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Development of Interactive Multimedia for Grade VII Informatics Education

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Abstract

Computational Thinking instruction in Grade VII Informatics at SMPN 8 Bukittinggi remains constrained by limited access to interactive learning media, as classroom activities predominantly rely on textbooks and one-way presentation tools, resulting in suboptimal student engagement. This study aimed to develop interactive multimedia that is valid, practical, and effective in supporting Computational Thinking instruction. The study employed a Research and Development (R&D) approach based on the 4D model, comprising the Define, Design, Develop, and Disseminate stages. The multimedia was developed using Articulate Storyline and published in a web-based HTML5 format. Product validity was evaluated by material and media experts, practicality was assessed through student responses, and effectiveness was measured by comparing pretest and posttest scores using N-Gain analysis. Material validation yielded a score of 95.71%, indicating that the product was highly valid, while media validation after revision also classified it as highly valid. The practicality assessment produced a mean score of 4.52, placing the multimedia in the highly practical category. Students' mean learning score increased from 61.50 on the pretest to 83.67 on the posttest, with an N-Gain score of 0.58 (58%), representing a moderate improvement. These findings demonstrate that the developed interactive multimedia is valid, practical, and sufficiently effective as a supplementary resource for Grade VII Informatics instruction. The product contributes a more interactive digital learning resource that can facilitate students' logical and systematic understanding of Computational Thinking concepts.

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Keywords: Interactive Multimedia; Informatics Education; Computational Thinking; Articulate Storyline; 4D Development Model

INTRODUCTION

The rapid development of Information and Communication Technology (ICT) has brought significant changes to the education system, requiring continuous adaptation to technological developments and preparedness to address the challenges of the increasingly digitalized Industry 4.0 era (Setiawati et al., 2024). Requiring continuous adaptation and teacher readiness to utilize learning media relevant to the demands of the digital era (Lagrutta et al., 2025; Pratiwi, 2024).

Learning media constitute one of the important components supporting the successful implementation of the learning process (Pratiwi, 2024). The National Education Association (NEA), as cited in Daniyati et al., (2023), defines media as tools that can be developed and utilized in various forms, including audio, visual, and textual formats, and that function to support learning activities.

Interactive multimedia integrates text, audio, graphics, animation, and video into an organized system to present information effectively and engagingly (Devi, 2025). With advances in digital technology, it also provides meaningful learning experiences through active interaction, enabling students to control their learning, explore materials independently, and receive immediate feedback (Sevil et al., 2018). By combining diverse media elements and interactive features, multimedia can enhance conceptual understanding, student participation, and the achievement of learning objectives (Irwansyah et al., 2025).

According to Piaget's cognitive development theory, junior high school students aged 12–13 are generally transitioning from the concrete operational to the formal operational stage, where abstract, logical, and systematic thinking begins to develop (Asdar, 2023). These characteristics align with computational thinking, which requires abstract reasoning. Therefore, students need interactive learning media that facilitates the gradual transition from concrete to abstract understanding (Rochim et al., 2026).

PISA results reported by Haryadi and Juldial (2024) indicate that Indonesian students' thinking and reasoning abilities remain relatively low, with difficulties in understanding, analyzing, and solving problems that require higher-order reasoning, which is fundamental to computational thinking.

Nevertheless, Informatics learning, particularly computational thinking, faces challenges related to students' cognitive abilities, curriculum readiness, learning media, and teacher support (Haryadi & Juldial, 2024). The abstract nature of computational thinking and its demand for higher-order reasoning can further hinder students' understanding.

A preliminary study through observations and interviews at SMP Negeri 8 Bukittinggi from September 9 to 18, 2025, identified limitations in the use of technology for Informatics learning. Although the school has adequate facilities, including LCD projectors and a well-equipped computer laboratory, they have not been optimally utilized, particularly for abstract materials. Learning remains dominated by printed textbooks and one-way presentation media, with limited interactive digital media that allow students to engage directly with learning materials and receive automated feedback.

This condition affects student engagement and learning outcomes, as classroom observations showed that most students were passive and dependent on teacher explanations. Most students did not meet the KKTP of 70, with a class mean score of only 60.74, as presented in Table 1.

Table 1. Daily Assessment Scores of Grade VII Students at SMP Negeri 8 Bukittinggi

Class	Number of Students	Learning Objective Achievement Criteria (KKTP)	Score
VII 1	32	70	54.85
VII 2	32	70	65.48
VII 3	32	70	61.88
Mean	—	—	60.74

Source: *Informatics Teacher of Grade VII, SMP Negeri 8 Bukittinggi*

The low learning outcomes cannot be separated from the characteristics of computational thinking, which is abstract in nature and requires higher-order reasoning skills through four main elements: decomposition, pattern recognition, abstraction, and algorithmic thinking. Based on an interview with the Informatics teacher, it was also stated that the implementation of computational thinking materials requires a greater degree of understanding compared with other topics because it involves logical reasoning. Consequently, students require more time and repeated practice to fully understand the concepts. In learning computational thinking, students need learning activities that enable them to decompose problems, identify patterns, perform abstraction, and develop algorithms through progressively structured exercises. Therefore, learning media are needed

that not only present information but also facilitate students' active interaction throughout the learning process.

As an effort to address these challenges, technological innovations in learning media are needed, one of which is the development of interactive multimedia. The use of interactive multimedia in learning is supported by Mayer's Cognitive Theory of Multimedia Learning 2009, which states that students can develop a deeper understanding of learning materials when information is presented through a combination of verbal and visual elements simultaneously rather than through a single channel alone. Accordingly, interactive multimedia is considered capable of assisting students in understanding abstract computational thinking concepts through learning materials presented in a more concrete and interactive manner.

Based on these problems, this study focuses on developing an interactive multimedia product containing computational thinking materials for Grade VII Informatics at SMP Negeri 8 Bukittinggi. The interactive multimedia is developed using *Articulate Storyline* and contains learning materials, instructional videos, exercises and simple games, as well as interactive quizzes designed to assess students' understanding. The multimedia can be accessed through computers and mobile devices, thereby supporting learning flexibility and encouraging active student engagement. The developed interactive multimedia is tailored to the characteristics of computational thinking materials and the learning needs of Grade VII junior high school students and has not previously been implemented at SMP Negeri 8 Bukittinggi.

Previous studies have demonstrated that the use of interactive multimedia can serve as an alternative approach to improving the quality of learning. One study on the development of interactive learning multimedia for Information and Communication Technology (ICT) showed that the use of the 4D development model could produce a product that was valid and practical for use in the learning process. This study is similar to the present research in terms of developing interactive learning multimedia and assessing the validity and practicality of the developed product. However, the previous study focused on ICT as the subject area, whereas the present study focuses on Informatics, particularly computational thinking for Grade VII junior high school students.

Another relevant study is entitled “Development of Interactive Science Learning Media Based on Articulate Storyline for the Solar System Topic in Junior High School,”

which reported that the developed media obtained material and media validity scores of 79% each, while the practicality test results reached 82% in the small-group trial and 83% in the field trial. These findings indicate that Articulate Storyline-assisted interactive multimedia has the potential to produce valid and practical learning media while supporting students' learning activities.

Based on previous studies, there remains a need for interactive multimedia specifically designed to support computational thinking through its four core elements: decomposition, pattern recognition, abstraction, and algorithms. This study addresses this gap by developing Articulate Storyline-based multimedia that integrates case-study problem solving, matching activities, identification of essential information, algorithm sequencing through drag-and-drop, practice questions, and quizzes with automatic feedback. These features are designed to align the learning activities with the characteristics of computational thinking and the needs of Grade VII junior high school students.

This study aims to develop and evaluate the feasibility of interactive multimedia for Grade VII Informatics in terms of validity, practicality, and effectiveness. Specifically, it examines the 4D development process, product validity based on expert assessments, practicality based on student responses, and effectiveness based on improvements in learning outcomes.

METHODS

This study employed a Research and Development (R&D) method using the 4D model, comprising Define, Design, Develop, and Disseminate stages, to develop Articulate Storyline-based interactive multimedia for Grade VII Informatics on computational thinking. The Define stage included needs, learner, task, and concept analyses and learning objective formulation. The Design stage involved media and format selection and storyboard development. The Develop stage covered product development, expert validation, revision, practicality testing, and effectiveness testing. The Disseminate stage involved distributing the multimedia link to the Informatics teacher and through the Informatics Subject Teachers' Working Group (MGMP Informatika).

The subjects comprised three validators (one subject-matter expert and two media experts) and 30 Grade VII.3 students of SMP Negeri 8 Bukittinggi. Data included qualitative and quantitative data collected through subject-matter and media validation questionnaires,

a practicality questionnaire, and pretest–posttest learning outcomes. Data were analyzed descriptively using qualitative and quantitative techniques. Validity and practicality were determined from percentages comparing obtained and maximum scores, while effectiveness was assessed using the N-Gain score to measure improvements in learning outcomes after using the multimedia.

RESULTS

1. Results of Interactive Multimedia Development

At the Define stage, needs, learner, task, and concept analyses were conducted, along with learning objective formulation. The needs analysis showed that SMP Negeri 8 Bukittinggi had adequate technology facilities, but their use was not optimized. Learning remained dominated by printed textbooks and one-way presentations, resulting in passive student participation. Given the logical and abstract nature of computational thinking, learning materials therefore need to be presented in a more concrete, engaging, and interactive manner. At the Design stage, web-based interactive multimedia was developed using Articulate Storyline, with supporting visual elements designed in Canva. The product featured a simple and engaging interface with navigation, text, images, videos, exercises, games, and interactive quizzes. A flowchart and storyboard were prepared as the basis for product development.

At the Develop stage, the multimedia was developed according to the design and underwent expert validation, revision, practicality testing, and effectiveness testing. The final product was published in web/HTML5 format, enabling access through web-browser-compatible devices.

2. Product Validation Results

Validation was conducted to assess the feasibility of the interactive multimedia before student implementation. Content validation by one subject-matter expert yielded a mean score of 4.78 (95.71%), categorized as "Very Valid," indicating that the materials aligned with the learning outcomes and met content, presentation, and assessment criteria.

Media validation was conducted in two stages. In Stage I, Validators I and II obtained scores of 66.4% and 71.6%, respectively, both categorized as "Valid," but revisions were required. Revisions included correcting subject and grade-level information, removing unnecessary menu elements, improving video resolution, revising fonts and capitalization, fixing the pause button and media instructions, and adding instructions for interactive

activities. Following revision, Stage II scores increased to 95.4% and 87%, respectively, both categorized as "Very Valid." These results indicate that the multimedia met feasibility criteria in terms of content, visual design, navigation and interactivity, language, and usability.

3. Practicality Test Results

The practicality test involved 30 Grade VII.3 students of SMP Negeri 8 Bukittinggi and assessed five aspects: appearance, learning materials, interactivity, evaluation, and usefulness.

Table 2. Results of the Interactive Multimedia Practicality Test

Aspect	Mean	Percentage	Category
Appearance	4.64	92.8%	Very Practical
Learning Materials	4.40	88.0%	Very Practical
Interactivity	4.41	88.2%	Very Practical
Evaluation	4.62	92.4%	Very Practical
Usefulness	4.51	90.2%	Very Practical
Overall Mean	4.52	90.4%	Very Practical

Table 2 shows that the interactive multimedia obtained an overall mean score of 4.52 (90.4%), categorized as "Very Practical." The appearance aspect received the highest score (92.8%), while learning materials had the lowest (88.0%); however, both remained within the "Very Practical" category.

4. Effectiveness Test Results

The effectiveness of the interactive multimedia was assessed by comparing Grade VII.3 students' pretest and posttest results using equivalent test instruments. The results showed improved learning outcomes following the use of the multimedia.

Table 3. Pretest, Posttest, and N-Gain Results

Indicator	Result
Total pretest score	1,845
Total posttest score	2,510
Mean pretest score	61.50
Mean posttest score	83.67
N-Gain	0.58
N-Gain percentage	58%
Category	Moderate

Table 3 shows that the mean score increased from 61.50 on the pretest to 83.67 on the posttest. The N-Gain score was 0.58 (58%), categorized as moderate, with most students showing moderate improvement and several achieving high improvement. These findings

indicate that the interactive multimedia was effective in improving students' understanding of computational thinking concepts.

This study developed Articulate Storyline-based interactive multimedia for teaching computational thinking to Grade VII junior high school students. The product achieved 95.71% content validity, 95.4% and 87.0% Stage II media validity, and 90.4% practicality, all categorized as "Very High." Students' mean learning outcomes increased from 61.50 to 83.67, with an N-Gain of 0.58 (58%), categorized as moderate. These findings indicate that the multimedia met the criteria of validity, practicality, and effectiveness as a supporting medium for Informatics learning.

DISCUSSION

The interactive multimedia was developed using the 4D model (Define, Design, Develop, and Disseminate), which provides a simple and systematic approach suitable for technology-based learning media development. This is consistent with Sugiyono (2022), who defines R&D as a method for producing products while testing their effectiveness. Therefore, systematic implementation of each stage is essential to ensure product feasibility before broader use.

At the Define stage, needs, learner, task, and concept analyses were conducted, along with learning objective formulation. The findings showed that Grade VII students are developing logical thinking abilities but still benefit from concrete and engaging learning materials. Consistent with Piaget's cognitive development theory and the abstract nature of computational thinking, interactive multimedia was selected to address limitations of existing media and promote active student engagement.

At the Design stage, media and format selection and initial product design were conducted based on the preceding analyses. Articulate Storyline was selected for its ability to integrate multimedia elements, while Canva was used to create supporting visual elements. The multimedia featured a simple and engaging interface with systematic navigation, while a flowchart and storyboard were developed to illustrate the learning flow and navigation structure. At the Develop stage, the product was developed according to the design and evaluated through validity, practicality, and effectiveness testing.

Product validity was assessed by subject-matter and media experts using a five-point Likert-scale questionnaire. Validity refers to the extent to which an instrument or product

meets established indicators and objectives (Ulfah et al., 2025; Subhaktiyasa, 2024). Subject-matter validation obtained a mean score of 4.7 (95.71%), categorized as "Very Valid," while media validation by two experts reached a mean score of 4.56 (91.2%) after revisions, also categorized as "Very Valid." These results indicate that the multimedia met the required criteria in terms of content, design, and media quality.

The practicality test, conducted according to Yanto (2019), assessed the usability of the multimedia in classroom implementation. The product obtained a mean score of 4.52 (90.4%), categorized as "Very Practical," indicating that it was well accepted by students and suitable as a supporting medium for learning.

Effectiveness was assessed by comparing pretest and posttest scores using the N-Gain formula. Based on Hake (1998), N-Gain values are classified as high ($g > 0.70$), moderate ($0.30 \leq g \leq 0.70$), or low ($g < 0.30$). The mean N-Gain score was 0.58 (58%), categorized as "Moderate," indicating a positive contribution to students' understanding of computational thinking, although the effectiveness did not reach the highest category. This result may also be influenced by factors such as duration of use, students' learning readiness, and implementation conditions.

The findings are consistent with Ananda et al. (2022) and Nadzif et al. (2022), who demonstrated the feasibility and usability of Articulate Storyline-based interactive multimedia at the junior high school level. However, the present study differs in learning context and development model: Ananda et al. focused on ICT, Nadzif et al. addressed the Solar System using the Plomp-Tessmer model, whereas this study focuses on computational thinking for Grade VII students using the 4D model. Its novelty lies in integrating the four computational thinking elements into one multimedia product through specific interactive activities, including case studies, matching, key-information selection, algorithm sequencing through drag-and-drop, and quizzes with automatic feedback. The product was also adapted for school-based implementation through HTML5.

These findings have implications for Informatics learning at the junior high school level. Interactive multimedia can support teachers in overcoming the limitations of one-way learning media by combining text, images, videos, interactive activities, and assessments. This approach is consistent with the Cognitive Theory of Multimedia Learning, which suggests that integrating verbal and visual information can facilitate deeper understanding. Practically, the product provides teachers with an alternative medium for computational thinking and

supports students' interactive and independent learning. It can also be further developed for other Informatics topics.

This study has two main limitations. First, the multimedia covers only computational thinking, comprising decomposition, pattern recognition, abstraction, and algorithms, and therefore does not encompass all Grade VII Informatics materials and learning outcomes. Second, the trial involved only 30 Grade VII.3 students at SMP Negeri 8 Bukittinggi, limiting the generalizability of the findings to schools with different student characteristics, facilities, and learning conditions.

In conclusion, the Articulate Storyline-based interactive multimedia developed for Grade VII Informatics fulfilled the criteria of validity, practicality, and effectiveness as a supporting medium for computational thinking instruction. The product provides an interactive and systematic learning experience that addresses limitations of conventional learning media while supporting students' engagement and understanding of computational thinking.

CONCLUSION

This study developed Articulate Storyline-based interactive multimedia for computational thinking among Grade VII junior high school students using the 4D model. The product achieved 95.71% subject-matter validity and 95.4% and 87.0% final-stage media validity, all categorized as "Very Valid." The practicality score was 90.4% ("Very Practical"), while mean learning outcomes increased from 61.50 to 83.67, with an N-Gain of 0.58 (58%), categorized as "Moderate." These findings indicate that the multimedia is valid and practical as a supporting medium for Informatics learning and provides an interactive and systematic approach to computational thinking instruction. Future research should expand the learning content, incorporate more contextualized interactive activities, extend the implementation duration, and involve more diverse students and schools to strengthen the generalizability and effectiveness of the product.

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