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Developing an Articulate Storyline-Based Interactive Learning Media for High School Kinematics: Validity, Practicality, and Effectiveness

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Abstract
Understanding kinematics remains challenging for many high school students because the topic requires learners to interpret and relate multiple forms of representation, including verbal explanations, mathematical equations, graphs, and motion visualizations. Although Articulate Storyline has been widely used to develop digital learning media, studies focusing on high school kinematics while comprehensively evaluating the product in terms of validity, practicality, and effectiveness remain limited. This study aimed to develop an Articulate Storyline-based interactive learning media for kinematics using the ADDIE instructional design model. The product was validated by three subject-matter experts and three media experts. Its practicality was evaluated by one physics teacher and 32 tenth-grade students, while its effectiveness was examined using a pretest-posttest control group design involving 62 students. Data were analyzed using descriptive statistics and normalized gain (N-gain). The developed learning media achieved a content validity score of 90.7% and a media validity score of 88.9%, both categorized as very valid. The practicality evaluation indicated that the media was very practical, with teacher and student practicality scores of 90.0% and 93.9%, respectively. The effectiveness evaluation showed that the experimental group achieved a high N-gain score of 0.72, whereas the control group obtained a moderate N-gain score of 0.58, indicating greater learning improvement among students who used the developed media. These findings demonstrate that the Articulate Storyline-based interactive learning media is valid, practical, and effective for improving students' conceptual understanding of kinematics and can serve as an alternative digital learning resource for senior high school physics instruction.

INTRODUCTION

The rapid advancement of digital technology has transformed many aspects of human life, including education. This transformation has shifted instructional practices from teacher-centered approaches toward student-centered learning, where technology plays a pivotal role in creating more interactive, flexible, and meaningful learning experiences. Within this context, digital learning media are no longer viewed merely as instructional aids but as learning environments that enable students to actively construct knowledge through interactions with multiple forms of information. Previous studies have consistently reported that interactive learning media improve the quality of classroom instruction by promoting conceptual understanding, increasing students' engagement in learning activities, and encouraging more active participation throughout the learning process (Fasita et al., 2024; Maulidia & Muthi, 2025; Widiastuti A et al., 2021). Consequently, the development of technology-enhanced learning media has become an essential strategy for improving teaching and learning practices in the digital era.

Among school subjects, physics presents distinctive learning challenges because students are expected not only to acquire scientific concepts but also to interpret and connect multiple forms of representation, including verbal explanations, mathematical equations, graphs, tables, diagrams, and visual illustrations. The ability to translate information across these representations is fundamental to developing conceptual understanding, as most physics concepts cannot be adequately understood through a single representation alone but require meaningful connections among different representations to explain physical phenomena comprehensively (Ainsworth & VanLabeke, 2004). Kinematics is one of the foundational topics that demands such representational competence. As the basis of mechanics, a solid understanding of kinematics is essential because it underpins students' learning of more advanced topics, including dynamics, work and energy, momentum, and rotational motion.

Despite its fundamental role in physics, numerous studies have identified kinematics as one of the most challenging topics for high school students. These learning difficulties are largely associated with students' limited ability to interpret and integrate multiple representations, such as graphs, mathematical equations, tables, diagrams, and verbal descriptions, into a coherent conceptual framework. Takaoğlu (2024) reported that although high school students were generally able to interpret pictorial, tabular, and graphical representations, they experienced considerable difficulty when translating between verbal and algebraic representations and other forms of representation, resulting in incomplete conceptual understanding. Similarly, Erceg and Aviani (2014) found that many students struggled to interpret velocity–time graphs, particularly when identifying the physical meaning of graph features, determining slopes, and relating graphical representations to actual motion. Comparable findings were reported by Phage (2017), who showed that students were often capable of manipulating mathematical equations but encountered difficulties when connecting mathematical expressions with graphical representations in kinematics. Consequently, many students relied on memorizing formulas rather than developing a meaningful understanding of motion concepts. These findings highlight the need for learning media that can present multiple representations in an integrated and interactive manner, enabling students to visualize motion phenomena more concretely while establishing meaningful connections among different representations.

The challenges associated with learning kinematics suggest that effective instructional media should extend beyond presenting information in an attractive format. Instead, they should facilitate students' conceptual construction by integrating multiple forms of representation within meaningful learning experiences. One theoretical framework that supports the design of such learning media is Mayer's Cognitive Theory of Multimedia Learning (CTML) (Mayer, 2021). According to CTML, learning is more effective when information is presented through coordinated verbal and visual representations because learners process information through two complementary cognitive channels. Well-designed interactive multimedia that combines text, images, animations, videos, audio, and interactive exercises therefore has the potential to support students in visualizing abstract motion concepts, strengthening representational connections, and developing a deeper conceptual understanding of kinematics.

Evidence from previous studies further supports the potential of interactive multimedia in physics education. Liliana et al. (2020) reported that digital interactive learning media integrating various multimedia elements improved both students' learning achievement and their interest in learning physics by providing more engaging and participatory learning experiences. Similar findings were reported by Yulianci et al. (2021), who found that interactive multimedia facilitated students' understanding of physics concepts by presenting abstract phenomena through more concrete visualizations while simultaneously fostering creative thinking skills. More recently, Kafle (2024) emphasized that interactive multimedia designed in accordance with the principles of the Cognitive Theory of Multimedia Learning (CTML) can substantially enhance conceptual understanding by encouraging learners to actively process information through the integration of text, images, animations, simulations, and interactive learning activities. Collectively, these findings suggest that interactive multimedia offers considerable potential for supporting the learning of kinematics, a topic that requires students to coordinate and interpret multiple forms of representation.

Among the various authoring tools available for developing interactive multimedia, *Articulate Storyline* has emerged as one of the most widely adopted platforms in educational settings. Its flexibility enables developers to combine text, graphics, animations, videos, audio, simulations, interactive quizzes, and immediate feedback within a single, well-organized learning environment. In addition to its intuitive interface, the platform supports multiple publishing formats, including HTML5 and Android applications, allowing students to access learning materials across different devices and learning contexts. Recent studies have consistently demonstrated that learning media developed using *Articulate Storyline* are valid, practical, and effective in supporting physics instruction. Beyond improving students' conceptual understanding, these media have also been reported to enhance learning motivation and science process skills by creating richer and more interactive learning experiences (Fatikhah & Anggaryani, 2022; Nuranisa, 2024; Prasetyo et al., 2025; Wahyuni et al., 2023). These advantages make *Articulate Storyline* a promising platform for designing interactive learning media that can address the representational challenges commonly encountered in learning kinematics.

Despite the growing body of research on *Articulate Storyline*-based learning media, existing studies have primarily focused on specific physics topics, such as linear motion, Newton's laws, fluid dynamics, and introductory physics. Most of these studies have emphasized evaluating media feasibility, learning motivation, or science process skills, while relatively little attention has been given to developing interactive learning media specifically for high school kinematics and examining its quality through comprehensive measures of validity, practicality, and effectiveness. This gap is particularly important because kinematics requires students to coordinate multiple representations and develop a coherent conceptual understanding of motion, making it one of the most suitable topics for interactive multimedia learning. To address this gap, the present study developed an *Articulate Storyline*-based interactive learning media for teaching kinematics at the high school level using the ADDIE development model. The study further evaluated the developed media in terms of its validity, practicality, and effectiveness. Beyond producing a learning medium that is suitable for classroom use, this study contributes to the growing body of research on interactive multimedia in physics education by providing empirical evidence on the development and evaluation of *Articulate Storyline*-based learning media designed to support students' conceptual understanding of kinematics through interactive and visually rich learning experiences.

METHOD

Research Design

This study employed a Research and Development (R&D) approach to develop an interactive learning media for high school kinematics using Articulate Storyline. The development process followed the ADDIE instructional design model, which consists of five systematic phases: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was selected because it provides a structured framework for designing, developing, validating, implementing, and evaluating educational products in a systematic and iterative manner (Branch, 2009).

During the Analysis phase, information was gathered to identify instructional needs, students' characteristics, curriculum requirements, and learning problems related to kinematics. The Design phase focused on preparing the instructional flow, storyboard, user interface, learning activities, assessment components, and multimedia elements incorporated into the learning media. The prototype was then produced during the Development phase and underwent expert validation followed by product revisions based on the reviewers' recommendations.

The validated product was subsequently implemented in classroom learning during the Implementation phase to examine its applicability in authentic instructional settings. Finally, the Evaluation phase was conducted to determine the overall quality of the developed media by examining its validity, practicality, and effectiveness. Figure 1 illustrates the research procedure based on the ADDIE development model adopted in this study.

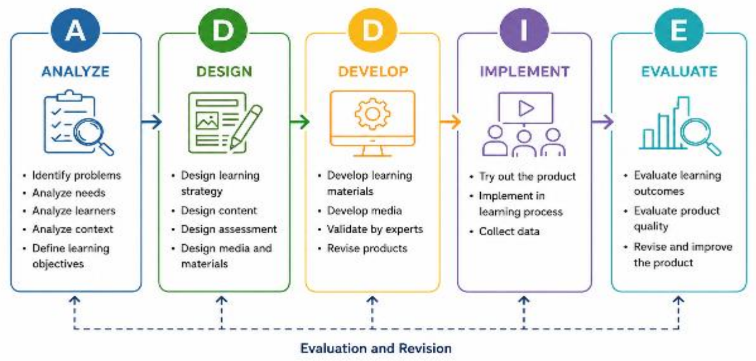

Figure 1. Research Prosedure Based on ADDIE Model (Branch, 2009)

Participants

Different groups of participants were involved at each stage of the ADDIE development process according to their respective roles. During the validation stage, the developed learning media were evaluated by six experts, comprising three subject-matter experts in physics education and three media experts. Their evaluations focused on the appropriateness of the learning content, instructional design, language, visual appearance, navigation, and technical functionality of the developed media. Suggestions provided by the experts were used as the basis for revising and refining the product before classroom implementation.

The practicality evaluation involved one experienced high school physics teacher and 32 tenth-grade students from SMA Negeri 2 Batusangkar. The teacher assessed the media from the perspectives of instructional usability, content presentation, and classroom implementation, while the students evaluated the ease of use, attractiveness, clarity of presentation, and overall learning experience after using the media.

The effectiveness of the developed media was examined through a pretest–posttest control group design involving 62 tenth-grade students. The two classes were selected from existing intact classrooms to preserve the natural learning environment and minimize disruption to regular instructional activities. The experimental group consisted of 32 students who learned kinematics using the Articulate Storyline-based interactive learning media, whereas the control group comprised 30 students who received conventional instruction using the learning resources commonly employed in the classroom. The comparison of students' learning outcomes before and after the intervention was used to determine the effectiveness of the developed learning media**.**

The study population consisted of all tenth-grade students of SMA Negeri 2 Batusangkar. Prior to sample selection, the five available classes were examined using normality and homogeneity tests based on students' previous summative assessment scores to ensure comparable academic characteristics. After all classes met these assumptions, simple random sampling was conducted through a lottery procedure to determine the research sample. As a result, Class X.E4 was selected as the experimental group, while Class X.E6 served as the control group. This procedure was intended to minimize selection bias and ensure comparable learning conditions before the implementation of the developed learning media.

The implementation phase was carried out over four classroom meetings. The first meeting was used to administer the pretest, the subsequent meetings involved learning activities using the developed Articulate Storyline-based interactive learning media in the experimental class and conventional instruction in the control class, and the final meeting concluded with the posttest.

Development Procedure

The interactive learning media were developed following the five phases of the ADDIE instructional design model, namely Analysis, Design, Development, Implementation, and Evaluation. Each phase involved a series of systematic activities that guided the development process from identifying instructional needs to producing the final learning media. The activities performed and the expected outputs at each stage are summarized in Table 1.

Table 1. Development Activities and Outputs at Each Phase of the ADDIE Model

ADDIE Phase	Main Activities	Output
Analysis	Needs analysis, students' characteristics analysis, kinematics content analysis, and analysis of the learning media currently used in schools.	Specification of the instructional and media requirements
Design	Preparation of learning objectives, flowchart, storyboard, user interface, instructional materials, assessments, and navigation structure.	Initial prototype of the interactive learning media.
Development	Development of the learning media using Articulate Storyline, expert validation by subject-matter experts and media experts, followed by product revision.	Validated prototype of the interactive learning media.
Implementation	Classroom implementation of the developed media in the experimental class, while the control class received instruction using the learning media commonly employed by the teacher. The implementation was conducted over four meetings, including pretest, learning activities, and posttest.	Implementation of the developed learning media in classroom instruction.
Evaluation	Analysis of practicality and effectiveness data, followed by final product refinement based on the implementation results.	Final version of the interactive learning media.

Research Instruments

Data were collected using three instruments: expert validation sheets, practicality questionnaires, and a learning achievement test. The selection of these instruments was aligned with the objectives of each evaluation stage, namely to examine the validity, practicality, and effectiveness of the developed interactive learning media.

The expert validation sheets were completed by three subject-matter experts and three media experts to evaluate the quality of the developed media. The validation covered six aspects, namely content accuracy, instructional design, language, visual appearance, navigation, and technical functionality. Feedback provided by the experts was incorporated into the revision process before the media were implemented in classroom learning.

The practicality questionnaires were administered to one physics teacher and 32 tenth-grade students after the implementation stage. The questionnaires assessed the usability of the developed media in terms of ease of use, content presentation, learning support, visual attractiveness, and overall user experience. Responses were recorded using a five-point

Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The learning achievement test was used to evaluate the effectiveness of the developed media. The test consisted of multiple-choice items covering the learning objectives of the kinematics topic and was administered as both a pretest and a posttest to the experimental and control groups. Before being used in the main study, the test instrument underwent expert validation followed by empirical item analysis, including item validity, test reliability, item difficulty, and discrimination index. Test reliability was examined using the Kuder–Richardson Formula 20 (KR-20), yielding a reliability coefficient of 0.947, which indicates very high reliability. Following the item analysis, 20 of the initial 30 items met the established criteria and were retained for use in the effectiveness evaluation. The research instruments employed at each stage of the study are summarized in Table 2.

Table 2. Research Instruments

Aspect Evaluated	Instrument	Participants	Data Collected
Validity	Expert validation sheets	Three subject-matter experts and three media experts	Expert validation scores
Practicality	Practicality questionnaire	One physics teacher	Teacher responses
Practicality	Practicality questionnaire	32 students	Students' responses
Effectiveness	Learning achievement test (pretest–posttest)	Experimental group (n = 32) and control group (n = 30)	Students' learning achievement scores

Data Analysis

The collected data were analyzed quantitatively to evaluate the validity, practicality, and effectiveness of the developed interactive learning media. The validity of the learning media was determined using descriptive statistics based on the evaluation scores provided by the subject-matter and media experts. The obtained scores were converted into percentages and interpreted according to predetermined validity criteria to determine the feasibility of the developed product.

The practicality of the learning media was analyzed descriptively using the responses obtained from the physics teacher and students after the implementation stage. Questionnaire scores were converted into percentages and interpreted according to the established practicality criteria.

The effectiveness of the developed learning media was determined by comparing students' pretest and posttest scores using the normalized gain (N-gain) index proposed by Hake (1998). According to Hake, an N-gain value of $g \geq 0.70$ is classified as high, $0.30 \leq g < 0.70$ as medium, and $g < 0.30$ as low. The N-gain values were interpreted according to established classification criteria to determine the extent of students' learning improvement after using the interactive learning media.

RESULT AND DISCUSSION

Need Analysis

A needs analysis was conducted prior to the development of the interactive learning media to identify the instructional problems, students' learning characteristics, and the features required in the proposed learning media. Data were collected through classroom observations, interviews with the physics teacher, student questionnaires, and an analysis of the instructional media currently used in physics learning. The summary of the needs analysis is presented in Table 3.

Table 3. Summary of the Needs Analysis Results

Aspect	Main Findings	Design Implications
Learning conditions	Physics instruction was predominantly delivered through lectures using printed textbooks and Microsoft PowerPoint.	The learning media should provide a more interactive and student-centered learning experience.
Students' characteristics	66.7% of students reported difficulties in understanding kinematics concepts.	The media should facilitate conceptual understanding through

		visualization of abstract motion concepts.
Effectiveness of existing learning media	63.3% of students stated that the existing learning media did not adequately support their understanding of the material.	The media should integrate various multimedia elements to improve content delivery and conceptual understanding.
Students' learning preferences	70.0% of students preferred audio-visual learning, while 66.7% expected interactive learning media.	The media was designed by integrating text, graphics, animations, instructional videos, interactive quizzes, and immediate feedback.
Experience with Articulate Storyline	86.7% of students had never used learning media developed with Articulate Storyline; however, almost all students supported its implementation.	Articulate Storyline was selected as an innovative platform that aligns with students' learning needs and preferences.

As shown in Table 1, the needs analysis revealed several challenges in the existing physics learning process. Classroom instruction remained largely teacher-centered, relying primarily on printed textbooks and Microsoft PowerPoint presentations. Although these instructional resources adequately presented theoretical content, they provided limited opportunities for students to actively engage with the learning materials or to visualize abstract concepts dynamically. Consequently, students tended to assume a passive role during classroom instruction, reducing opportunities for meaningful conceptual construction.

The questionnaire findings further confirmed these classroom observations. Approximately 66.7% of the students reported difficulties in understanding kinematics concepts, while 63.3% indicated that the learning media currently used in the classroom did not sufficiently support their understanding of the subject matter. In addition, 70.0% of the students expressed a preference for audio-visual learning, and 66.7% expected interactive learning media that could facilitate active participation during instruction. Interestingly, although 86.7% of the students had never previously used learning media developed with Articulate Storyline, almost all respondents expressed positive expectations regarding its implementation in physics learning. These findings indicate that students are receptive to technology-enhanced learning environments and expect instructional media that provide richer visualization, interactivity, and immediate feedback.

The findings of this study are consistent with previous studies reporting that conventional instructional media often fail to support students' understanding of abstract physics concepts. Previous research by Fatikhah and Anggaryani (2022), Prasetyo et al., (2025) and Saputri et al. (2025) demonstrated that interactive learning media developed using Articulate Storyline significantly improved students' engagement, motivation, and conceptual understanding because the platform enables the integration of text, graphics, animations, videos, and formative assessments within a single interactive learning environment. These studies suggest that interactive multimedia provides more meaningful learning experiences than conventional instructional approaches, particularly for topics that require multiple representations and conceptual visualization.

The results of the needs analysis also served as the primary foundation for determining the design specifications of the developed learning media. Rather than selecting multimedia features solely based on technological availability, every instructional component was intentionally designed to address the specific learning problems identified during the preliminary analysis. Animations and dynamic visualizations were incorporated to facilitate students' understanding of abstract motion concepts, instructional videos were included to reinforce conceptual explanations, while interactive quizzes accompanied by immediate feedback were designed to promote active learning and self-assessment. In addition, learner-controlled navigation was implemented to enable students to learn at their own pace and revisit instructional content whenever necessary. Consequently, the development of the Articulate Storyline-based learning media was systematically guided by empirical evidence obtained during the needs analysis rather than by technological considerations alone.

This need-based instructional design approach represents one of the major strengths of the present study. By directly aligning the instructional features with students' learning needs, the developed media was expected to provide learning experiences that were not only technologically interactive but also pedagogically meaningful. Such an approach ensures that each multimedia component contributes to addressing specific instructional challenges identified during the preliminary investigation, thereby enhancing the relevance, usability, and educational value of the learning media.

From the perspective of the Cognitive Theory of Multimedia Learning (CTML), meaningful learning occurs when learners actively process verbal and visual information through complementary cognitive channels (Mayer, 2021). The integration of text, graphics, animations, instructional videos, and interactive assessments within the developed learning media is therefore expected to optimize cognitive processing while minimizing unnecessary cognitive load (Schnotz, 2021). As a result, students are provided with richer opportunities to construct conceptual understanding of kinematics through coordinated visual and verbal representations. The close alignment between the identified learning needs, multimedia learning principles, and instructional design features provides both a theoretical and empirical justification for the subsequent stages of product development and evaluation.

Based on these identified needs, the interactive learning media was subsequently developed and subjected to expert validation to determine its content and media quality before classroom implementation

Overview of the Developed Learning Media

Based on the findings of the needs analysis, an interactive learning media for the topic of kinematics was developed using Articulate Storyline 3 following the ADDIE instructional design model. The media was designed to support both classroom instruction and independent learning by integrating textual explanations, graphics, animations, instructional videos, interactive quizzes, and immediate feedback within a single multimedia environment. These multimedia components were intentionally selected to address the instructional problems identified during the preliminary analysis, particularly students' difficulties in understanding abstract motion concepts and interpreting multiple representations in kinematics.

The learning media was organized into several interconnected sections that guide students throughout the learning process. The opening page introduces the learning media and provides access to the main menu, which serves as the central navigation interface (Figure 2). From the main menu, students can access the learning objectives, instructional materials, learning videos, interactive exercises, quizzes, and supporting information (Figure 3). The navigation system was designed to be simple and intuitive, allowing students to move between learning sections independently while maintaining a logical learning sequence.

Figure 2. Home Page Of the Articulate Storyline-Based Interactive Learning Media.

Figure 3. Main Menu Displaying the Learning Components and Navigation Features

The instructional materials were organized according to the senior high school physics curriculum and presented sequentially, beginning with fundamental concepts before progressing to more complex applications. To facilitate conceptual understanding, each topic integrates concise explanations with relevant illustrations, animations, and contextual examples. Learning videos were also incorporated to provide dynamic visualization of motion phenomena that are difficult to observe directly in conventional classroom instruction (Figure 4).

Figure 4. Example of the kinematics learning material integrated with visual illustrations and multimedia elements.

To encourage active learning, the media also includes interactive quizzes equipped with immediate feedback. Students receive direct responses after answering each question, enabling them to identify misconceptions and monitor their own learning progress. This feature allows learners to evaluate their understanding independently while reinforcing key concepts before proceeding to subsequent learning activities (Figure 5).

Figure 5. Interactive quiz with immediate feedback.

The overall design of the developed learning media reflects the principles of the Cognitive Theory of Multimedia Learning (CTML), which emphasizes that meaningful learning occurs when learners actively integrate verbal and visual information. Accordingly, text, graphics, animations, videos, and interactive assessments were combined in a coherent instructional environment to facilitate conceptual understanding of kinematics. Rather than functioning merely as presentation media, the developed product was designed as an interactive learning environment that actively engages students throughout the learning process.

Following the completion of the development stage, the interactive learning media underwent expert validation to evaluate its content quality, instructional design, and technical aspects before being implemented in classroom learning.

Validity of the Developed Learning Media

The validity evaluation was conducted before classroom implementation to determine whether the developed interactive learning media met the required content and media quality standards. The validation process involved three subject-matter experts and three media experts, who evaluated the learning media using structured validation instruments. The assessment covered both instructional quality and technical quality, including curriculum alignment, content accuracy, language, presentation, visual design, accessibility, navigation, and implementation aspects.

The results of the expert validation indicate that the developed learning media achieved a high level of validity. The average score obtained from the subject-matter experts was 90.7%, while the average score from the media experts was 88.9%, indicating that the product is highly valid and appropriate for classroom implementation after minor revisions. The detailed results of the expert evaluations are presented in Tables 4 and 5.

Table 4. Results of Subject-Matter Expert Validation

Aspect	Percentage (%)	Category
Curriculum alignment	87.5	Very Valid
Language	95.0	Very Valid
Content presentation	87.5	Very Valid
Content accuracy	91.7	Very Valid
Completeness of presentation	91.7	Very Valid
Evaluation (Quiz)	88.9	Very Valid
Average	**90.7**	**Very Valid**

The results presented in Table 4 demonstrate that all evaluated aspects achieved scores above 85%, indicating excellent content quality. The highest score was obtained for the language aspect (95.0%), suggesting that the instructional language was clear, communicative, and appropriate for senior high school students. High scores were also achieved for content accuracy and completeness of presentation, indicating that the learning materials were scientifically accurate, systematically organized, and aligned with the intended learning objectives. Furthermore, the positive evaluation of the assessment component indicates that the quizzes and learning activities were considered appropriate for measuring students' conceptual understanding of kinematics.

These findings suggest that the developed learning media adequately satisfies important instructional requirements, including curriculum relevance, conceptual accuracy, and pedagogical organization. The systematic presentation of learning materials enables students to construct conceptual understanding progressively, beginning with fundamental concepts before advancing to more complex applications. Such organization is essential for physics learning because students are required to integrate multiple representations when solving kinematics problems.

Table 5. Results of Media Expert Validation

Aspect	Percentage (%)	Category
Interface design	88.9	Very Valid
Language	95.0	Very Valid
Accessibility	75.0	Valid
Implementation	87.5	Very Valid
Average	**88.9**	**Very Valid**

As shown in Table 5, the developed learning media also demonstrated excellent technical quality. The language aspect obtained the highest score (95.0%), while interface design and implementation also received very high evaluations. The accessibility aspect obtained a lower score (75.0%) than the other components; however, it remained within the valid category. The relatively lower score for accessibility suggests that several interface components, such as navigation consistency and display optimization, required minor refinements prior to classroom implementation. These revisions were incorporated based on the experts' recommendations to improve the overall usability of the learning media.

Overall, the high validity scores indicate that the developed learning media successfully integrates scientifically accurate learning content with appropriate multimedia design principles. The combination of well-organized instructional materials, attractive visual design, intuitive navigation, and interactive learning activities provides a learning environment that supports meaningful learning. These findings are consistent with previous studies by Fatikhah and Anggaryani (2022), Prasetyo et al., (2025) and Wilyanti et.al (2023) which reported that Articulate Storyline-based learning media generally achieve high validity when instructional content is systematically integrated with multimedia features that support student interaction and conceptual understanding.

From the perspective of the Cognitive Theory of Multimedia Learning (CTML), the high validity of the developed media reflects the successful integration of verbal and visual information into a coherent instructional environment. The use of graphics, animations, instructional videos, interactive quizzes, and learner-controlled navigation enables students to process information through complementary cognitive channels, thereby facilitating meaningful learning while minimizing unnecessary cognitive load (Mayer, 2021). Consequently, the validated media provides a strong pedagogical foundation for subsequent classroom implementation.

Based on the expert validation results, the developed learning media was considered suitable for classroom application. After incorporating the experts' suggestions, the revised product proceeded to the practicality evaluation stage involving both teachers and students.

Practicality of the Developed Learning Media

Following the expert validation and product revision stages, the developed interactive learning media was implemented in classroom learning to evaluate its practicality. The practicality evaluation aimed to determine the extent to which the media could be used efficiently and conveniently in actual classroom settings from the perspectives of both teachers and students. One physics teacher and 32 Grade X students participated in this evaluation after completing the learning activities using the Articulate Storyline-based interactive learning media.

The results indicate that the developed learning media achieved a very high level of practicality. The physics teacher assigned an overall practicality score of 90.0%, while the students reported an average practicality score of 93.9%, both of which fall within the very practical category. These findings suggest that the developed media is easy to use, supports classroom instruction effectively, and provides a positive learning experience for users. The detailed practicality evaluation results are presented in Tables 6 and 7.

Table 6. Practicality Evaluation by the Teacher

Aspect	Score	Maximum Score	Percentage (%)	Category

Ease of Use	22	24	91.7	Very Practical
Perceived Benefits	21	24	87.5	Very Practical
Learning Time Efficiency	11	12	91.7	Very Practical
Total	54	60		
Average			**90.0**	**Very Practical**

The teacher's evaluation demonstrates that the developed learning media can be implemented effectively in classroom instruction. The highest scores were obtained for Ease of Use and Learning Time Efficiency (91.7%), indicating that the navigation system, interface design, and organization of learning activities enabled the teacher to conduct instruction smoothly without additional technical support. Although the Perceived Benefits aspect obtained a slightly lower score (87.5%), it remained within the very practical category, suggesting that the teacher considered the media beneficial in facilitating the teaching of kinematics concepts and improving students' classroom participation.

Table 7. Practicality Evaluation by the Students

Aspect	Score	Maximum Score	Percentage (%)	Category
Ease of Use	843	896	94.1	Very Practical
Perceived Benefits	606	640	94.7	Very Practical
Learning Time Efficiency	715	768	93.1	Very Practical
Total	2,164	2,304		
Average			93.9	Very Practical

Students also responded very positively to the developed learning media. The highest score was obtained for Perceived Benefits (94.7%), indicating that students considered the media helpful in understanding kinematics concepts. Likewise, Ease of Use (94.1%) received a very high rating, demonstrating that students were able to navigate the learning media independently with minimal difficulty. The Learning Time Efficiency aspect also achieved a very practical rating (93.1%), suggesting that the multimedia features enabled students to complete learning activities efficiently while maintaining their engagement throughout the learning process.

The consistently high practicality scores obtained from both the teacher and students indicate that the developed learning media successfully combines instructional effectiveness with technical usability. The integration of text, graphics, animations, instructional videos, interactive quizzes, and immediate feedback created a learning environment that was not only visually attractive but also easy to operate and supportive of classroom instruction. These characteristics are particularly important for physics learning, where abstract concepts require clear visualization and active learner interaction.

These findings are consistent with previous studies reporting that Articulate Storyline-based learning media generally demonstrate high practicality in classroom implementation. Fatikhah and Anggaryani (2022) found that the platform facilitates learning through an intuitive interface and interactive instructional features. Similarly, Wahyuni et al. (2023) and Prasetyo et al. (2025) reported that interactive multimedia developed using Articulate Storyline was perceived as easy to use, engaging, and effective in increasing students' motivation and participation during learning activities. The agreement between the present findings and previous studies further supports the suitability of Articulate Storyline as a platform for developing interactive learning media in physics education.

From the perspective of the Cognitive Theory of Multimedia Learning (CTML) (Mayer, 2021), the high practicality of the developed learning media reflects its ability to present verbal and visual information in an integrated and learner-friendly environment. The combination of animations, graphics, instructional videos, interactive assessments, and immediate feedback enables students to actively process information through complementary cognitive channels while maintaining engagement throughout the learning process. Consequently, the developed learning media not only simplifies instructional delivery but also creates meaningful learning experiences that support students' conceptual understanding of kinematics.

Overall, the practicality evaluation demonstrates that the developed learning media satisfies both pedagogical and technical requirements for classroom implementation. The positive responses from teachers and students indicate that the media successfully provides an engaging, user-friendly, and instructionally effective learning environment. Following this stage, the effectiveness of the developed learning media was further evaluated through students' learning achievement using pretest and posttest data.

Effectiveness of the Developed Learning Media

The effectiveness of the developed learning media was evaluated by comparing students' learning achievement before and after the implementation of the Articulate Storyline-based interactive learning media. Students' learning improvement was determined using pretest and posttest scores, followed by the normalized gain (N-gain) analysis. The results are presented in Table 8.

Table 8. Learning Achievement and N-gain Results

Learning Achievement	Control Group		Experimental Group	
	Pretest	Posttest	Pretest	Posttest
Maximum Score	11	17	13	19
Minimum Score	1	12	3	15
Mean Score	32.50	74.50	38.28	83.75
N-gain	**0.58**		**0.72**	
Category	**Moderate**	**High**		

As presented in Table 8, both groups demonstrated improved learning achievement after the learning process. However, students who learned using the Articulate Storyline-based interactive learning media achieved greater learning improvement than those in the control group. The mean score of the experimental group increased from 38.28 on the pretest to 83.75 on the posttest, whereas the control group improved from 32.50 to 74.50. These findings indicate that the developed interactive learning media contributed more effectively to students' understanding of kinematics concepts than the conventional instructional media used in the control class.

The N-gain analysis further confirmed the effectiveness of the developed media. The experimental group obtained an N-gain of 0.72, which is classified as high, whereas the control group achieved an N-gain of 0.58, categorized as moderate(Hake, 1998; Wilyanti et al., 2023). This difference indicates that students who learned using the developed media experienced greater conceptual improvement throughout the learning process. The higher learning gains observed in the experimental group suggest that the interactive multimedia features successfully facilitated students in constructing conceptual understanding rather than merely memorizing formulas and procedures.

One possible explanation for this improvement lies in the instructional characteristics of the developed learning media. The integration of concise explanations, relevant illustrations, animations, instructional videos, interactive quizzes, and immediate feedback enabled students to visualize motion phenomena more clearly while actively interacting with the learning content. These multimedia features encouraged students to explore concepts independently, receive immediate responses to their answers, and continuously monitor their own learning progress, thereby creating a more engaging and meaningful learning experience.

The findings of this study are consistent with previous research demonstrating the effectiveness of interactive multimedia in physics education. Liliana et al. (2020) reported that interactive digital learning media significantly improved students' learning achievement and learning interest by creating more engaging learning experiences. Similarly, Yulianci et al. (2021) found that interactive multimedia enhanced students' conceptual understanding through concrete visualizations while simultaneously promoting creative thinking skills. More recently, Kafle (2024) emphasized that multimedia designed according to multimedia learning principles can substantially improve conceptual understanding because students actively process information through the integration of text, graphics, animations, simulations, and interactive learning activities. The consistency between the present findings and previous studies further supports the effectiveness of interactive multimedia for improving students' understanding of abstract physics concepts.

The effectiveness of the developed learning media can also be explained from the perspective of the Cognitive Theory of Multimedia Learning (CTML). According to CTML, meaningful learning occurs when learners actively integrate verbal and visual information through complementary cognitive channels (Castro et al., 2021; Schnotz, 2021). The developed learning media intentionally combines textual explanations with graphics, animations, videos, and interactive assessments, enabling students to establish meaningful connections among multiple representations of kinematics concepts. Consequently, students are better able to understand relationships between displacement, velocity, acceleration, and motion graphs, leading to greater conceptual understanding and higher learning achievement.

Overall, the effectiveness evaluation indicates that the Articulate Storyline-based interactive learning media not only satisfies the validity and practicality criteria but also effectively improves students' learning achievement in kinematics. The high N-gain score obtained by the experimental group demonstrates that the developed media provides a meaningful and interactive learning environment capable of enhancing conceptual understanding in senior high school physics learning.

CONCLUSION

This study developed an interactive learning media based on Articulate Storyline for senior high school kinematics using the ADDIE development model and evaluated its quality in terms of validity, practicality, and effectiveness. The findings indicate that the developed media met all quality criteria. Expert validation confirmed that the media was highly valid in terms of content, instructional design, language, and technical aspects. The practicality evaluation further demonstrated that the media was considered very practical by both the teacher and students, indicating that it was easy to use, supported classroom instruction effectively, and created an engaging learning experience. In addition, the effectiveness evaluation revealed that students who learned using the developed media achieved a higher improvement in learning outcomes than those who received conventional instruction, as indicated by the high N-gain score obtained by the experimental group.

The findings suggest that integrating multimedia elements such as text, illustrations, animations, instructional videos, interactive quizzes, and immediate feedback into a single learning environment can facilitate students' conceptual understanding of kinematics. The developed media not only provides an attractive digital learning resource but also supports student-centered learning by encouraging active participation and independent learning. Therefore, Articulate Storyline can serve as an effective platform for developing interactive physics learning media, particularly for topics that require visualization and multiple representations.

Although this study focused on kinematics at the senior high school level, the development approach presented in this research has the potential to be adapted to other physics topics with similar conceptual characteristics. Future studies are recommended to investigate the long-term impact of Articulate Storyline-based learning media on students' conceptual understanding, problem-solving skills, and learning motivation using broader participant groups and different educational contexts.

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