JKTP: Jurnal Kajian Teknologi Pendidikan
Vol. 8, No. 2, May 2025: 180-191
e-ISSN: 2615-8787
DOI: 10.17977/um038v8i22025p180
https://journal-fip.um.ac.id/index.php/jktp

# DEVELOPMENT OF INTERACTIVE MEDIA CONTENT EDUCATION RESPONSIVE DIGITAL ON THE FORCE AND MOTION SCIENCE TOPIC OF CLASS 4 ELEMENTARY SCHOOL

**Rida Bakty Nurwibawa, Zainal Abidin Arief, Hendri Tanjung**
*Pasca Sarjana Teknologi Pendidikan Universitas Ibn. Khaldun, Kota Bogor*
*baktyrida82@gmail.com*

**Article History**
*Received: 12 March 2025, Accepted: 30 May 2025,* ***Published: 30 May 2025***

**Abstrak**
Penelitian ini dilaksanakan untuk mengembangkan media pembelajaran interaktif yang dirancang khusus guna mendukung pemahaman konsep gaya dan gerak dalam pembelajaran Ilmu Pengetahuan Alam dan Sosial di tingkat sekolah dasar. Media ini diberi nama CERDAS atau *Content Education Responsive Digital Articulate Storyline*, yang dirancang berbasis teknologi digital dengan pendekatan yang sesuai dengan karakteristik belajar siswa. Pengembangan dilakukan melalui tahapan sistematis mulai dari analisis kebutuhan hingga implementasi media di dalam kelas. Hasil dari proses pengembangan menunjukkan bahwa media interaktif CERDAS berhasil memenuhi aspek kelayakan baik dari sisi isi materi, desain tampilan, maupun kemudahan penggunaan. Respon siswa terhadap media ini sangat positif, terlihat dari peningkatan keterlibatan selama pembelajaran serta kemudahan mereka dalam memahami materi yang sebelumnya dianggap sulit. Media ini juga terbukti mampu menciptakan suasana belajar yang lebih menyenangkan dan membangun motivasi belajar siswa. Penelitian ini menegaskan bahwa media interaktif CERDAS dapat dijadikan sebagai alternatif inovatif dalam pembelajaran IPAS di sekolah dasar. Media ini tidak hanya membantu siswa memahami materi secara lebih mendalam, tetapi juga memberikan pengalaman belajar yang interaktif, kontekstual, dan sesuai dengan perkembangan zaman.

**Kata Kunci**: pembelajaran interaktif; gaya dan gerak; sekolah dasar; media digital; CERDAS

***Abstract***
*This study was conducted to develop an interactive learning media specifically designed to enhance students' understanding of the concepts of force and motion in science and social studies subjects at the elementary school level. The media, titled CERDAS or Content Education Responsive Digital Articulate Storyline, was created using a digital-based approach tailored to the learning characteristics of young learners. The development process followed a systematic sequence from needs analysis to classroom implementation. The results of the development process indicate that CERDAS meets key criteria in terms of content accuracy, visual design, and user accessibility. Students responded positively to the use of this media, showing increased engagement during lessons and greater ease in grasping concepts that were previously difficult to understand. The media also contributed to a more enjoyable and motivating learning environment. This research concludes that CERDAS serves as an innovative alternative for elementary science instruction. It not only facilitates deeper conceptual understanding but also offers an interactive and contextual learning experience that aligns with the needs of modern education.*

***Keyword****: interactive learning; force and motion; elementary education; digital media; CERDAS*

***To cite this article:***
Nurwibawa, R. B., Arief, Z. A., & Tanjung, H. (2025). Development Of Interactive Media Content Education Responsive Digital On The Force And Motion Science Topic Of Class 4 Elementary School. *JKTP: Jurnal Kajian Teknologi Pendidikan*, 8(2), 180–191. doi: 10.17977/um038v8i22025p180

## INTRODUCTION

Basic education serves as a critical foundation for shaping character, thought patterns, and cognitive abilities in children from an early age. At this level, students are not only introduced to fundamental knowledge, but also guided in developing life skills, moral values, and learning habits that will underpin their success in subsequent educational stages. Therefore, learning at the elementary school level should not focus solely on cognitive aspects, but must be comprehensively designed to develop affective and psychomotor domains in a balanced manner.

Alongside the rapid advancement of information and communication technology, education has entered a phase of digital transformation, significantly altering how children learn. The digital-native generation possesses learning characteristics that differ greatly from previous generations. They are more accustomed to engaging with visual media, open to technology-based learning experiences, and respond better to dynamic and responsive teaching methods. This condition calls for more meaningful and contextual learning that actively involves students as learning agents, rather than passive recipients of information.

Conventional teaching methods, such as one-way lectures, written exercises, and reliance on textbooks as the sole learning resource, still dominate classroom instruction in many schools. As a result, student engagement tends to be low due to the lack of visual, interactive, and exploratory stimuli. Concept comprehension often remains superficial and memorization-based, especially when dealing with abstract subjects. A clear example of this is the subject of Natural and Social Sciences (IPAS), which includes topics such as force, motion, energy, and object interaction. Without adequate visual aids, these concepts are difficult for students to grasp concretely.

The integration of technology into IPAS instruction in elementary schools is no longer a complementary tool, but a necessity to bridge these gaps. Interactive digital learning media can simplify complex content, making it more accessible through visualizations, simulations, and contextual experiences. Beyond enhancing conceptual understanding, interactive media can increase students' interest and motivation, encouraging them to actively engage in the learning process. In this new learning paradigm, teachers no longer serve as the sole source of knowledge, but rather as facilitators who guide students in exploring materials through technology aligned with their learning needs.

Innovative efforts to design and implement digital learning media that meet student needs are essential strategies in addressing today's educational challenges. The development of such media must be systematic, grounded in real needs assessments, and guided by modern learning theories and evidence-based pedagogical practices.

This condition is clearly evident at SD Negeri 2 Kalaparea. Initial observations revealed that the average student scores in IPAS, particularly in the topic of force and motion, remained below the Minimum Learning Mastery Criteria. Midterm assessments showed unsatisfactory results, indicating a gap between curriculum expectations and classroom learning outcomes. One of the main causes is the absence of interactive and contextual learning media capable of presenting force and motion concepts in a visual and applicable manner. When students rely solely on verbal explanations or textbook readings without concrete illustrations, concept internalization becomes less effective. Yet, with appropriate approaches and the use of technology, abstract concepts like gravitational force, friction, and object movement can be understood through more engaging simulations and hands-on interactions.

Previous studies have demonstrated that interactive learning media based on technology, such as those developed using Articulate Storyline, hold great potential in improving student

engagement and learning effectiveness. Sari, Wahyuni, and Pratama (2021) found that the use of Articulate Storyline-based instructional media significantly increased student engagement and positively impacted conceptual understanding and learning outcomes. Similarly, Haryanto and Sumarni (2022) stated that interactive media enhances students' interest and strengthens their comprehension of the delivered material. Furthermore, Nuraini (2023) emphasized that integrating interactive teaching media into the elementary school curriculum is a strategic step in creating learning that adapts to the needs of digital-age learners.

In the context of developing such interactive media, the Research and Development (R&D) approach is considered both relevant and systematic. The ADDIE model introduced by Gustafson and Branch (2002), along with the 4D model by Thiagarajan, Semmel, and Semmel (1974), have proven to provide structured and effective frameworks for learning product development. These models include critical stages such as needs analysis, design, development, evaluation, and dissemination, allowing the media to be developed in alignment with real classroom contexts and student characteristics.

However, most existing studies are still general in scope and have not specifically focused on developing Articulate Storyline-based interactive media tailored to specific subjects, particularly in elementary education. For the subject of IPAS, which encompasses abstract concepts like force and motion, there is a pressing need for visual and interactive approaches to help students develop concrete understanding. This gap presents a crucial opportunity for targeted and contextual media innovation.

In response to this need, the present study aims to develop an interactive media called CERDAS (Content Education Responsive Digital Articulate Storyline), specifically designed to help elementary students better understand the concepts of force and motion. This media is developed through the integration of the ADDIE and 4D models and adopts constructivist theory and multimodal learning approaches, enabling students to engage in active, exploratory, and visual learning experiences. CERDAS is not only designed to meet curriculum requirements but is also aligned with the learning characteristics of digital-age students, including the need for interactivity, immediate feedback, and flexible learning processes.

The scientific novelty of this research lies in the integration of learning theory, digital technology, and a systematic media development approach. CERDAS is specifically focused on the topic of force and motion for Grade IV elementary students, offering practical and contextual contributions to the development of effective learning media. With a responsive approach to students' needs and the realities of elementary school environments, this media is expected to serve as an innovative solution for enhancing the quality of IPAS instruction in a more effective and engaging way.

## METHOD

This study employed a Research and Development (R&D) approach with the primary aim of exploring the development process, feasibility testing, and effectiveness evaluation of the interactive media CERDAS (Content Education Responsive Digital Articulate Storyline) for teaching the topic of force and motion to fourth-grade students at SD Negeri 2 Kalaparea, Sukabumi. The R&D approach was chosen because it provides a systematic framework for researchers to produce instructional products that can be directly tested in the classroom and refined based on real needs in the field. In its implementation, this study integrated two development models—the ADDIE model and the 4D model—each offering a structured workflow encompassing the stages of define, analysis, design, development, implementation, evaluation, and dissemination of results.

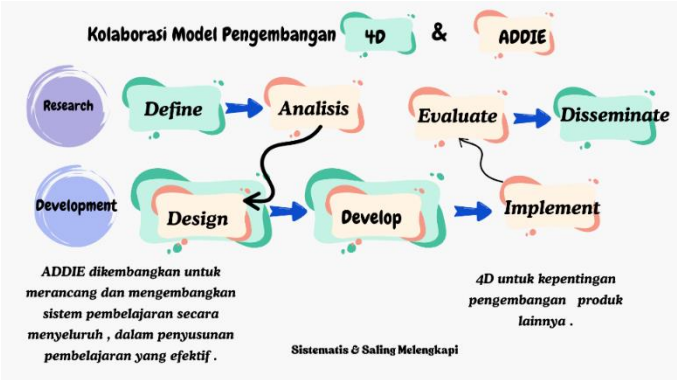


**Figure 1. Research steps for developing ADDIE and 4D models**

The subjects of this study were fourth-grade students at SD Negeri 2 Kalaparea. The selection of this subject group was based on the consideration that at this level, students possess the cognitive readiness to learn concepts related to force and motion but still require a more visual and interactive learning approach. In addition to students, the involvement of teachers and experts was also an essential part of the media validation process. The research was conducted over a six-month period, from January to June 2025, with time allocated for problem identification, media design and development, trial implementation, and evaluation.

The instruments used in this study included validation questionnaires completed by subject matter experts, instructional design experts, and media experts, as well as student response questionnaires to assess engagement, comfort, effectiveness, and learning experience. Furthermore, pre-test and post-test instruments were used to measure the students' understanding of the concepts of force and motion before and after using the interactive CERDAS media. To ensure the validity and quality of the instruments, both validity and reliability tests were conducted using SPSS 22, with significance values ($< 0.05$) and Cronbach's Alpha coefficients ($> 0.6$) used as benchmarks to indicate measurement consistency and accuracy.

Data collection procedures were structured into several stages to obtain valid and relevant data. The first stage involved initial classroom observations and interviews with teachers to identify learning issues, specifically regarding the topic of force and motion in the Science and Social Studies (IPAS) subject. The findings revealed that students had difficulty understanding abstract concepts due to the lack of suitable instructional media in the classroom, which still relied heavily on conventional methods.

Based on these preliminary findings, the researcher developed an interactive learning media using the Articulate Storyline application. This media integrated various visual and interactive elements, such as animations, simulations, digital quizzes, and instructional scenarios designed to encourage active student participation. The initial prototype was then tested on a small group of students to gather early feedback regarding its interface, content, and conceptual clarity. Subsequently, the media underwent validation by three groups of experts—subject matter, instructional design, and media experts. Feedback from these experts was used as a basis for revising the media prior to full-class implementation.

Following the revision process, the media was implemented among the entire fourth-grade student group as the primary subjects of the study. Data were collected comprehensively through the administration of pre-tests and post-tests to measure learning gains after using the CERDAS media. Additionally, a student response questionnaire was distributed to capture perceptions regarding comfort, engagement, and instructional effectiveness. During the implementation phase,

classroom observations were also conducted to directly observe student participation, their interaction with the media, and how teachers integrated the media into their daily teaching practices.

The data collected from the pre-tests, post-tests, questionnaires, and observations were analyzed using a quantitative approach. Data analysis techniques included percentage calculations and the N-Gain test. Percentage analysis was used to determine the media's feasibility level based on expert validation and student feedback. This calculation compared the actual scores to the ideal maximum scores and converted them into percentage form. The results were categorized into five levels: very good, good, fair, poor, and very poor. These categories served as a reference for determining media quality and the need for further revisions.

Meanwhile, the effectiveness of the media in enhancing student learning outcomes was measured using the N-Gain test. This formula calculated the difference between post-test and pre-test scores, divided by the difference between the ideal score and the pre-test score. The resulting N-Gain values were then categorized into three levels of effectiveness: high, moderate, and low. These classifications followed the guidelines established by Melzer. To offer a more practical interpretation, N-Gain values were also converted into percentages and analyzed according to Hake's learning effectiveness criteria: ineffective, less effective, fairly effective, and effective.

By applying this systematic procedure for data collection and analysis, the study not only assessed the feasibility of the CERDAS interactive media but also evaluated its direct impact on student learning outcomes. The integration of the ADDIE and 4D development models, along with expert involvement and student feedback during the evaluation process, enhanced the media's validity and reliability. The entire methodological framework was designed to ensure that the research findings accurately reflected real classroom needs and contributed practical insights to the development of technology-based instructional media in primary education settings.

## RESULT

This study resulted in the development of an interactive learning media called CERDAS (Content Education Responsive Digital Articulate Storyline), designed as an innovative learning tool for the topic of force and motion in the IPAS (Science and Social Studies) subject for fourth-grade students at SD Negeri 2 Kalaparea. The findings of this research indicate that the media, developed through the combined use of the ADDIE and 4D models, effectively addresses students' needs for a more interactive, contextual, and engaging learning experience. The development process began with a needs analysis, which revealed the limitations of conventional teaching methods that were still predominantly used by teachers. Observations showed that students tended to be passive, easily bored, and struggled to grasp abstract concepts such as magnetic force and gravity. This condition highlighted the urgent need for technology-based learning media to optimize the learning process.

The analysis of student characteristics revealed that fourth-grade students showed a preference for visual and kinesthetic learning styles and already possessed basic digital literacy skills. A survey conducted among the students showed that more than 80% preferred learning through images, videos, or game-based activities. This finding further reinforced the argument that interactive and digital media is highly compatible with their learning preferences. The selected topic of force and motion is also relatively complex for elementary school students, as it is conceptual in nature and not always directly observable. Therefore, multimedia approaches such as animation, simulation, and interactive narration are considered effective in simplifying and visualizing these abstract concepts.


**Figure 2. Main storyline page**

During the design phase, the media was developed with student-centered content, incorporating bright visual elements and simple navigation. The initial draft was created using the Articulate Storyline 3 application. The media consisted of several components, including a student login page, learning objectives, a content map, video-based explanations, real-life examples, and interactive quizzes. All elements were carefully designed to create an enjoyable and immersive learning experience for the students. Below is an example of the storyline design.

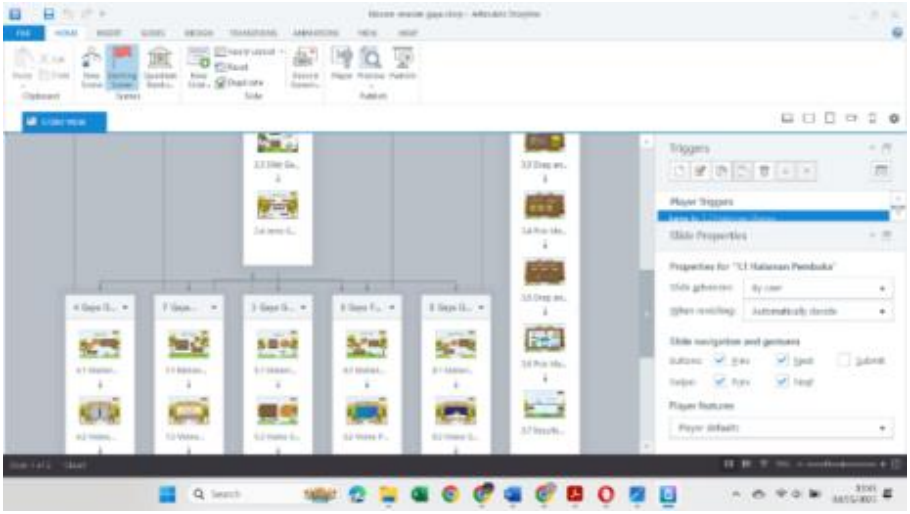

**Figure 3. Story board in storyline 3**

The product trial phase demonstrated that the CERDAS interactive media met the standards for being highly feasible. Validation results from subject matter experts indicated a 100% alignment with the curriculum, with an overall score of 97%, falling into the “excellent” category. The expert suggested adding more video variations and discussion instructions in the practice exercises, which were then accommodated in the media revision. Validation from the instructional design expert yielded a score of 94%, with an emphasis on revising learning objectives to be more measurable. Meanwhile, media expert validation received a score of 91%, indicating a high level of feasibility, though suggestions were made to improve the quality of visuals and animations to better suit student preferences.


**Figure 4. CERDAS interactive media login page**

A small group trial was conducted with 10 students in a face-to-face setting, showing a significant increase in student engagement. Engagement scores reached 88.8%, comfort 92%, effectiveness 88%, and overall experience 88%. Observations revealed that students were enthusiastic, more focused, and able to complete learning tasks effectively. These results served as a strong foundation to proceed with full-scale classroom implementation.

During the media effectiveness testing phase, pre-tests and post-tests were administered to 58 students. The results showed an increase in the average score from 68.02 to 93.53. The calculated N-Gain value reached 0.78 or 78%, which falls into the "effective" category. These findings confirm that the CERDAS interactive media significantly improved students' understanding of force and motion concepts. In addition, students demonstrated increased motivation and enthusiasm for learning, as evidenced by questionnaire results showing average scores above 87% in terms of comfort, engagement, effectiveness, and overall learning experience.

The validity and reliability of the post-test items were also tested using SPSS 22. The validity results showed that all test items had r-count values higher than the r-table (0.2586) and significance values less than 0.05, indicating that all items were valid. The Cronbach's Alpha reliability score of 0.775 demonstrated that the assessment instrument was reliable.

These findings support the hypothesis that CERDAS interactive media can enhance the effectiveness of teaching force and motion, improve students' conceptual understanding, and create a more engaging and enjoyable learning atmosphere. They also address the central research issue: how to develop responsive interactive media that meet students' needs and effectively enhance comprehension of IPAS concepts.

Despite its highly positive results, some limitations must be considered for future development. First, the media implementation was limited to one school and one subject, making the generalization of findings limited and in need of broader testing. Second, technological infrastructure and internet connectivity remain obstacles in some schools. Third, the relatively short testing duration did not allow for the measurement of long-term impacts on student learning outcomes. Finally, teacher involvement in the consistent use of the media needs to be strengthened so that the media becomes not just a learning aid but an integral part of the learning process.

In conclusion, the CERDAS interactive media has proven to be a feasible and effective learning innovation that enhances the quality of the teaching and learning process in elementary schools. These findings provide concrete contributions to the development of digital technology-based media that is responsive to the evolving educational landscape and students' learning needs.

## DISCUSSION

The findings of this study indicate that the development of the CERDAS (Content Education Responsive Digital Articulate Storyline) interactive learning media was successfully realized through the integration of two proven development models: ADDIE and 4D. The ADDIE model provided a solid and systematic foundation in the instructional design process, starting from the needs analysis stage to the evaluation of the developed product. This model ensured that each decision made during the development process was data-driven and based on real needs in the field. On the other hand, the 4D model (Define, Design, Develop, and Disseminate) offered a highly practical and applicable approach, particularly in the validation and implementation phases of educational media development ready for classroom use. The combination of these two models resulted in a balanced approach between strategic planning and implementation flexibility, making the development process of CERDAS media not only logically structured but also adaptive to the dynamic learning needs at the elementary school level.

The initial development stage began with observations and in-depth interviews with fourth-grade teachers at SD Negeri 2 Kalaparea. The aim of this activity was to gain a comprehensive understanding of the challenges faced by teachers and students in the learning process, especially in the topic of force and motion in the Natural and Social Sciences (IPAS) subject. The observations revealed that the instructional methods used were still traditional, relying heavily on lectures and textbooks, without support from visual or interactive media that could facilitate the understanding of abstract concepts. Teachers acknowledged that most students had difficulty connecting theoretical knowledge of force and motion to real-life experiences or phenomena around them. As a result, the learning process lacked context and tended to depend on rote memorization rather than deep conceptual understanding.

This condition reflects a gap between the abstract nature of IPAS content and the concrete-operational learning needs of elementary students, as described in Piaget's theory of cognitive development. Students at the concrete operational stage require learning media that they can see, touch, and manipulate visually or interactively in order to gradually construct understanding through direct experience. In this context, learning media plays a crucial role. Arsyad (2011) emphasized that media is not merely a technical aid but an integral part of the learning system that stimulates the senses, sparks interest, and clarifies the delivery of abstract information.

Therefore, the development of the CERDAS interactive media was directed to address these needs by offering features such as gravity simulations, animations of object interactions, interactive quizzes, and visual narratives that guide students in understanding concepts through a multimodal approach. The development process was carried out continuously through limited trials, expert validation, and product revisions. This aligns with the principles of formative evaluation in the ADDIE model and iterative revision in the 4D model, both of which emphasize repeated validation and refinement as essential steps to ensure the quality of the final product.

In conclusion, the successful development of the CERDAS media through the integration of the ADDIE and 4D models not only demonstrates methodological rigor but also responsiveness to real classroom learning challenges. This strategy has produced a media product that is not only technically well-crafted and visually appealing but also contextual, meaningful, and aligned with the principles of the Merdeka Curriculum—a curriculum that promotes student-centered learning, contextual understanding, and learner autonomy.

The validation results from subject matter experts, instructional design experts, and media experts indicate that the CERDAS media falls into the "excellent" category. The assessed aspects included content alignment with the curriculum, clarity of material delivery, visual and navigation

quality, and ease of use. The average validation scores were consistently above 90 percent. These evaluations were further supported by student response questionnaires, which revealed that students felt comfortable, interested, and greatly assisted by the developed media.

These findings are consistent with the research of Sari et al. (2021), which demonstrated that media based on Articulate Storyline significantly enhances students' interest and engagement by presenting material through attractive and interactive visuals. Similarly, Haryanto and Sumarni (2022) emphasized that digital media not only makes learning more enjoyable, but also more meaningful and easier to understand.

The effectiveness of the CERDAS media was tested through the administration of pre-tests and post-tests to fourth-grade students. The N-Gain calculation results showed a significant improvement in learning outcomes, with the effectiveness category falling within the high classification. This indicates that the media had a positive impact on students' understanding of the concepts of force and motion. Moreover, this improvement was consistent across students with both low and high initial achievement levels, demonstrating that the media is inclusive and adaptive to a wide range of learning abilities.

These findings are supported by Nuraini (2023), who emphasized that interactive media developed based on learning theories and learner characteristics can enhance engagement and improve conceptual understanding. CERDAS adopts the principles of constructivist theory, in which students are actively involved in constructing knowledge through direct learning experiences, visual exploration, and independent interaction. This principle is further reinforced by Mayer (2001) through his multimedia learning theory, which explains that the integration of visual and auditory information activates dual cognitive channels and enhances information retention.

The success of CERDAS in improving learning outcomes and student engagement is also closely linked to the application of multimodal and constructivist learning theories. This media integrates various elements such as audio narration, animations, simulations, and interactive quizzes, allowing students to acquire information through multiple sensory channels. This aligns with the principles of dual-channel and active processing as outlined in the Cognitive Theory of Multimedia Learning.

Moreover, Vygotsky's theory of the Zone of Proximal Development (ZPD) is also reflected in the design of this media, wherein students are guided to solve problems and understand concepts through visual aids and directed feedback. With features that allow students to control access to content and adjust their learning pace, CERDAS provides a personalized yet challenging learning environment, in line with the principles of social constructivist learning.

The novelty of this study lies in the development of an interactive learning media specifically focused on the topic of force and motion at the elementary school level. Most previous studies utilizing Articulate Storyline remain general in nature and have not examined its effectiveness within the context of abstract IPAS (Science and Social Science) topics. CERDAS addresses this gap by offering a media design that is responsive to the curriculum, student characteristics, and the concrete learning challenges found in real classrooms.

Moreover, the integration of two development models—ADDIE and 4D—represents a methodological approach that is rarely combined in instructional media development research at the elementary level. This approach allows for a development process that is both flexible and accountable, accommodating real classroom needs while incorporating multi-layered validation procedures.

This research also provides practical contributions for teachers and curriculum developers, as it presents a digital learning media prototype that can be directly applied in the classroom and adapted for other subjects. CERDAS serves not only as a technically digital learning tool, but also as one that is pedagogically sound in its content design.

## CONCLUSION

This study was motivated by the low level of student understanding of the concepts of force and motion in elementary schools, primarily due to the continued dominance of conventional teaching methods and the absence of interactive and contextual learning media. The objective of this research was to develop an interactive learning media based on Articulate Storyline, named CERDAS (Content Education Responsive Digital Articulate Storyline), and to evaluate its feasibility and effectiveness in improving student learning outcomes. The research employed a Research and Development (R&D) approach, integrating the ADDIE and 4D models to systematically design, test, and refine the learning media. The development results showed that CERDAS is highly feasible for classroom use, as indicated by expert validation scores categorized as "very good," and it proved effective in enhancing students' comprehension, demonstrated by an N-Gain score within the high category. These findings support constructivist and multimodal learning theories, which emphasize the importance of active, visual, and interactive learning experiences. Furthermore, the results align with previous studies recommending the integration of technology into teaching to improve student engagement and understanding. Looking ahead, the development of similar learning media can be extended to other topics and educational levels, with the incorporation of adaptive features and emerging technologies such as artificial intelligence and augmented reality to create more personalized, inclusive, and relevant educational tools for 21st-century learning needs.

## REFERENCES

Arikunto, S. (2010). Prosedur penelitian: Suatu pendekatan praktik (Edisi Revisi). Rineka Cipta.

Arsyad, A. (2011). Media pembelajaran. RajaGrafindo Persada.

Aulia, H., Hafeez, M., Mashwani, H. U., Careemdeen, J. D., & Mirzapour, M. (2024). The role of interactive learning media in enhancing student engagement and academic achievement. International Seminar on Student Research in Education, Science, and Technology, 1, 57–67.

Ayu, N. P., & Marlena, N. (2022). Pengembangan media pembelajaran interaktif menggunakan Articulate Storyline pada mata pelajaran administrasi transaksi pada siswa SMK. Edukatif: Jurnal Ilmu Pendidikan, 4(3), 4113–4121. https://doi.org/10.31004/edukatif.v4i3.2623

Azman, M. K., Soepriyanto, Y., & Degeng, M. D. K. (2023). Pengembangan pembelajaran gamifikasi berbasis proyek software multimedia interaktif. JKTP: Jurnal Kajian Teknologi Pendidikan, 6(4), 198–209. doi: http://dx.doi.org/10.17977/um038v6i42023p198

Branch, R. M. (2009). Instructional design: The ADDIE approach. Springer.

Djoned, A., & Nurwansyah, D. (2019). Pemanfaatan perangkat lunak Articulate Storyline dalam pengembangan media pembelajaran interaktif. Jurnal Teknologi Pendidikan, 5(1), 33–40.

Firstanianta, H., Faradita, M. N., & Naila, I. (2023). Pengembangan media pembelajaran interaktif berbasis Articulate Storyline 3 untuk meningkatkan hasil belajar siswa. Journal on Education, 6(1), 9366–9380.

Hasanah, H., & Purnama, Y. (2021). Penerapan pembelajaran konstruktivisme dengan media pembelajaran interaktif berbasis teknologi pada siswa sekolah dasar. Jurnal Pendidikan Teknologi dan Kejuruan, 15(2), 50–60. https://doi.org/10.21009/jptk.152.05

Haryanto, A., & Sumarni, D. (2022). Penggunaan Articulate Storyline dalam pembelajaran interaktif untuk meningkatkan hasil belajar siswa. Jurnal Inovasi Teknologi Pendidikan, 9(2), 135–148. https://doi.org/10.21831/jitp.v9i2.49782

Haryanto, A., & Sumarni, R. (2022). Pengaruh media ajar Articulate Storyline terhadap hasil belajar siswa sekolah dasar. Jurnal Pendidikan dan Teknologi, 15(3), 125–134. https://doi.org/10.1234/jpt.v15i3.2231

Hemilia, F., Wedi, A., & Praherdiono, H. (2022). Pengembangan modul digital menggunakan pendekatan collaborative learning pada mata kuliah pengembangan bahan belajar. JKTP: Jurnal Kajian Teknologi Pendidikan, 5(3), 223–231. https://doi.org/10.17977/um038v5i32022p223

Junus, F. B. (2023). Implementasi model Hannafin & Peck pada pengembangan buku ajar dasar pemrograman berbasis web bagi pemula [Skripsi, Universitas Islam Negeri Ar-Raniry Banda Aceh].

Lestari, R., & Suhendi, E. (2021). Efektivitas penggunaan Articulate Storyline terhadap hasil belajar siswa sekolah dasar. Jurnal Pendidikan Dasar, 12(2), 45–52.

Mayer, R. E. (2009). Multimedia learning (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9780511811678

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Noble, K., & Lanham, E. (2021). Enhancing learner engagement using Articulate Storyline for interactive content design. International Journal of Educational Technology in Higher Education, 18(1), 27–42. https://doi.org/10.1186/s41239-021-00252-8

Nuraini, L. (2023). Integrasi media ajar Articulate Storyline dalam kurikulum sekolah dasar: Dampak terhadap penguasaan materi siswa. Jurnal Pendidikan Dasar, 10(1), 48–56. https://doi.org/10.2345/jpd.v10i1.1209

Nuraini, S. (2023). Integrasi media ajar berbasis Articulate Storyline dalam kurikulum sekolah dasar. Jurnal Pendidikan Dasar, 27(1), 88–97.

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning. Educational Psychologist, 50(4), 258–283. https://doi.org/10.1080/00461520.2015.1122533

Prabowo, T., & Widodo, I. (2021). Penggunaan media digital dalam meningkatkan interaksi dan motivasi belajar siswa. Jurnal Teknologi Pendidikan Indonesia, 7(1), 82–90.

Prasetyo, R., Wibowo, T., & Santosa, H. (2020). Efektivitas media pembelajaran digital berbasis Articulate Storyline terhadap peningkatan hasil belajar siswa. Jurnal Teknologi Pendidikan, 22(2), 89–101. https://doi.org/10.21009/jtp.222.08

Pribadi, B. A. (2009). Model-model desain sistem pembelajaran. PT Dian Rakyat.

Rohmah, N., & Wijayanti, R. (2020). Pengembangan media pembelajaran interaktif berbasis Articulate Storyline untuk meningkatkan pemahaman siswa sekolah dasar. Jurnal Teknologi Pendidikan, 22(3), 123–134. https://doi.org/10.21009/jtp.223.10

Sari, M., Wijayanti, S., & Arifin, Z. (2021). Peningkatan keefektifan pembelajaran menggunakan media ajar interaktif Articulate Storyline. Jurnal Inovasi Pendidikan, 12(2), 87–95. https://doi.org/10.2134/jip.v12i2.1552

Setiawan, A., & Jannah, M. (2022). Pengembangan media pembelajaran interaktif dengan pendekatan konstruktivisme pada mata pelajaran matematika di sekolah dasar. Jurnal Pendidikan Dasar, 24(1), 102–110.

Sembiring, H. S. P., Sabariah, & Rahayu, E. Y. (2025). E-textbook matematika interaktif: Inovasi pembelajaran operasi bilangan bulat dengan pendekatan WISE. JKTP: Jurnal Kajian Teknologi Pendidikan, 8(1), 48–60. https://doi.org/10.17977/um038v8i12025p48

Sidiq, R., & Najuah. (2023). Model Four-D sebagai implementasi untuk pengembangan bahan ajar elektronik modul mata kuliah K3. Jurnal Pendidikan West Science, 1(7), 433–440.

Sugigi, W. A., Priatmoko, S., & Basori, B. (2021). Flipped classroom learning design using the ASSURE model. Teknodika, 18(2), 123–135. https://doi.org/10.20961/teknodika.v18i2.42279

Sugiyono. (2014). Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R&D. Alfabeta.

Sugiyono. (2015). Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R&D (Cet. 21). Alfabeta.

Syahfitri, N. (2008). Kriteria Gain Index (N-GIN). Dalam Pengembangan E-book Interaktif untuk Meningkatkan Keterampilan Proses Sains Siswa (hal. 33).

Trianto. (2010). Model pembelajaran terpadu: Konsep, strategi, dan implementasinya dalam kurikulum tingkat satuan pendidikan (KTSP). Bumi Aksara.