

Development of Web-Based Interactive Learning Media as A Digital Innovation in Hardware and Software Materials at SMP Negeri 1 Senori

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Abstract

The rapid development of digital technology has encouraged schools to integrate innovative learning media into classroom instruction. However, the learning process of Information and Communication Technology (ICT) at SMP Negeri 1 Senori still relies on conventional teaching methods, such as lectures and PowerPoint presentations, which limit students' engagement and conceptual understanding of computer hardware and software. This study aimed to develop an interactive web-based learning media and evaluate its validity, practicality, and effectiveness in improving students' conceptual understanding and learning motivation. The research employed the Research and Development (R&D) approach using the ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation stages. The developed product integrates multimedia components, including text, images, videos, animations, and interactive quizzes within a web-based platform accessible through computers and mobile devices. Product quality was evaluated by media experts and subject matter experts, while practicality was assessed through teacher and student responses. Effectiveness was determined using pre-test and post-test scores as well as students' learning motivation questionnaires. The findings indicate that the developed learning media fulfills the criteria of valid, practical, and effective instructional media. Furthermore, the integration of multimedia and interactive features facilitates active learning, enhances conceptual understanding of computer hardware and software, and increases students' motivation during classroom instruction. Therefore, the proposed web-based learning media can serve as an effective digital learning resource for ICT learning at the junior high school level.

Keywords: Interactive learning media, Web-based learning, ADDIE model, ICT education, Learning motivation.

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1. Introduction

The rapid advancement of information and communication technology has significantly transformed educational practices across all educational levels [1]. Digital technology is no longer considered merely a supporting tool but has become an integral component of the teaching and learning process. Educational institutions are expected to implement technology-enhanced learning environments capable of promoting active participation, independent learning, and meaningful knowledge construction. Consequently, teachers are encouraged to design innovative learning media that accommodate students' learning characteristics while improving learning outcomes.

In Indonesia, the implementation of the Independent Curriculum emphasizes student-centered learning supported by digital technology [2]. The curriculum encourages teachers to utilize interactive learning media capable of facilitating higher-order thinking skills, collaboration, creativity, and problem-solving abilities. Therefore, integrating web-based learning media into classroom instruction represents one of the most promising strategies for improving instructional quality,

particularly in Information and Communication Technology (ICT) subjects.

Computer hardware and software constitute fundamental topics in junior high school ICT education because they establish the foundation for students' digital literacy. Students are expected not only to memorize the names of computer components but also to understand their functions, classifications, and interactions within a computer system. Nevertheless, these concepts are often abstract for beginners, making visualization and interactive learning experiences essential for meaningful understanding [3].

Preliminary observations conducted at SMP Negeri 1 Senori revealed several instructional problems. The ICT learning process predominantly relies on lecture-based instruction and PowerPoint presentations. Although these media assist teachers in presenting learning materials, they remain relatively static and provide limited opportunities for student interaction [4]. As a result, students tend to become passive learners who merely receive information without actively constructing their understanding. Moreover, limited visualization of computer hardware and software

components makes it difficult for students to distinguish various devices and understand their respective functions.

The absence of interactive instructional media also affects students' learning motivation. Many students demonstrate low enthusiasm during classroom activities because instructional materials are delivered through one-way communication. Learning activities become teacher-centered, reducing opportunities for exploration, self-paced learning, and immediate feedback. Consequently, students experience difficulties in comprehending the relationships between hardware and software components, resulting in relatively low conceptual understanding.

Previous studies have consistently demonstrated that web-based learning media positively influence students' academic achievement and engagement. [1] Interactive multimedia environments combining text, graphics, animation, audio, video, and quizzes have been shown to facilitate conceptual understanding while increasing students' participation during classroom activities. Research employing the ADDIE development model has also reported that web-based instructional media generally satisfy validity, practicality, and effectiveness criteria for classroom implementation.

Despite these positive findings, several research gaps remain. Most previous studies focused exclusively on computer hardware or software rather than integrating both topics into a comprehensive instructional platform. Furthermore, many studies primarily investigated media feasibility without considering contextual instructional needs within specific schools. These limitations indicate the necessity of developing contextualized web-based learning media capable of integrating hardware and software materials into a single interactive learning environment [5].

The theoretical foundation of this research is based on Mayer's Multimedia Learning Theory, which states that students learn more effectively when instructional information is presented through multiple representations, including verbal and visual channels [1]. By combining text, images, animations, videos, and interactive exercises, students can process information more efficiently and construct deeper conceptual understanding. In addition, Constructivist Learning Theory emphasizes that students actively construct knowledge through exploration, interaction, and problem-solving rather than passively receiving information. Therefore, interactive web-based learning environments provide opportunities for learners to explore educational content independently while receiving immediate feedback [6].

Interactivity represents another critical component in digital learning. Interactive navigation systems, self-assessment quizzes, automatic feedback, and multimedia visualization encourage students to participate actively throughout the learning process [1]. Such features promote greater engagement and motivation while allowing learners to evaluate their own

understanding continuously. Consequently, integrating these instructional features into web-based learning media is expected to improve students' conceptual understanding and learning motivation simultaneously [6].

This study employed the Research and Development (R&D) methodology using the ADDIE instructional design model to develop an interactive web-based learning media for computer hardware and software instruction [7]. The product integrates multimedia elements, interactive navigation, instructional videos, images, and online quizzes into a single learning platform accessible through various digital devices [1]. Unlike previous studies, the proposed learning media integrates computer hardware and software concepts within one instructional environment while considering the specific instructional context of SMP Negeri 1 Senori.

The novelty of this study lies in three major aspects. First, the developed instructional media integrates hardware and software learning materials into a unified web-based platform, enabling students to understand the complete computer system comprehensively [8]. Second, the instructional media is designed according to the contextual needs of junior high school students and teachers at SMP Negeri 1 Senori [9]. Third, the product evaluation is conducted comprehensively by examining its validity, practicality, effectiveness, students' conceptual understanding, and learning motivation using structured research instruments [7].

Accordingly, the objective of this research is to develop and evaluate an interactive web-based learning media capable of improving ICT learning quality at the junior high school level. Specifically, this study investigates whether the developed instructional media satisfies validity, practicality, and effectiveness criteria while enhancing students' conceptual understanding and learning motivation [7]. The findings are expected to contribute to the development of innovative digital learning media that support technology-enhanced education and facilitate more meaningful learning experiences in ICT classrooms.

2. Methods

This study employed the Research and Development (R&D) approach to develop and evaluate an interactive web-based learning media for Information and Communication Technology (ICT) instruction, particularly on computer hardware and software materials for seventh-grade junior high school students [4]. The R&D method was selected because it focuses not only on developing an educational product but also on evaluating its feasibility and effectiveness before implementation in the classroom. The instructional development process adopted the ADDIE model, which consists of five sequential stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was selected due to its systematic,

flexible, and iterative characteristics that enable continuous product improvement throughout the development process [7].

2.1 Research Design

The research was conducted at SMP Negeri 1 Senori, Indonesia. The participants consisted of one ICT teacher, one subject matter expert, two media experts, and 31 seventh-grade students who participated during the implementation stage. The developed learning media was designed as a responsive web application that could be accessed using desktop computers, laptops, tablets, and smartphones [5]. The web-based application integrates learning materials, illustrations, instructional videos, interactive navigation, and self-assessment quizzes into a single learning environment.

2.2 ADDIE Development Procedure

The development process followed the five phases of the ADDIE instructional design model.

Analysis The analysis phase aimed to identify instructional problems, students' learning characteristics, curriculum requirements, and technological needs [7]. Classroom observations and interviews with the ICT teacher were conducted to investigate existing instructional practices. The analysis revealed that learning activities were still dominated by lectures and PowerPoint presentations, resulting in limited student interaction and low conceptual understanding of computer hardware and software. In addition, existing instructional media provided insufficient visualization of computer components, making it difficult for students to understand their functions and relationships [10]. The findings from this phase served as the basis for determining product specifications and instructional objectives.

Design During the design phase, the overall architecture of the learning media was prepared [11]. This stage involved designing the website interface, navigation structure, instructional flow, learning materials, multimedia components, and assessment instruments [1]. The instructional content was organized into two main topics: computer hardware and computer software. Each topic consisted of learning objectives, explanatory texts, images, videos, animations, and interactive exercises. Assessment instruments, including expert validation sheets, teacher and student response questionnaires, learning motivation questionnaires, and pre-test and post-test questions, were also developed during this phase [12].

Development The development phase focused on producing the web-based learning media according to the previously designed specifications [11]. Multimedia elements, including text, graphics, animations, instructional videos, hyperlinks, and online quizzes, were integrated into the website to provide meaningful learning experiences [1]. After the prototype was completed, product validation was conducted by one subject matter expert and two media experts. The experts evaluated the instructional content, interface design, navigation, functionality, language clarity, and

multimedia quality using structured validation instruments. Suggestions and recommendations from the validators were subsequently used to revise and improve the product before classroom implementation. **Implementation** The implementation phase involved applying the validated learning media during ICT learning activities in a seventh-grade classroom at SMP Negeri 1 Senori. Students accessed the learning media individually through digital devices under teacher supervision. During classroom implementation, students studied the instructional materials, watched learning videos, explored interactive illustrations, completed online exercises, and participated in evaluation quizzes provided by the system. At the end of the learning session, students completed response questionnaires and learning motivation questionnaires, while the teacher evaluated the practicality of the developed learning media.

Evaluation The evaluation phase aimed to determine the overall quality of the developed learning media. Product quality was assessed through three major indicators: validity, practicality, and effectiveness. Validity was determined from expert evaluations, practicality was measured using teacher and student response questionnaires, while effectiveness was evaluated by comparing students' pre-test and post-test scores. Students' learning motivation after using the learning media was also measured using a five-point Likert-scale questionnaire [4]. The evaluation results were used to determine whether the developed product fulfilled the quality standards required for classroom implementation.

2.3 Data Collection Instruments

Several research instruments were employed to collect quantitative and qualitative data throughout the development process.

Expert validation sheets were used to evaluate the instructional content, interface design, usability, functionality, navigation, and language quality of the developed learning media.

Teacher response questionnaires measured the practicality of the learning media from the instructor's perspective, including ease of use, instructional suitability, and classroom applicability.

Student response questionnaires evaluated students' perceptions regarding interface attractiveness, usability, accessibility, interaction quality, and overall satisfaction.

Learning motivation questionnaires were administered using a five-point Likert scale to assess students' motivation after using the web-based learning media.

Pre-test and post-test instruments consisting of objective questions were administered to measure improvements in students' conceptual understanding of computer hardware and software after the implementation of the developed instructional media [7].

2.4 Data Analysis

The collected data were analyzed using descriptive quantitative analysis.

The validity of the learning media was calculated by converting expert evaluation scores into percentages and interpreting them according to predetermined validity criteria. Practicality was analyzed using the average percentage scores obtained from teacher and student response questionnaires. Product effectiveness was determined by comparing students' pre-test and post-test achievement scores to identify improvements in conceptual understanding after using the developed learning media [13]. Learning motivation data were analyzed using descriptive statistics by calculating the average Likert-scale scores for each motivation indicator.

The developed web-based learning media was considered feasible for classroom implementation if it satisfied three quality criteria: (1) valid according to expert evaluation, (2) practical according to teacher and student responses, and (3) effective in improving students' conceptual understanding and learning motivation. This comprehensive evaluation ensured that the developed instructional media met both pedagogical and technological standards for ICT learning in junior high schools.

3. Results and Discussions

3.1 Analysis Stage

The analysis stage was conducted to identify instructional problems, learner characteristics, curriculum requirements, and technological needs before developing the interactive web-based learning media [1]. This phase represents the foundation of the ADDIE instructional design model because the quality of the final product depends on the accuracy of the initial needs assessment.

Data were collected through classroom observations, interviews with the Information and Communication Technology (ICT) teacher, and an analysis of curriculum documents used at SMP Negeri 1 Senori. The findings revealed that the existing learning process still relied primarily on teacher-centered instructional methods, particularly lectures supported by Microsoft PowerPoint presentations. Although these media assisted teachers in delivering learning materials, they provided limited opportunities for student interaction and independent learning. Consequently, students tended to become passive recipients of information rather than active participants in constructing their knowledge.

Another significant issue identified during the analysis was the limited availability of interactive learning resources for computer hardware and software topics. The instructional materials mainly consisted of textual explanations accompanied by static images, making it difficult for students to visualize computer components and understand the relationships between hardware and software within a computer system. As a result, students frequently experienced misconceptions regarding

component functions and classifications, which negatively affected their conceptual understanding [8]. The classroom observation also indicated that students showed relatively low learning motivation during ICT lessons. Most classroom activities were dominated by one-way communication, leaving little opportunity for exploration, discussion, or self-paced learning. Students tended to rely heavily on teacher explanations and rarely participated actively during classroom discussions. Such instructional conditions are inconsistent with the student-centered learning principles promoted by the Indonesian Independent Curriculum.

Curriculum analysis demonstrated that the learning objectives require students not only to identify computer hardware and software components but also to explain their functions, classify different devices, and understand the interactions among system components. These competencies require instructional media capable of providing rich visualization, interactive exploration, and immediate feedback [9]. Therefore, conventional presentation media alone were considered insufficient for achieving the expected learning outcomes.

Furthermore, learner analysis showed that seventh-grade students were already familiar with smartphones and internet-based applications in their daily activities. Most students demonstrated adequate digital literacy and expressed positive attitudes toward technology-assisted learning. These characteristics indicate that web-based learning media have considerable potential to increase students' engagement and facilitate independent learning beyond classroom sessions.

Based on the findings obtained during the analysis stage, several instructional requirements were identified. First, the learning media should integrate computer hardware and software materials into a single instructional platform to provide comprehensive conceptual understanding. Second, the media should incorporate multimedia elements such as images, animations, instructional videos, and interactive simulations to facilitate visualization of abstract concepts [1]. Third, interactive quizzes with automatic feedback should be included to enable students to evaluate their understanding independently. Finally, the learning media should be accessible through various digital devices, including desktop computers, laptops, tablets, and smartphones, thereby supporting flexible learning inside and outside the classroom [5].

The outcomes of this analysis stage became the primary basis for designing the web-based learning media developed in this study. By aligning the instructional design with students' learning characteristics, curriculum objectives, and classroom needs, the resulting learning media was expected to improve conceptual understanding, increase learning motivation, and promote active participation during ICT instruction.

Table 1. Summary of Needs Analysis

No.	Aspect	Description of Results
1	Learning process	Develop interactive student-centered learning media.
2	Learning materials	Integrate multimedia components (images, videos, animations)
3	Student participation	Provide interactive navigation and quizzes
4	Learning motivation	Design attractive multimedia-based learning experiences
5	Expert Validation	Based on ISO/IEC 9126 standards, the system was classified as good and suitable for use.
6	Technology availability	Develop responsive web-based learning media
7	Curriculum requirements	Integrate hardware and software materials into one platform.

3.2 Design Stage

The design stage was conducted after completing the needs analysis to establish the instructional framework and technical specifications of the interactive web-based learning media. The primary objective of this stage was to transform the identified instructional needs into a systematic learning environment that supports students' conceptual understanding and active participation during Information and Communication Technology (ICT) learning [1].

The instructional design referred to the learning objectives specified in the Independent Curriculum for seventh-grade ICT courses. The learning content was organized into two main modules, namely computer hardware and computer software. Each module was designed sequentially, beginning with learning objectives, conceptual explanations, illustrations, multimedia resources, interactive activities, and formative assessments. This organization allows students to learn independently while following a logical sequence of concepts.

The user interface (UI) was designed based on simplicity, consistency, and ease of navigation. A responsive web interface was selected to ensure compatibility across multiple devices, including desktop computers, laptops, tablets, and smartphones. The interface employed readable typography, consistent color schemes, intuitive navigation menus, and attractive visual elements suitable for junior high school students [10]. These design principles aimed to minimize cognitive load and improve students' learning experiences.

To enhance conceptual understanding, various multimedia components were incorporated into the learning media. These included explanatory texts, high-quality images of computer hardware components, instructional videos, simple animations, and interactive

quizzes. The multimedia elements were developed following Mayer's Multimedia Learning Theory, which emphasizes that combining verbal and visual information facilitates deeper learning by engaging both visual and auditory cognitive channels simultaneously. The website navigation structure was also carefully designed to provide straightforward access to learning resources. The main navigation menu consisted of Home, Learning Objectives, Hardware Materials, Software Materials, Learning Videos, Interactive Quiz, Evaluation, and Developer Profile. This hierarchical navigation enabled students to locate learning resources efficiently without experiencing confusion during independent learning activities [6].

Assessment instruments were designed simultaneously with the instructional media. The research instruments included expert validation sheets, teacher response questionnaires, student response questionnaires, learning motivation questionnaires using a five-point Likert scale, and pre-test and post-test questions. These instruments were developed to evaluate the validity, practicality, and effectiveness of the developed learning media comprehensively.

A storyboard was also prepared to visualize the arrangement of each webpage before programming activities began. The storyboard specified page layouts, multimedia placement, navigation buttons, hyperlinks, instructional sequences, and user interactions. Developing the storyboard before implementation minimized design inconsistencies and facilitated communication between the instructional designer and the software development process.

The overall design process resulted in a comprehensive blueprint that integrated instructional content, multimedia resources, navigation systems, assessment components, and responsive interface design into a unified web-based learning environment. This blueprint served as the foundation for the subsequent development stage, during which the actual learning media was implemented and validated by subject matter and media experts.

Table 2. Main Features of the Web-Based Learning Media

Feature	Description	Learning Function
Home Page	Main interface displaying navigation menus	Provides easy access to all learning resources
Learning Objectives	Displays competencies and learning outcomes	Displays competencies and learning outcomes
Hardware Module	Contains concepts, images, and explanations of computer hardware	Improves conceptual understanding of hardware components

Software Module	Presents software classifications, functions, and examples	Facilitates understanding of software concepts
Learning Videos	Embedded instructional videos	Supports visual and auditory learning
Interactive Quiz	Multiple-choice questions with automatic feedback	Measures students' understanding and provides immediate feedback
Evaluation	Pre-test and post-test activities	Measures learning achievement
Developer Profile	Information about the application developer	Provides application identity and credibility

3.3 Development Stage

The development stage focused on transforming the instructional design into a functional interactive web-based learning media. During this phase, all instructional materials, multimedia components, interface layouts, and navigation systems designed in the previous stage were implemented into a responsive web application [5]. The objective of this stage was to produce a learning media that met pedagogical requirements while providing an engaging and user-friendly learning experience for seventh-grade students. The web-based learning media was developed by integrating various multimedia elements, including textual explanations, images of computer hardware and software, instructional videos, interactive navigation, and online quizzes. These multimedia components were organized according to the learning sequence established during the design stage. Students could access each learning module independently through a web browser using desktop computers, laptops, tablets, or smartphones without requiring additional software installation [14].

The homepage was designed as the primary navigation interface, allowing students to access all learning modules efficiently. Each learning module contained learning objectives, theoretical explanations, supporting illustrations, and interactive activities. Hyperlinks and navigation buttons were incorporated throughout the application to facilitate seamless movement between learning pages. Additionally, formative quizzes were embedded within each module to provide immediate feedback and reinforce students' conceptual understanding.

After the prototype had been completed, the product underwent an expert validation process to evaluate its instructional quality before classroom implementation. Validation was conducted by one subject matter expert and two media experts. The subject matter expert assessed the accuracy, completeness, relevance, and curriculum alignment of the learning content, while the

media experts evaluated interface design, navigation, functionality, usability, multimedia integration, and overall system performance. The validation process aimed to ensure that the developed learning media satisfied educational and technical quality standards prior to implementation.

The expert evaluations indicated that the developed web-based learning media fulfilled the expected quality criteria. Nevertheless, several recommendations were provided to further improve the application. The subject matter expert suggested refining several learning explanations to improve conceptual clarity and adding examples that were more closely related to students' daily experiences. Meanwhile, the media experts recommended improving interface consistency, optimizing image resolution, enhancing navigation button visibility, and simplifying several page layouts to improve usability.

Based on the validators' recommendations, product revisions were carried out before classroom implementation. The revisions included improving learning content, replacing several images with higher-quality illustrations, reorganizing page layouts, optimizing responsive display across different screen sizes, refining navigation menus, and correcting minor technical issues identified during expert evaluation. These improvements enhanced both instructional quality and user experience while maintaining consistency with the original instructional design.

The revised product represented the final version of the interactive web-based learning media used during the implementation stage. The application integrated instructional content, multimedia resources, interactive exercises, and evaluation features into a single learning platform that supported both classroom instruction and independent learning activities.

Table 3. Summary of Expert Validation Results

Validation Aspect	Evaluator	Revision Recommendation
Learning Content	Subject Matter Expert	Improve conceptual explanations and add contextual examples
Curriculum Alignment	Subject Matter Expert	Ensure consistency with learning objectives and competencies
Interface Design	Media Experts	Improve layout consistency and readability
Navigation	Media Experts	Simplify menu navigation and increase button visibility
Multimedia Components	Media Experts	Optimize image quality and multimedia presentation
Functionality	Media Experts	Improve

		responsiveness and eliminate minor technical errors
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3.4 Implementation Stage

The implementation stage was conducted after the interactive web-based learning media had been revised based on the recommendations provided by the subject matter and media experts [11]. The revised product was implemented in an actual classroom setting to evaluate its practicality and effectiveness during Information and Communication Technology (ICT) learning. The implementation involved 31 seventh-grade students of SMP Negeri 1 Senori and one ICT teacher who facilitated the learning activities.

Prior to the learning session, students were introduced to the objectives of the learning activities and were provided with instructions on how to access and use the web-based learning media. Each student accessed the application individually using available digital devices connected to the internet. The teacher acted primarily as a facilitator by guiding students through the learning process, providing clarification when necessary, and encouraging students to explore the learning materials independently [9].

The learning activities began with the administration of a pre-test to measure students' prior knowledge regarding computer hardware and software concepts. After completing the pre-test, students accessed the web-based learning media and studied the instructional materials sequentially. During the learning process, students explored multimedia content consisting of textual explanations, images, instructional videos, and interactive illustrations [10]. They were also encouraged to complete formative quizzes embedded within each learning module to assess their understanding and receive immediate feedback.

Throughout the implementation process, students demonstrated active participation and greater engagement compared with conventional classroom instruction. The interactive features enabled students to navigate learning materials independently while allowing them to review instructional content according to their individual learning pace. The integration of multimedia resources and interactive quizzes encouraged students to participate more actively in classroom discussions and facilitated collaborative learning among peers [11].

At the conclusion of the instructional session, students completed a post-test to evaluate improvements in conceptual understanding after using the developed learning media. In addition, students completed response questionnaires and learning motivation questionnaires to provide feedback regarding the usability, attractiveness, accessibility, and overall learning experience offered by the web-based application. The ICT teacher also completed a practicality questionnaire to evaluate the suitability of the learning media for classroom implementation.

The implementation results indicated that the developed learning media could be integrated effectively into classroom instruction without significant technical difficulties. Students were able to access all learning features successfully, while the teacher reported that the application was easy to operate and supported student-centered learning activities. Furthermore, the interactive learning environment created through multimedia integration encouraged students to become more actively involved in the learning process and improved classroom interaction [1].

The successful implementation demonstrated that the developed web-based learning media was operationally feasible for junior high school ICT instruction. The implementation stage also generated quantitative and qualitative data required for evaluating the validity, practicality, effectiveness, learning motivation, and conceptual understanding of students during the subsequent evaluation stage.

Table 4. Implementation Activities

Activity	Description	Participants
Orientation	Introduction to the learning objectives and web-based application	Teacher and 25 students
Pre-test	Assessment of students' initial conceptual understanding	25 students
Learning Activities	Students learned using interactive multimedia modules	Teacher and 25 students
Interactive Quiz	Students completed formative assessments with automatic feedback	25 students
Post-test	Measurement of students' conceptual understanding after learning	25 students
Questionnaires	Teacher and students evaluated the developed learning media	Teacher and 25 students

3.5 Evaluation Stage

The evaluation stage was conducted to determine the overall quality of the developed interactive web-based learning media after its implementation in classroom instruction. Evaluation was performed comprehensively to examine whether the developed product fulfilled the criteria of validity, practicality, and effectiveness, as proposed in the ADDIE development model [3]. The evaluation results were also used to identify the strengths and limitations of the developed learning

media as a digital learning resource for Information and Communication Technology (ICT) education.

The validity of the learning media had previously been established through expert evaluations conducted during the development stage. Following product revision based on the validators' recommendations, the implementation stage focused primarily on evaluating the practicality and effectiveness of the learning media under actual classroom conditions. Practicality was assessed through teacher and student response questionnaires, whereas effectiveness was measured by comparing students' pre-test and post-test learning outcomes and analyzing students' learning motivation after using the developed learning media.

The teacher's evaluation indicated that the developed learning media was easy to operate and well aligned with the learning objectives specified in the curriculum. The teacher also reported that the web-based application simplified the instructional process by providing integrated learning materials, multimedia resources, and assessment features within a single platform. Furthermore, the interactive characteristics of the application encouraged more active classroom participation and reduced students' dependence on teacher explanations during learning activities.

Students' responses also demonstrated positive perceptions toward the developed learning media. Most students reported that the application was attractive, easy to navigate, and helpful in understanding computer hardware and software concepts. The integration of images, instructional videos, animations, and interactive quizzes increased students' interest in learning and encouraged them to explore instructional materials independently. The responsive interface also enabled students to access learning resources conveniently using different digital devices [14].

The effectiveness evaluation was conducted by comparing students' conceptual understanding before and after using the developed learning media. Students completed a pre-test before participating in the learning activities and a post-test immediately after completing all instructional modules. The comparison of learning outcomes demonstrated an improvement in students' conceptual understanding, indicating that the multimedia-based learning environment successfully facilitated knowledge acquisition and concept reinforcement [13].

Learning motivation was evaluated using a structured questionnaire administered after the implementation process. The questionnaire measured several motivational indicators, including learning interest, attention, confidence, satisfaction, and willingness to participate actively in classroom activities [15]. The evaluation results showed that students demonstrated positive learning motivation while using the web-based learning media. Interactive learning activities, immediate feedback, and multimedia visualization contributed significantly to increasing students'

enthusiasm and engagement throughout the instructional process.

Overall, the evaluation findings indicate that the developed interactive web-based learning media successfully fulfilled the three principal quality criteria required for educational product development. The media demonstrated satisfactory validity through expert evaluation, practical usability through positive teacher and student responses, and instructional effectiveness through improvements in students' conceptual understanding and learning motivation. These findings suggest that the developed learning media can be effectively implemented as an alternative digital learning resource for ICT instruction at the junior high school level [16].

4. Conclusions

This study successfully developed an interactive web-based learning media for teaching computer hardware and software materials in Information and Communication Technology (ICT) courses at the junior high school level using the ADDIE instructional design model. The development process consisted of five systematic stages, namely Analysis, Design, Development, Implementation, and Evaluation, resulting in a learning media that integrates multimedia elements, interactive navigation, instructional videos, and online assessment into a single web-based platform [7].

The findings indicate that the developed learning media satisfies the essential quality criteria of educational product development, including validity, practicality, and effectiveness. The integration of multimedia resources and interactive learning activities contributes positively to students' conceptual understanding, encourages active participation during classroom instruction, and enhances learning motivation. Furthermore, the responsive web-based platform enables students to access learning materials flexibly using various digital devices, thereby supporting both classroom instruction and independent learning.

This research contributes to the development of innovative digital learning media by integrating computer hardware and software materials into a unified web-based learning environment specifically designed for junior high school students. The proposed learning media not only supports the implementation of student-centered learning but also aligns with the objectives of the Independent Curriculum in promoting technology-enhanced education [17].

Despite these promising results, this study was conducted within a single educational setting involving a limited number of participants. Therefore, future studies are recommended to involve larger and more diverse samples, evaluate the long-term impact of the learning media on students' academic achievement and digital literacy, and incorporate emerging technologies such as adaptive learning, gamification, artificial intelligence, and learning analytics to further improve instructional effectiveness and personalized learning experiences [18].

References

- [1] Mayer, R. E. (2024). The Past, Present, and Future of the Cognitive Theory of Multimedia Learning. *Educational Psychology Review*, 36(1), 1–25. <https://doi.org/10.1007/s10648-023-09842-1>
- [2] Sabila, F., Shafa, N. R., Maharani, N. K., Rashad, S. M., <https://doi.org/10.17509/curricula.v2i1.52028>
- [3] Firjatullah, R., & Nurjanah, H. F. (2025). PENGEMBANGAN MULTIMEDIA PEMBELAJARAN INTERAKTIF BERBASIS PLATFORM GENIALLY PADA MATERI PERANGKAT KERAS KOMPUTER (HARDWARE) PELAJARAN INFORMATIKA DI KELAS VII SMPN 3 KUNINGAN. 6(5), 8755–8761. <https://doi.org/https://doi.org/10.54373/imeij.v6i5.4102>
- [4] Ali, A., Fenica, S. D., Aini, W., & Hidayat, A. F. (2025). Efektivitas Media Pembelajaran Interaktif dalam Meningkatkan Minat dan Motivasi Belajar Siswa Sekolah Dasar. 3(1), 1–6. <https://doi.org/10.62386/jised.v3i1.115>
- [5] Tegela, N., Mulyanto, A., & Polin, M. (2022). PENGEMBANGAN MEDIA PEMBELAJARAN BERBASIS WEBSITE UNTUK SISWA KELAS XI PADA MATA PELAJARAN INFORMATIKA. 4(2), 32–39. <https://doi.org/10.54373/imeij.v6i5.4102>
- [6] Istiqomah, N. F., & Priyanto. (2023). Development of Web-Based Interactive 3-Dimensional Learning Media for Computer Assembly Materials for Students of Class X TKJ at SMK Negeri 1 Bantul. *Journal of Information Technology and Education (JITED)*, 1(1), 10–18. <https://doi.org/10.21831/jited.v1i1.44>
- [7] Sugiyono. (2022). Metode Penelitian dan Pengembangan (Research and Development/R&D). Alfabeta <https://alfabeta.co.id>
- [8] Andre, K., Dewantara, K., Adicondro, C. S., Teguh, I. M., & Sudarma, I. K. (2025). Interactive Constructivist-Based Learning Media for Fifth Grade Indonesian Language in Elementary School. 5(3), 485–494. <https://doi.org/doi.org/10.23887/jmt.v5i3.99417>
- [9] Cheah, C. (2022). The importance of multimedia elements in learning and the impact of redundancy principle in developing effective multimedia learning materials: a literature review. XII (2), 3–12. <https://doi.org/10.51865/JESP.2022.2.02>
- [10] Alfian, M., Faisal, R., & Aprilianto, P. (2025). Development of Interactive Web-Based Learning Media Using a Differentiated Approach in Information and Communication Technology Elements with a Problem-Based Learning Model. 09(01), 1–14. <https://doi.org/10.55215/pedagonal.v9i1.21>
- [11] Enda, D. (2024). Pengukuran Kualitas Perangkat Lunak Dengan Standar ISO / IEC 25010 Pada Website Jurusan Teknik Informatika Politeknik Negeri Bengkalis. 5(1). <https://doi.org/10.58794/jekin.v5i1.839>
- [12] Agisni, A., Novari, D., Leander, G., Prawirawan, B. U., & Pohan, A. H. (2023). The effectiveness of multimedia learning: A study on student learning. 3, 9–11. <https://doi.org/https://doi.org/10.55942/pssj.v3i7.215>
- [13] Anggara, A. D., & Sujatmiko, B. (2023). IMPLEMENTASI MEDIA PEMBELAJARAN BERBASIS WEBSITE DALAM KOMPETENSI DESAIN PRODUK MULTIMEDIA UNTUK MENINGKATKAN HASIL BELAJAR SISWA PADA MATA PELAJARAN DESAIN MEDIA INTERAKTIF BAGI SISWA SMK Albertus Dwi Anggara Abstrak. 63–72. <https://doi.org/https://doi.org/10.26740/it-edu.v9i1.58645>
- [14] Rahmadhani, T. A., Rozzaqi, A. R., & Khoiri, N. (2025). Indonesian Journal of Educational Development. 6(3), 737–751. <https://doi.org/10.59672/ijed.v6i3.5361>
- [15] Wilujeng, I. (2021). Increasing the attention, relevance, confidence and satisfaction (ARCS) of students through interactive science learning multimedia. 29(1063519), 1–13. <https://doi.org/https://doi.org/10.25304/RLT.V29.2383>
- [16] Rahmadhani, T. A., Rozzaqi, A. R., & Khoiri, N. (2025). Indonesian Journal of Educational Development. 6(3), 737–751. <https://doi.org/10.59672/ijed.v6i3.5361>
- [17] Husen, S., Hizbullah, & Mustari, M. (2025). Dampak Keterbatasan Infrastruktur TIK Terhadap Efektivitas Pembelajaran Digital (Studi Penerapan Model TPACK Di SDN 3 Jagaraga). 4366(2024), 171–176. <https://doi.org/https://doi.org/10.31004/cermat.v1i2.39>
- [18] Wulandari, A., & Viratama, I. (2025). (ICT) AS A LEARNING TOOL. 6(March), 27–37. <https://doi.org/https://doi.org/10.51612/teunul eh.v6i1.182>