model (Define, Design, Develop, Disseminate) combined with a quasi-experimental design (quasi-experimental pretest-posttest control group design) with an intervention duration of 3 meetings, this study applied a purposive sampling technique involving 48 eleventh-grade students divided into an experimental group (n=24) and a control group (n=24). The results showed that the media was highly valid (97.31%) and highly practical based on teacher perception (92.11%) and student perception (92.71%). Data collection for critical thinking skills used a standardized test ($\alpha = 0.90$). The effectiveness test using an independent samples t-test showed a statistically significant increase in critical thinking skills, where the experimental class achieved an average N-Gain score of 83.98% (high category) compared to the control class which only obtained 48.69% ($p = 0.000$). In addition, students' communication skills in the experimental group increased significantly based on the Mann-Whitney U test ($p = 0.000$) with a large effect size ($r = 0.862$). In conclusion, the Digital Storytelling video media proved to be valid, practical, and highly effective in improving students' critical thinking and communication skills on environmental change material.



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Introduction

Twenty-first-century skills, particularly critical thinking and communication, represent essential competencies in modern science education (Novia et al., 2024; Pramudia, 2025; Tallat et al., 2024; Thornhill-Miller et al., 2025). Critical thinking enables students to analyze information objectively, evaluate evidence, and solve complex socio-scientific issues logically (Dewi et al., 2025; Hasanah & Malik, 2020), while communication skills facilitate the articulation of ideas, active listening, and constructive argumentation both orally and in writing (Kasrah, 2023; Wardani & Widyastono, 2025). Consequently, preliminary observations in secondary schools revealed low baseline critical thinking scores (47.30%–57.00%) as well as limited active oral communication during classroom discussions (Pursitasari et al., 2023). This gap is largely driven by conventional teacher-centered learning practices and the scarcity of interactive multimedia resources that provide contextual learning stimuli (Amirova, 2025; Nurhanipah et al., 2025; Wahyuni & Yokhebed, 2019).

Environmental change material encompasses dynamic, contextual concepts rich in socio-scientific issues ranging from local to global levels, such as waste pollution, global warming, and ecosystem degradation (Daud & Agustini, 2024; Jayanti, 2020). Studying this topic requires representational media capable of bridging abstract concepts into concrete visualizations relevant to students' real lives (De Vega et al., 2024; Fadilah & Kanya, 2023; Triana et al., 2023). The Digital Storytelling (DS) approach offers an innovative pedagogical solution combining the power of structured story narratives (problem, conflict, resolution) with digital multimedia elements such as photorealistic 3D animation, emotional audio narration, natural sound effects, and scientific explanatory text (Lambert, 2010; Poonsawad et al., 2022; Robin, 2008). Through a narrative arc closely connected to everyday phenomena, DS media can stimulate curiosity, reduce students' cognitive load, and provide contextual scaffolding to simultaneously train critical reasoning skills and communicative argumentation (Çetinkaya & Demir, 2025; Ferdiansyah, 2019; Selviani, 2019; Ugap et al., 2025).

Based on these various problems and potentials, this study utilizes a Research and Development (R&D) 4-D model framework combined with a quasi-experimental design (quasi-experimental pretest-posttest control group design) to develop, test the validity and practicality, and prove the effectiveness of Digital Storytelling-based learning video media in improving high school students' critical thinking and communication skills. Subject determination was carried out through a purposive sampling technique involving 48 eleventh-grade students (divided into experimental and control groups with an intervention duration of 3 meetings), supported by a validated critical thinking test instrument oriented toward Ennis's indicators (having a reliability coefficient of $\alpha = 0.90$) and a standard communication skills observation sheet. The novelty of this study lies in the integration of dramatic narratives based on photorealistic 3D animation characters (Bumi, Nabila, and Raka), systematically combined with prompt questions for environmental problem-solving, and embedded directly into the Kurikulum Merdeka teaching module package via flexible Quick Response (QR) code access (Asbari, 2024; Rachmawati et al., 2022; Syerlita & Siagian, 2024).

Method

This research is a Research and Development (R&D) study implementing Thiagarajan's 4-D model, which consists of four main stages: Define, Design, Develop, and Disseminate (Sugiyono, 2016, 2018; Thiagarajan, 1974). The media design process adapts Morra's eight-step digital storytelling framework (Morra, 2013, as cited in Saripudin et al., 2021) and Pratiwi's interactive narrative stages (Pratiwi, 2016), utilizing Gemini AI for 3D cinematic animation asset creation and CapCut for audio-visual editing.

The subjects of this study consisted of 48 eleventh-grade students at SMAN 2 Sungai Tarab selected using a purposive sampling technique based on the availability of intact classrooms, then placed into an experimental class ($n=24$, using DS media) and a control class ($n=24$, using conventional methods) within a quasi-experimental non-equivalent control group pretest-posttest design.

The Develop stage focused on validity testing by 3 biology education expert lecturers and 1 practitioner teacher, practicality testing by teachers and students, and field effectiveness testing. The effectiveness testing was conducted using the aforementioned quasi-experimental design with the same subjects (48 eleventh-grade students). Data collection instruments consisted of validation questionnaires for material, presentation, and language experts with an adequate Content Validity Index (CVI); user practicality questionnaires (Haviz et al., 2018); 25 valid multiple-choice critical thinking objective tests based on content validity testing (CVI = 0.88) and Cronbach's alpha reliability coefficient ($\alpha = 0.90$) oriented toward Ennis's 5 indicators (2011), namely elementary clarification, basic support, inference, advanced clarification, and strategy & tactics (Arikunto, 2016, 2020); as well as communication skills performance observation sheets referring to Greenstein's 7 indicators (2012) validated by experts (CVI = 0.91) and tested for inter-rater reliability using Cohen's kappa ($\kappa = 0.85$).

Results and Discussions

The development of Digital Storytelling-based learning video media on environmental change material produced 4 thematic MP4 video series with a total duration of 19 minutes 17 seconds (Video 1: Our Village Has Changed; Video 2: The Mystery of Pollution Around Us; Video 3: Why Earth Lost Its Balance; Video 4: The Mission to Save Earth). This media was integrated into the teaching modules via QR codes on Student Worksheets (LKPD). The results of media quality testing covering validity, practicality, and effectiveness aspects are comprehensively presented in the following sections.

Validity of Digital Storytelling Video Media

Media validity testing by four expert validators covered three main domains: material feasibility, multimedia presentation, and language and readability. The recapitulation of validation assessment results is presented in Table 1.

Table 1. Recapitulation of Validity Test Results of Digital Storytelling-Based Learning Media

Assessment Aspect	Obtained Score	Maximum Score	Validity (%)	Category
Material Feasibility	159	160	99,38	Very Valid
Multimedia Presentation	219	224	97,77	Very Valid
Language and readability	91	96	94,78	Very Valid
Rata-Rata Total Validitas			97,31	Very Valid

Based on Table 1, the average validity score of 97.31% proves that the DS video media meets exceptionally high theoretical and didactic feasibility requirements. The near-perfect score in the material aspect (99.38%) confirms the accuracy of biological scientific concepts, alignment with curriculum learning outcomes, and richness of environmental problem stimuli presented. In the presentation (97.77%) and language (94.79%) aspects, the combination of 3D visual animation, audio narration, sound effects, and communicative diction was deemed highly harmonious in facilitating student understanding. Constructive feedback from validators regarding improvements to voice-over quality, animation synchronization with lip-sync, standardized language, and the addition of scene summaries was thoroughly refined prior to field testing.

Practicality of Learning Media

A practicality test was conducted to evaluate ease of use, learning time allocation efficiency, and media usefulness from the perspective of teachers and students. The results of the practicality test are summarized in Table 2.

Table 2. Practicality Test Results of Digital Storytelling Media by Teachers and Students

Practicality Aspect	Teacher Practicality (%)	Student Practicality (%)
Ease of Use	159	160
Learning Time Efficiency	219	224
Learning Benefits	91	96
Total Average Validity	92,11 (Very Practical)	92,71 (Very Practical)

The practicality results from teachers (92.11%) and students (92.71%) indicated a highly positive response regarding usability. Teachers stated that the concise video duration helped reduce lecture dominance and facilitated the visualization of abstract environmental phenomena. For students, presenting concepts through attractive fictional character narratives fostered learning interest and facilitated independent study outside school hours via QR Code scanning.

Media Effectiveness on Critical Thinking Skills

The media's effectiveness in improving critical thinking skills was analyzed through pre-test and post-test score comparisons and inferential statistical hypothesis testing. Descriptive data and test difference results are presented in Table 3.

Table 3. Descriptive Statistical Analysis and Hypothesis Testing of Critical Thinking Skills

Group	Pre-test (Mean $\pm$ SD)	Post-test (Mean $\pm$ SD)	N-Gain (%) $\pm$ SD	Independent t-Test	Kategori Efektivitas
Experimental Class (n=24)	44,83 $\pm$ 11,13	91,17 $\pm$ 5,00	83,98 $\pm$ 8,66	T=8,170 Df=32,45 P=0,000	High (effective)
Control Class (n=24)	44,00 $\pm$ 11,31	71,33 $\pm$ 10,79	48,69 $\pm$ 15,59		Moderate (Fair)

The Independent Samples t-Test yielded a value of $t = 8.170$ ($df = 32.449$; $p = 0.000 < 0.05$), proving the rejection of H_0 and acceptance of H_1 . There was a highly significant difference in the improvement of critical thinking skills between the experimental and control classes. The experimental class's N-Gain achievement reached 83.98% (high category), outperforming the control class, which only obtained 48.69% (moderate category). This significant increase occurred because the storytelling structure in the videos was designed to

feature socio-scientific dilemmas and prompt questions that required students to clarify problems, analyze causality, evaluate evidence, and deduce rational environmental mitigation actions (Bono, 2007; Halimah, 2025; Rahmaniah et al., 2023; Santrock, 2003).

Media Effectiveness on Communication Skills

The performance assessment of students' communication skills during the learning process was analyzed using the non-parametric Mann-Whitney U Test, given that the experimental class data were not normally distributed ($p = 0.004 < 0.05$). The summary of the analysis is presented in Table 4.

Table 4. Analysis of Students' Communication Skills and Non-Parametric Test

Group	Mean Score	Standar Deviation	Uji ManWhitney U	Effect Size ®
Experimental Class (n=24)	86,46	4,24	U=0,000	T=8,170
Control Class (n=24)	62,81	3,71	Z=-5,973 P=0,000	Df=32,45 P=0,000

Based on Table 4, the average score of communication skills for the experimental class reached 86.46 (very good category), differing significantly from the control class score of 62.81 (fair category). The Mann-Whitney U test showed a value of $U = 0.000$ ($Z = -5.973$, $p = 0.000 < 0.05$), confirming the acceptance of H. The Effect Size value ($r = 0.862$), which exceeds the threshold of 0.50, indicates that the application of DS video media provides a very strong practical impact on improving students' communication skills. The video narration provides a shared context that facilitates students in conveying oral arguments, listening actively, and presenting environmental problem-solving solutions persuasively and confidently (Proniaieva & Fedchenko, 2021; Rosmlasari et al., 2025).

Theoretically, the effectiveness of DS media is rooted in the integration of multimedia principles and authentic narrative learning (Lambert, 2010; Miftah, 2013; Nurfadhillah et al., 2021). The dual presentation of visual and auditory information reduces cognitive load, while personal narration triggers students' emotional engagement. This aligns with previous findings that technology-based digital storytelling media can strengthen higher-order thinking skills, motivation, and students' communicative literacy (Andreanty & Harjono, 2024; Ashari & Wahyu, 2018; Fajrideani & Nugroho, 2024; Sirajuddin et al., 2025; Tarigan et al., 2023). Thus, the developed Digital Storytelling-based learning video media is proven to comprehensively meet the criteria of validity, practicality, and effectiveness.

Conclusions

Based on the results of development research using the 4-D model and quasi-experimental evaluation involving 48 eleventh-grade students at SMAN 2 Sungai Tarab (24 students in the experimental group and 24 students in the control group), it can be concluded that the Digital Storytelling (DS) video learning media on environmental change material meets very valid criteria with an average percentage of 97.31% in terms of material, presentation, and language. This media also proved to be very practical based on teacher perception (92.11%) and student perception (92.71%). Effectiveness testing via independent samples t-test proved that the DS media significantly improved students' critical thinking skills with an average N-Gain score achievement of 83.98% (high category, $t = 8.170$, $p < 0.001$). In addition, based on the Mann-Whitney U test ($p < 0.001$), this media proved to significantly improve students' communication skills up to an average of 86.46 with a large effect size ($sr = 0.862$). Therefore, this Digital Storytelling video media is highly recommended as an alternative contextual teaching material innovation in supporting the implementation of the Kurikulum Merdeka in senior high schools.

References

- Amirova, N. (2025). Traditional vs. non-traditional teaching in secondary education: A comparative analysis. *Porta Universorum*, 1(3), 101–109.
- Andreanty, V., & Harjono, H. S. (2024). Pengembangan media digital storytelling dalam pembelajaran menulis cerpen pada siswa SMA. *Jurnal Onoma: Pendidikan, Bahasa dan Sastra*, 10(3), 2810–2823.
- Asbari, M. (2024). Prinsip pembelajaran dalam Kurikulum Merdeka. *Journal of Information Systems and Management*, 3(2), 11–17.

- Ashari, F., & Wahyu, A. (2018). Pengembangan media digital storytelling dalam pembelajaran biologi SMA untuk menunjang model pembelajaran blended learning. *BioEdu: Berkala Ilmiah Pendidikan Biologi*, 7(2), 145–152.
- Çetinkaya, M., & Demir, İ. (2025). Digital storytelling in science education: A systematic review. *The Journal of Limitless Education and Research*, 10(1), 45–62.
- Chan, R., Tan, M., & Verma, A. (2025). The relationship between teacher digital literacy and the use of technology in learning. *International Journal of Educational Narratives*, 3(1), 12–25.
- Dewi, Y. K., Khalid, A., & Agam, A. A. (2025). The role of critical thinking skills in enhancing problem-solving abilities among high school students. *Journal of Education and Social Science*, 2(1), 19–24.
- Ennis, R. H. (2011). Critical thinking: Reflection and perspective Part I. *Inquiry: Critical Thinking Across the Disciplines*, 26(1), 4–18. <https://doi.org/10.5840/inquiryctnews20112613>
- Fadilah, A., & Kanya, N. A. (2023). Pengertian media, tujuan, fungsi, manfaat dan urgensi media pembelajaran. *Journal of Student Research*, 1(2), 1–15.
- Fajrideani, W., & Nugroho, R. A. (2024). Pengembangan bahan ajar digital storytelling cerita rakyat untuk meningkatkan kemampuan bernalar kritis siswa di SMA. *Jurnal Onoma: Pendidikan, Bahasa dan Sastra*, 10(3), 3170–3187.
- Gitnita, S., Kamus, Z., & Gusnedi. (2018). Analisis validitas, praktikalitas, dan efektivitas pengembangan bahan ajar terintegrasi konten kecerdasan spiritual pada materi fisika tentang vektor dan gerak lurus. *Pillar of Physics Education*, 11(2), 153–160.
- Greenstein, L. (2012). *Assessing 21st century skills: A guide to evaluating mastery and authentic learning*. Thousand Oaks: Corwin Press.
- Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64–74. <https://doi.org/10.1119/1.18809>
- Halimah, N. (2025). Menerapkan berpikir kritis dalam kehidupan sehari-hari: Studi kasus penanganan berita hoaks. *Journal of Media and Communication*, 1(3), 40–44.
- Hasanah, H., & Malik, A. (2020). Blended learning in improving students' critical thinking and communication skills at university. *Cypriot Journal of Educational Sciences*, 15(5), 1295–1306. <https://doi.org/10.18844/cjes.v15i5.5168>
- Haviz, M., Karomah, H., Delfita, R., Umar, M. I. A., & Maris, I. M. (2018). Revisiting generic science skills as 21st century skills on biology learning. *Jurnal Pendidikan IPA Indonesia*, 7(3), 355–363. <https://doi.org/10.15294/jpii.v7i3.12438>
- Kasrah, R. (2023). Communication competency: The impact of communication on student's learning activities. *Journal of Communication, Religious, and Social Sciences*, 1(1), 24–34.
- Lambert, J. (2010). *Digital storytelling cookbook*. Berkeley: Digital Diner Press.
- Miftah, M. (2013). Fungsi dan peran media pembelajaran sebagai upaya peningkatan kemampuan belajar siswa. *Jurnal Kwangsang: Jurnal Teknologi Pendidikan*, 1(2), 95–105. <https://doi.org/10.31800/jtpk.v1n2.p95-105>
- Nofiasari, W., & Hutagalung, C. A. (2023). Storytelling sebagai teknik pembelajaran pengembangan karakter diri anak di Rumah Belajar Cahaya Indonesia. *Jurnal Abdimas Bina Bangsa*, 4(1), 392–402.
- Novia, F., Nurdianti, D., Purwanto, M. B., & Darussalam, P. (2024). English learning and innovation skills in 21st: Implementation of critical thinking, creativity, communication, and collaboration. *Asian Journal of Applied Education*, 3(2), 113–124.
- Nurfadhillah, S., Ningsih, D. A., Ramadhania, P. R., & Sifa, U. N. (2021). Peranan media pembelajaran dalam meningkatkan minat belajar siswa SD Negeri Kohod III. *PENA: Jurnal Pendidikan dan Ilmu Sosial*, 3(2), 243–255.
- Nurhanipah, N., Huda, A. N., Sari, A. S., Subarna, I. C., Hanifah, N., Saputra, R., & Kusnadi, A. (2025). Model pembelajaran Contextual Teaching and Learning (CTL) sebagai upaya untuk meningkatkan hasil belajar peserta didik. *Jurnal Riset Ilmiah*, 2(7), 2993–3002.
- Poonsawad, A., Srisomphan, J., & Sanrach, C. (2022). Synthesis of problem-based interactive digital storytelling learning model under gamification environment promotes students' problem-solving skills. *International Journal of Emerging Technologies in Learning*, 17(5), 103–119. <https://doi.org/10.3991/ijet.v17i05.28129>
- Pratiwi, R. (2016). Penerapan metode digital storytelling untuk meningkatkan keterampilan berbicara siswa. *Jurnal Pendidikan Guru Sekolah Dasar*, 1(1), 71–78.
- Proniaieva, V., & Fedchenko, O. (2021). Non-verbal communication in pedagogical interaction. *Pedagogical Sciences: Theory, History, Innovative Technologies*, 4(108), 215–224.
- Pursitasari, I. D., Rubini, B., & Suriansyah, M. I. (2023). Critical thinking & ecoliteracy: Kecakapan abad 21 untuk menunjang Sustainable Development Goals. Gorontalo: Ideas Publishing.

- Rachmawati, N., Marini, A., Nafiah, M., & Nurasih, I. (2022). Projek Penguatan Profil Pelajar Pancasila dalam implementasi kurikulum prototipe di sekolah penggerak jenjang sekolah dasar. *Jurnal Basicedu*, 6(3), 3613–3625. <https://doi.org/10.31004/basicedu.v6i3.2714>
- Rahmaniah, N., Oktaviani, A. M., Arifin, F., Maulana, G., Triana, H., Serepinah, M., & Abustang, P. B. (2023). *Berpikir kritis dan kreatif: Teori dan implementasi praktis dalam pembelajaran*. Makassar: Publica Indonesia Utama.
- Robin, B. R. (2008). Digital storytelling: A powerful technology tool for the 21st century classroom. *Theory Into Practice*, 47(3), 220–228. <https://doi.org/10.1080/00405840802153916>
- Rosmlasari, A. I., Champa, R. P., & Pratiwi, A. S. (2025). Metode digital storytelling dalam pengajaran sastra Arab di era pendidikan 4.0. *Jurnal Dirgantara Pendidikan*, 1(1), 39–46.
- Saripudin, D., Komalasari, K., & Anggraini, D. N. (2021). Value-based digital storytelling learning media to foster student character. *International Journal of Instruction*, 14(2), 369–384. <https://doi.org/10.29333/iji.2021.14221a>
- Selviani, I. (2019). Pengembangan modul biologi Problem Based Learning untuk meningkatkan kemampuan berpikir kritis peserta didik SMA. *IJIS Edu: Indonesian Journal of Integrated Science Education*, 1(2), 147–154. <https://doi.org/10.29300/ijisedu.v1i2.2032>
- Sirajuddin, M., Murniviyanti, L., & Irawan, D. B. (2025). Pengembangan media digital storytelling pada pembelajaran Bahasa Indonesia SDN 158 Palembang. *Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, 12(1), 55–68.
- Tallat, R., Hawbani, A., Wang, X., Al-Dubai, A., Zhao, L., Liu, Z., & Min, G. (2024). Navigating Industry 5.0: A survey of key enabling technologies, trends, challenges, and opportunities. *IEEE Communications Surveys & Tutorials*, 26(3), 1–48.
- Tarigan, F. N., Hasibuan, S. A., & Medan, K. (2023). Pengembangan digital storytelling berbasis Artificial Intelligence untuk meningkatkan kemampuan literasi dan critical thinking mahasiswa. *Jurnal Dunia Pendidikan*, 4(2), 485–491.
- Thiagarajan, S. (1974). *Instructional development for training teachers of exceptional children: A sourcebook*. Bloomington: Center for Innovation in Teaching the Handicapped, Indiana University.
- Ugap, C., Yahaya, W. A. W., Balakrishnan, B., Ekram, M., Hafis, A., Tochinai, F., & Nasir, S. (2025). Tech-infused narrative: A systematic review of digital storytelling in education. *Journal of Advanced Research Design Journal*, 1(1), 1–16.
- Wahyuni, E. S., & Yokhebed, Y. (2019). Deskripsi media pembelajaran yang digunakan guru biologi SMA Negeri di Kota Pontianak. *Jurnal Pendidikan Informatika dan Sains*, 8(1), 32–43. <https://doi.org/10.31571/saintek.v8i1.1105>