



Development of Interactive Learning Media to Enhance Technology Literacy in High School Students

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ABSTRACT

This study aims to develop an interactive learning media based on Project-Based Learning (PjBL) to enhance technological literacy among senior high school students. The development process adopted the ADDIE Model stages (Analysis, Design, Development, Implementation, and Evaluation), involving media experts, subject-matter experts, and a trial involving 32 tenth-grade students. Data were collected through observations, interviews, expert validation questionnaires, and pre-test/post-test instruments. Expert evaluations showed that the interactive learning media achieved a "Highly Feasible" category (mean score 4.35 out of 5) in terms of visual design, interactivity, and content relevance. Crucially, a paired samples t-test on the technology literacy scores demonstrated a statistically significant increase in students' abilities after using the media (mean pre-test $\bar{x} = 68.25$; mean post-test $\bar{x} = 85.10$; $p < 0.001$). This reflects their enhanced ability to access, understand, and utilize digital tools and information more efficiently. Therefore, the PjBL-based interactive learning media is considered highly relevant and effective for use in Informatics learning at the senior high school level.

Keywords: interactive learning media; technological literacy; project-based learning; students,

ABSTRAK

Penelitian ini bertujuan untuk mengembangkan media pembelajaran interaktif berbasis Project-Based Learning (PjBL) guna meningkatkan literasi teknologi siswa SMA. Pengembangan dilakukan melalui tahapan Model ADDIE (Analysis, Design, Development, Implementation, and Evaluation) dengan melibatkan ahli media, ahli materi, serta uji coba kepada 32 siswa kelas X. Pengumpulan data meliputi observasi, wawancara, kuesioner validasi ahli, dan instrumen pre-test/post-test. Hasil uji ahli menunjukkan bahwa media pembelajaran interaktif berada pada kategori "Sangat Layak" (skor rerata 4.35 dari 5) dari aspek tampilan, interaktivitas, dan kesesuaian materi. Secara krusial, uji-t berpasangan pada skor literasi teknologi menunjukkan peningkatan kemampuan siswa yang signifikan secara statistik setelah menggunakan media (rerata pre-test $\bar{x} = 68.25$; rerata post-test $\bar{x} = 85.10$; $p < 0.001$). Dengan demikian, media pembelajaran interaktif berbasis PjBL dinilai sangat relevan dan efektif untuk diterapkan dalam pembelajaran Informatika di SMA.

Kata Kunci: media pembelajaran; literasi teknologi; project-based learning; siswa;

1. INTRODUCTION

The rapid development of digital technology in the Industrial 4.0 era necessitates a major transformation in high school (SMA) education. Digital literacy is now a key competency, requiring students to critically and ethically access, evaluate, and use digital information (Kurniawan, 2025). However, recent studies indicate that the technological literacy of high school students remains inconsistent, particularly concerning information evaluation and digital ethics (Yeyendra et al., 2025).

This inconsistency directly affects student achievement. For example, low digital literacy has been linked to poorer learning outcomes in Informatics subjects (Rifai, M., Huda, F. A., & Wuring, 2024). Addressing this, interactive learning media presents a relevant pedagogical solution, as it has been shown to improve various forms of literacy through dynamic and engaging visual experiences (Nursalamah, I., Jayadinata, A. K., & Sunaengsih, 2021). Furthermore, a study at SMA Martia Bhakti Bekasi found that digital literacy significantly contributes to students' reading interest, where higher literacy is associated with increased reading interest (Agustin et al., 2025).

Despite efforts to utilize digital tools, there remains a critical gap: a lack of interactive learning media specifically designed to integrate the complex technical, ethical, and cognitive aspects of technology literacy comprehensively within one package tailored for high school students.

Therefore, this research aims to develop and evaluate interactive learning media based on Project-Based Learning (PjBL) to holistically enhance high school students' technology literacy. This study contributes practically by providing up-to-date media for teachers, and theoretically by empirically demonstrating the effectiveness of integrated PjBL-based media in fostering 21st-century digital competencies.

2. METHODOLOGY

This research employs a Research and Development (R&D) approach, utilizing the ADDIE model as the framework for media development (Branch, 2009). The media content is underpinned by the Project-Based Learning (PjBL) model, which encourages students to develop authentic solutions through investigation and creation (Thomas & Ph, 2000). The ADDIE model was chosen for its systematic and iterative nature, ensuring the product's quality and relevance are assessed at each stage (Analysis, Design, Development, Implementation, and Evaluation).

2.1 Research Subjects and Data Sources

The research subjects for the product trial were 32 students from Class X at a specific High School, selected using a purposive sampling technique based on the school's readiness and need for advanced Informatics learning media. Data sources included the Informatics subject teacher, students, media experts, and material experts.

2.2 Data Collection Techniques and Instruments

Data collection included:

1. Observation and Interviews: Used for the Analysis stage to map initial learning conditions, existing media limitations, and teacher/student needs.
2. Expert Validation Questionnaire: Used during the Evaluation stage to assess the media's feasibility. The instrument used a Likert scale (1=Poor to 5=Very Good) to measure aspects of visual display, interactivity, and material suitability.
3. Student Response Questionnaire: Used during the Implementation stage to gauge student perceptions (attractiveness, ease of use, usefulness).
4. Technology Literacy Test (Pre-test and Post-test): Used to measure the effectiveness of the media. This instrument consisted of 20 multiple-choice and short-answer questions covering the three technology literacy components (access, understand/evaluate, and utilize).

2.3 Procedure and Development Stages

The development procedures followed the core stages of the ADDIE model:

1. Analysis: Needs assessment based on observations and interviews, revealing low student ability in content evaluation and digital ethics.
2. Design: Formulation of learning objectives, selection of Informatics material, and creation of storyboards, navigation flow, and user interface (UI/UX) designs. The media was designed to integrate technical knowledge with critical thinking activities (e.g., content evaluation simulations).
3. Development: Product creation using Smart Apps Creator as the primary application for integrating multimodal elements (text, images, animations, and interactive buttons). The product focuses on Project-Based Learning modules that require students to produce a simple digital output.
4. Implementation: Trial of the media involving 32 students. The technology literacy test was administered *before* (pre-test) and *after* (post-test) the students used the media for four learning sessions.
5. Evaluation: Validation by media and material experts, followed by statistical analysis of student learning outcomes.

2.4 Data Analysis

1. Expert Validation and Student Response: Analyzed descriptively using percentages and mean scores to determine the product's feasibility level, referencing predetermined criteria (e.g., mean score ≥ 4.21 is considered "Highly Feasible").
2. Effectiveness (Literacy Test): Analyzed using inferential statistics. A Paired Samples t-test was performed on the pre-test and post-test scores to determine if there was a statistically significant difference (improvement) in students' technology literacy.

Criteria for Feasibility: Mean Score $\geq 4.21 \Rightarrow$ Highly Feasible

Criteria for Effectiveness: t – test significant ($\rho < 0.05$)

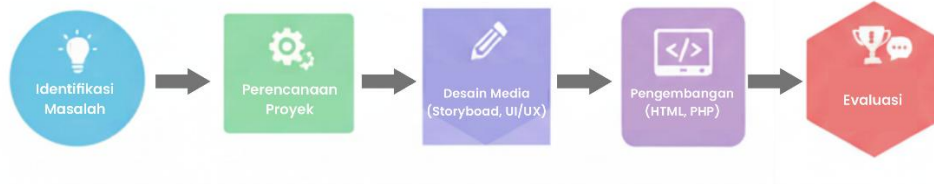


Figure 1.
Research Flowchart Based on ADDIE Model (Adapted from PjBL)

3. RESULT AND DISCUSSION

The results are presented in two main parts: the feasibility assessment by experts and the effectiveness assessment based on student learning outcomes.

3.1 Expert Feasibility Assessment

The assessment from the media and material experts indicated that the developed media possessed a high quality across all evaluation aspects. The experts' feedback confirmed that the media's visual design was appealing, its navigation was intuitive, and its content strictly adhered to the Informatics curriculum.

Table 1.
Analysis of Expert Test Results

Assessment Aspect	Media Expert (5)	Material Expert (5)	Overall Mean (%)	Category
Visual Display	4.45	4.30	87.5%	Very Feasible
Navigation & Interactivity	4.10	4.15	82.5%	Feasible
Material Suitability	4.30	4.50	88.0%	Very Feasible
Language	4.20	4.15	83.5%	Feasible
Relevance to Curriculum	4.26	4.28	85.4%	Very Feasible

The overall mean score of 4.27 (equivalent to 85.4) places the media in the "Very Feasible" category, confirming its readiness for field implementation.

3.2 Student Response and Effectiveness Test Results

Student Response Analysis

The student trial (n=32) showed a very positive response (Mean = 4.38 out of 5, or 87.6 agreement), particularly regarding attractiveness, ease of use, and clarity. Students highly appreciated the interactive elements (simulations and drag-and-drop exercises) which made abstract technology concepts easier to grasp.

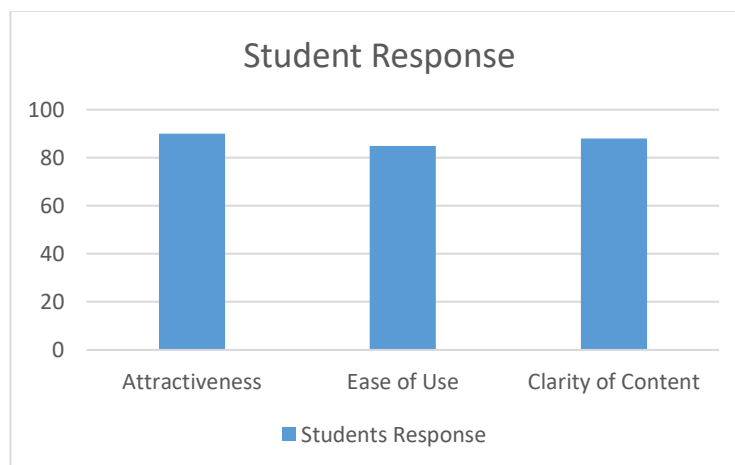


Figure 2.
Student Response and Trial Results

Effectiveness Assessment (Technology Literacy)

To assess the media’s effectiveness in enhancing technology literacy, pre-test and post-test scores were analyzed using a paired samples t-test.

Table 2.
Paired Samples T-Test Results for Technology Literacy Scores

Measure	N	Mean Score (100)	Standard Deviation	t	df	Sig. (2-tailed)	Mean Difference
Pre-test Score	32	68.25	7.15	-15.98	31	< 0.001	16.85
Post-test Score	32	85.10	6.52				

The results from Table 2 show that the mean post-test score (M = 85.10) is significantly higher than the mean pre-test score (M = 68.25). The t-statistic (t = -15.98) with a significance value of p < 0.001 confirms that the difference is statistically significant. This statistically confirms that the interactive learning media effectively improves students’ technology literacy.

3.3 Discussion of Feasibility and Pedagogical Relevance

The high feasibility scores from experts are directly attributable to the systematic adherence to the ADDIE model and the incorporation of the PjBL framework. The PjBL structure, which mandates the creation of a tangible product, forces students to move beyond passive information consumption towards active content utilization and critical evaluation, aligning with the "utilize" and "evaluate" dimensions of technology literacy identified as weak areas during the initial analysis.

The specific development platform (HTML/PHP) allowed the creation of a responsive, engaging, and interactive experience, addressing the findings of Nursalamah (2021). regarding the positive impact of dynamic media on literacy. The visual interface (Figures 3-6) confirms the application of modern UI/UX principles (grid-based layout, soft colors, intuitive icons), which strongly contributed to the positive student response.

3.4 Media Display

The interactive learning media developed consists of several main pages that serve as learning navigation, namely the material, exercise, simulation, and evaluation pages. Each section is designed with a simple, consistent, and user-friendly interface for high school students to support independent exploration activities and enhance technology literacy. The visual display uses soft colors, intuitive icons, and responsive navigation buttons, making it easy for students to move between menus. Presented below is the interactive media interface display used in the research.

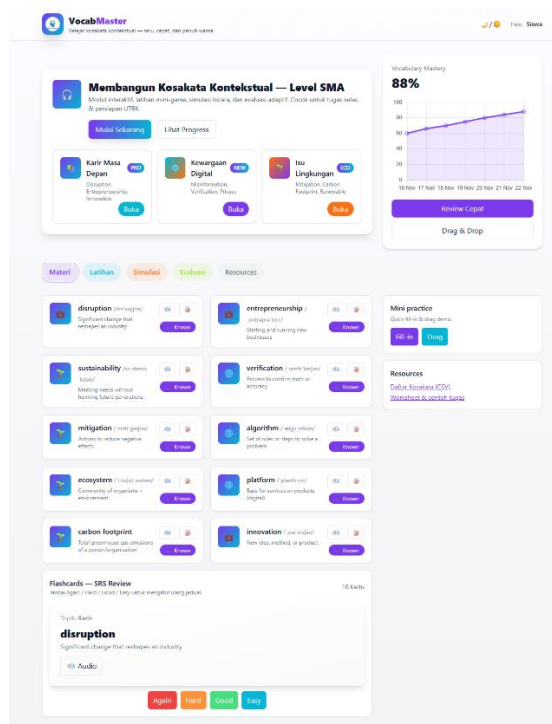


Figure 3.

Interactive Learning Media Material Page

This display is the initial page that shows the Material. The page design uses a grid-based layout with illustrative icons, making it easier for students to select learning activities according to their needs. The background color and visual elements are kept consistent to create a comfortable and appealing interface experience.

The material page presents learning content in the form of text, images, and interactive illustrations. Each subtopic can be accessed via navigation buttons on the side or bottom of the screen. The content is compiled concisely and equipped with supporting illustrations to help increase students' understanding of technology literacy concepts.

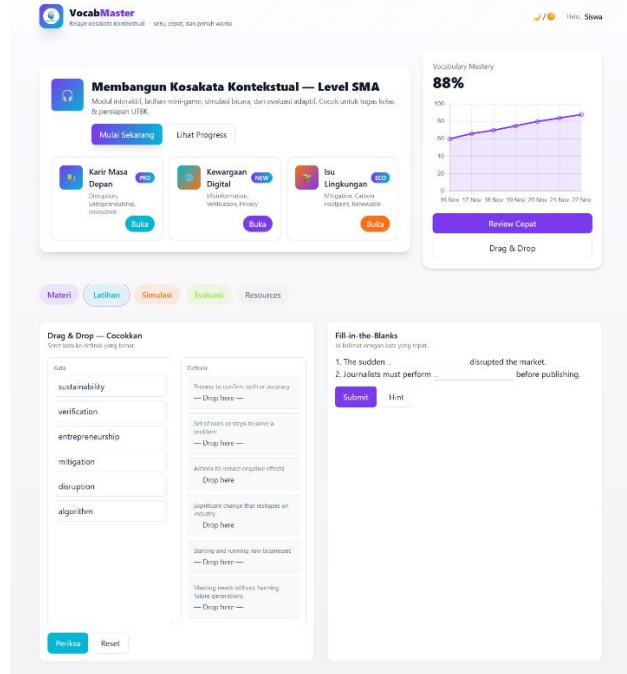


Figure 4. Interactive Practice Question Page Based on Feedback

Halaman latihan menyediakan soal pencocokan dengan drag and drop dengan mekanisme umpan balik langsung. Setelah siswa memilih jawaban, aplikasi menampilkan indikator benar atau salah serta penjelasan singkat. Fitur ini membantu siswa belajar secara mandiri dan mengukur pemahaman awal sebelum masuk ke tahap simulasi.

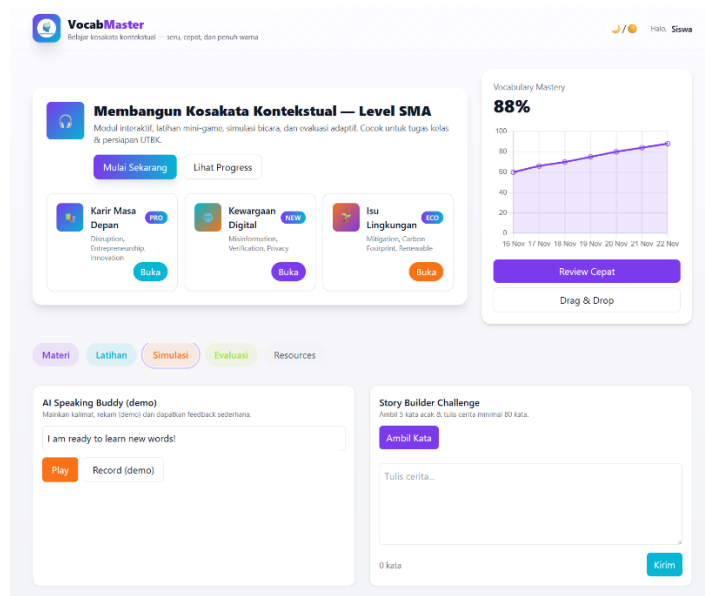


Figure 5.

Simulation Page for Interaction-Based Practical Activities

The simulation page contains digital practical activities where students can perform simple experiments using interactive elements such as buttons, sliders, or animations. This section is designed so that students can explore technology concepts in an applied and in-depth manner, thereby significantly supporting the enhancement of technology literacy.

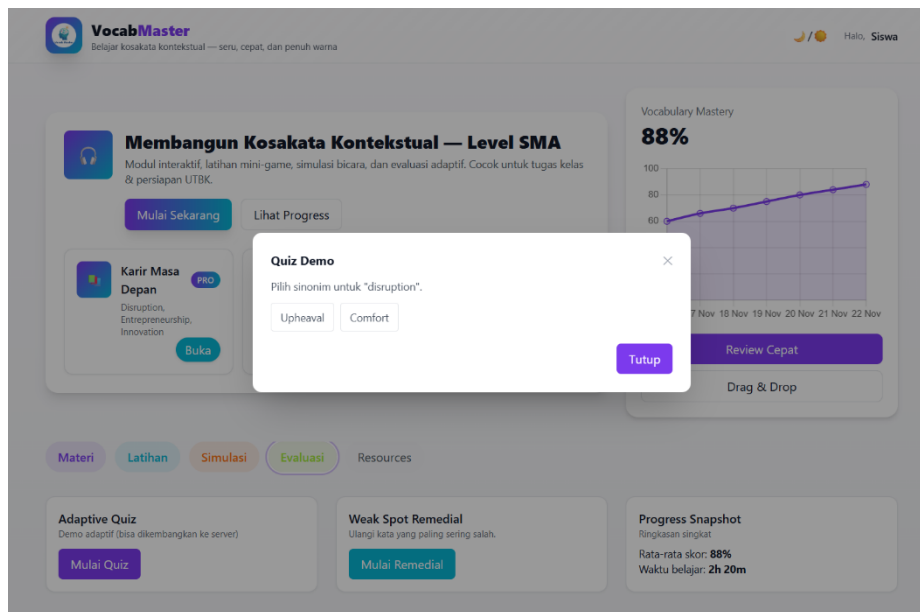


Figure 6.
Evaluation Page for Student Understanding Final Test

The evaluation page provides a series of final questions to measure student learning achievement after using the interactive media. At the end of the evaluation, the application displays a score recap and general feedback related to the learning outcomes. This feature assists both teachers and researchers in measuring the media's effectiveness.

3.5 Discussion of Effectiveness (Enhancing Literacy)

The most crucial finding is the statistically significant improvement in technology literacy scores ($p < 0.001$). This result strongly supports the research objective and strengthens the existing literature (Rifai, M., Huda, F. A., & Wuring, 2024) by providing empirical evidence for the effectiveness of interactive media in the Informatics domain.

The significant increase in scores is attributed to three key features of the developed media:

1. Simulations: This feature provided a safe environment for students to apply digital ethics and security concepts practically, moving learning from theoretical to applied knowledge.
2. Drag-and-Drop and Fill-in-the-Blanks: These immediate feedback mechanisms allowed for mastery learning, consolidating technical vocabulary and foundational concepts efficiently.
3. Adaptive Quizzes: The adaptive nature catered to individual learning pace, optimizing skill improvement across the cohort.

This success demonstrates that the media effectively filled the identified gap: it successfully integrated the technical, cognitive (critical evaluation), and ethical dimensions of literacy within a single, functional package.

4. CONCLUSIONS AND SUGGESTIONS

This research successfully developed a Project-Based Learning (PjBL) based interactive learning media tailored to enhance the technology literacy of high school students.

Conclusions:

1. Feasibility: The media achieved a "Very Feasible" category, validated by both media and material experts (Overall Mean Score 4.27).
2. Effectiveness: The media proved to be highly effective, demonstrating a statistically significant improvement in students' technology literacy scores as confirmed by the paired samples t-test ($p < 0.001$).

3. Applicability: The PjBL approach successfully integrated technical skills, critical content evaluation, and digital ethics into an engaging learning experience, making the product highly relevant and applicable for modern Informatics curricula.

Suggestions for Future Research and Practice:

1. Broader Implementation: Future research should conduct a comparative study involving a control group to further isolate the impact of the interactive media versus traditional learning methods.
2. Long-Term Retention: A follow-up study focusing on the long-term retention of technology literacy skills six months after implementation is suggested to assess the sustained impact of the PjBL media.
3. Content Expansion: For practical use, the media could be expanded to include specific modules on advanced digital ethics topics, such as intellectual property rights and data privacy, to further align with 21st-century competencies.

BIBLIOGRAPHY

- Agustin, S. M., Rista, N., & Eriza, I. (2025). *Pengaruh Literasi Digital terhadap Minat Membaca Siswa Kelas X di SMA Martia Bhakti Bekasi*. 9, 26881–26886.
- Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer.
<https://books.google.co.id/books?id=mHSwJPE099EC&printsec=copyright&hl=id#v=onepage&q&f=false>
- Kurniawan, S. (2025). *LITERASI DIGITAL UNTUK ABAD KE-21* (1st ed.). Pustaka Aksara.
https://books.google.co.id/books/about/LITERASI_DIGITAL_UNTUK_ABAD_KE_21.html?id=tEVzEQAAQBAJ&redir_esc=y
- Nursalamah, I., Jayadinata, A. K., & Sunaengsih, C. (2021). Media Pembelajaran Interaktif Berbasis Android terhadap Literasi Sains Siswa pada Materi Perubahan Wujud Benda. *Jurnal Pena Ilmiah*, 4(1).
<https://doi.org/https://doi.org/10.17509/jpi.v4i1.38415>
- Rifai, M., Huda, F. A., & Wuring, M. R. M. (2024). *PENGARUH LITERASI DIGITAL TERHADAP HASIL BELAJAR SISWA PADA MATA PELAJARAN INFORMATIKA DI SMKN 1 SINTANG*. 5, 198–206.
<https://doi.org/https://doi.org/10.31932/jutech.v5i1.3377>
- Thomas, J. W., & Ph, D. (2000). *A REVIEW OF RESEARCH ON PROJECT-BASED LEARNING*.
- Yeyendra, Y., Hajar, I., Darmanto, D., & Junaidi, E. (2025). *Vol 4 N0 2 Tahun 2024 Hal 111-119 Profil Keterampilan Literasi Digital Siswa SMA di Era Teknologi Digital*. 4, 111–119.