Salud, Ciencia y Tecnología. 2026; 6:2533
doi: 10.56294/saludcyt20262533

ORIGINAL

Jobsheet-Based Digital learning Media: A Pathway to Intelligent Education

Medios de aprendizaje digitales basados en hojas de trabajo: un camino hacia la educación inteligente

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Cite as: Putra R, Nanda I, Rifdarmon, Muslim, Wagino, Tridinanti Azry Z. Jobsheet-Based Digital learning Media: A Pathway to Intelligent Education. Salud, Ciencia y Tecnología. 2026; 6:2533. https://doi.org/10.56294/saludcyt20262533

Submitted: 11-08-2025 **Revised:** 14-10-2025 **Accepted:** 27-11-2025 **Published:** 01-01-2026

Editor: Prof. Dr. William Castillo-González

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ABSTRACT

Introduction: this study aims to design and develop digital job sheet-based learning media to improve the quality of learning in Software Engineering courses at universities.
Method: the study uses a Research and Development (R&D) design with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The media developed integrates Flip PDF, YouTube, Google Sheets, and Quizizz. Validity testing was conducted by experts in subject matter, media, and language; practicality testing involved lecturers and students; while effectiveness testing used a single-group pretest-posttest design with paired t-test analysis and N-Gain.
Results: the validation results showed an average of 85,68 % with a category of highly valid. Practicality obtained 86,33 % (lecturers) and 84,05 % (students), indicating that the media is very practical. Effectiveness analysis showed a significant increase in student learning outcomes ($p < 0,05$) with a moderate N-Gain score (0,46).
Conclusions: this study provides empirical evidence that the integration of digital job sheets with multimedia elements supports the principles of constructivist learning and increases interactivity and learning outcomes. The developed media can be a reference for smart learning inovation in the future.

Keywords: Digital Jobsheet; ADDIE Model; Software Engineering Education; Gamified Formative Assessment; Learning Effectiveness.

RESUMEN

Introducción: este estudio tiene como objetivo diseñar y desarrollar medios de aprendizaje digitales basados en fichas de trabajo para mejorar la calidad del aprendizaje en los cursos de Ingeniería de Software en universidades.
Método: el estudio utiliza un diseño de Investigación y Desarrollo (I+D) con el modelo ADDIE (Análisis, Diseño, Desarrollo, Implementación, Evaluación). Los medios desarrollados integran Flip PDF, YouTube, Hojas de Cálculo de Google y Quizizz. Las pruebas de validez fueron realizadas por expertos en la materia, los medios y el lenguaje; las pruebas de practicidad involucraron a profesores y estudiantes; mientras que las pruebas de efectividad utilizaron un diseño pretest-postest de un solo grupo con análisis de prueba t pareada y N-Gain.
Resultados: los resultados de la validación mostraron un promedio del 85,68 % con una categoría de alta validez. La practicidad obtuvo un 86,33 % (profesores) y un 84,05 % (estudiantes), lo que indica que el medio es muy práctico. El análisis de efectividad mostró un aumento significativo en los resultados de aprendizaje de los estudiantes ($p < 0,05$) con una puntuación N-Gain moderada (0,46).

Conclusiones: este estudio proporciona evidencia empírica de que la integración de fichas de trabajo digitales con elementos multimedia respalda los principios del aprendizaje constructivista y aumenta la interactividad y los resultados de aprendizaje. Los medios desarrollados pueden ser una referencia para la innovación en el aprendizaje inteligente en el futuro.

Palabras clave: Hoja de Trabajo Digital; Modelo ADDIE; Educación en Ingeniería de Software; Evaluación Formativa Gamificada; Eficacia del Aprendizaje.

INTRODUCTION

The acceleration of digital transformation in the post-pandemic era has changed the landscape of higher education towards a smart learning ecosystem that is student centered and supported by learning analytics and AI based collaborative technology. A number of recent reviews show that the integration of AI in collaborative learning in higher education can enrich interactions, personalize feedback, and improve learning effectiveness, but requires structured pedagogical design and strong ethical governance.[1,2,3]

At the same time, a meta-review of the 2020–2025 period confirms that the leap towards digital learning during and after COVID-19 has increased dependence on online learning resources and triggered variations in student satisfaction; the quality of instructional design has become a key determinant of learning experiences and outcomes.[4] Within the framework of Society 5.0 and Higher Education 5.0, universities are encouraged to build human-centric, adaptive, and sustainable learning experiences through the use of interactive technology and curricula that prepare students for future skills.[5] In line with this, the latest systematic review of virtual reality (VR)-based learning in higher education emphasizes the need for clear activity design and authentic assessment tools so that technology can contribute significantly to learning outcomes.[6] Even randomized controlled trials in the health context show that the effectiveness of online learning versus face-to-face learning depends on instructional design and feedback support, not solely on the medium chose.[7,8,9,10]

One consistently recommended design strategy is the development of digital worksheets/interactive worksheets including job sheets that orchestrate objectives, activities, and assessments into a single integrated learning experience. Empirical evidence from 2023–2025 shows that e-worksheets increase engagement, science process skills, and faculty student interaction; this approach is best integrated with systematic development models such as ADDIE.[11,12,13]The study on the development of STEM-PBL-based e-worksheets using the ADDIE model also reported high feasibility and a positive impact on students' problem solving skills, reinforcing the argument that digital worksheets are effective when aligned with explicit pedagogical strategies.[14,15] In vocational and technical secondary schools environments that strongly emphasize procedural skills the adoption of e-job sheets is becoming increasingly widespread, including QR code-based variants for step-by-step guidance. These findings highlight user readiness and implementation challenges, ranging from digital readiness to resource availability.[16]

In addition to orchestrating activities, gamified formative assessments such as Quizizz have been shown to increase motivation and learning outcomes when combined with digital worksheets, as they provide immediate feedback and data for teaching improvement. A recent study in 2025 showed a significant improvement in reading skills and learning outcomes when Quizizz was used as a formative assessment; a comparison between media also indicated certain advantages of Quizizz over other platforms in specific contexts.[17,18,19]

However, the literature highlights a design gap: many digital innovations are developed as separate learning resources (videos, quizzes, worksheets) without explicit instructional flow integration. A review of edtech adoption in higher education (2025) emphasizes that design integration goals, content, activities, assessment—is more decisive for success than simply adding new technology.[3,10,20,21,22] On the other hand, the study and implementation of the ADDIE model in various higher education course contexts demonstrate the effectiveness of this framework in ensuring the alignment of objectives, materials, activities, and evaluation, as well as testing the feasibility/practicality of educational products.[23,24] Based on these gaps, this study positions jobsheet based digital media as an integrated learning unit that: (1) combines step-by-step instructions, multimedia resources, and activity/assessment links in a single ecosystem; (2) utilizes gamification for formative assessment; and (3) is systematically developed and evaluated using ADDIE in the context of higher education in engineering/software. This approach is expected to contribute to (i) empirical evidence on the validity, practicality, and effectiveness of digital jobsheets in the Higher Education 5.0 environment, (ii) replicable design guidelines across practical courses, and (iii) the utilization of formative assessment data for learning quality assurance.[5,6,18,25]

Unlike prior studies focusing on individual digital tools, this research features a systematic integration of Flip PDF, YouTube, Google Sheets, and Quizizz within the ADDIE instructional design framework. This integrated approach provides a coherent instructional flow and addresses an identified gap in vocational education digital media design.

METHOD

Research Design

This study employs a Research and Development (R&D) design with an approach consisting of feasibility and pilot studies, which is a recognized method in the early phases of learning product development. This approach enables a systematic and replicable evaluation of the validity, practicality, and effectiveness of digital worksheet-based media (digital jobsheets). The development follows the ADDIE framework (Analysis, Design, Development, Implementation, Evaluation), widely used in modern learning media development studies due to its capability to ensure iterative alignment among objectives, content, activities, and assessments.[26,27]

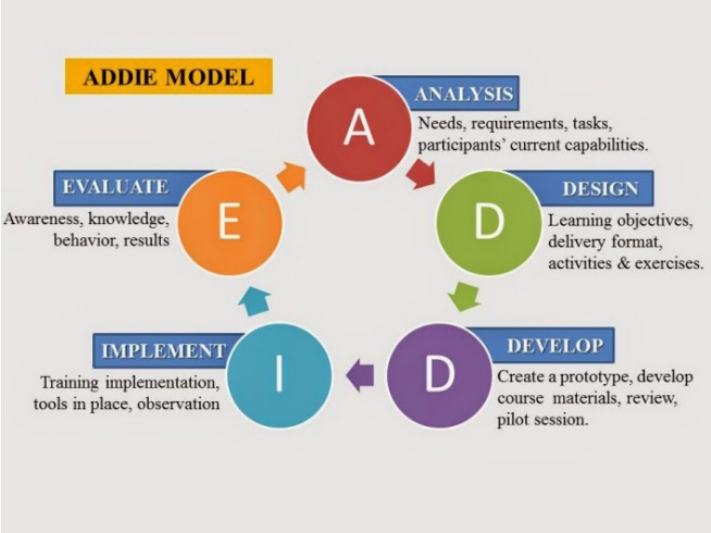


Figure 1. ADDIE Development Model

Digital Worksheet Development

The development process follows the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) with the following stages: 1) Analysis stage, which involves analyzing the learning needs of Software Engineering, including instructional needs and current teaching constraints. 2) Design, which entails designing the structure of the digital worksheet along with multimedia elements, including the integration of Flip PDF, YouTube, Google Sheets, and Quizizz. 3) Development, using tools such as Flip PDF for multimedia, Google Sheets for online assignment collection, and Quizizz for gamified formative assessment. 4) Implementation, and 5) Evaluation, which involves applying the media to students and evaluating it through expert validation, practicality assessments by lecturers and students, and effectiveness testing using a one-group pretest-posttest design.

This study employs a one-group pretest-posttest design, which is vulnerable to threats to internal validity such as maturation effects, history effects, and testing effects. This design was chosen due to practical constraints during the trial phase. Therefore, the results should be interpreted with caution. Future research using quasi-experimental designs or randomized controlled designs with control groups is needed to establish stronger causal relationships.

Participants and Recruitment

Table 1. Basic Participant Characteristics with Demographic Data and Experience Relevance

No	Variable	Description / Category	Count (n)	Percentage (%)
1	Number of Participants	Total student participants in the study	14	100
2	Age	Mean age (years)	20,5	-
3	Gender	Male	8	57,1
4		Female	6	42,9
5	Previous GPA	Mean Grade Point Average	3,2	-
6	Software Experience	Have used digital learning software	9	64,3
		Have not used	5	35,7

The research subjects consisted of three groups as follows: 1) expert validators (n=3), which included one Software Engineering course material expert, one digital learning media expert, and one Indonesian language expert. These three validators were purposively selected based on their specialized expertise and relevant experience in developing learning media. 2) Lecturers (n=5), who were respondents for the practicality testing of the media, purposively chosen from lecturers teaching the related course. 3) Students (n=14), who participated in the effectiveness test, enrolled in the fifth-semester Software Engineering course and recruited using convenience sampling. Detailed demographic characteristics of the students, including age, gender, previous GPA, and experience with digital learning software, are recorded in table 1.

The participants consisted of 14 students with an average age of 20,5 years. Most participants were male (57,1 %), while the remainder were female (42,9 %). The average prior cumulative GPA was 3,20. The majority of participants (64,3 %) had experience using digital learning software. These characteristics provide important context for understanding the background of participants in testing the digital worksheet-based learning media.

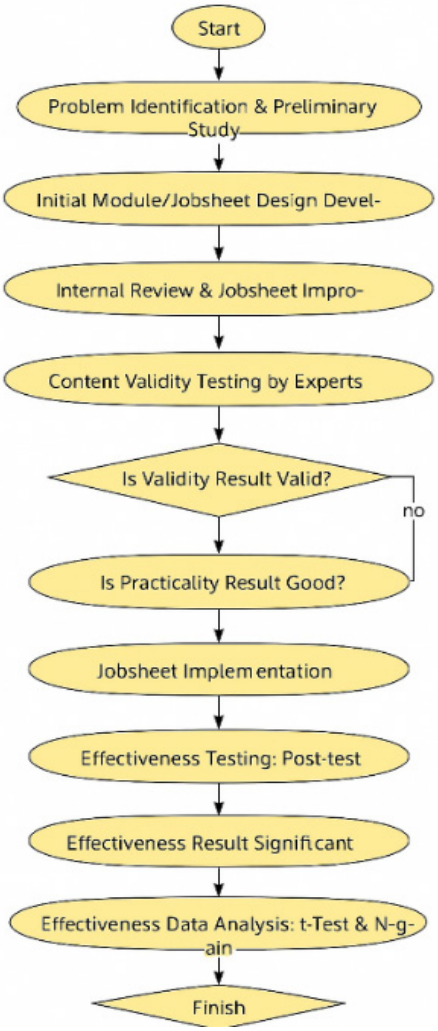


Figure 2. Digital Jobsheet Development Process Flowchart

This study aims to design and develop digital job sheet-based learning media to improve the quality of learning in Software Engineering courses at universities. The outputs of this study include digital job sheets and pre-test and post-test questions.

RESULTS

The results of this study confirm that the integration of digital media Flip PDF, Google Forms, QR Codes, and Quizizz accompanied by structured worksheets consistently improves student engagement, cognitive outcomes, and learning motivation.[28,29,30] Each medium demonstrates its own effectiveness in supporting 21st century pedagogical goals: digital literacy, interactivity, formative assessment, and independent learning. These findings are also reinforced by recent literature studies and real-world practices from various educational contexts.[15,31,32]

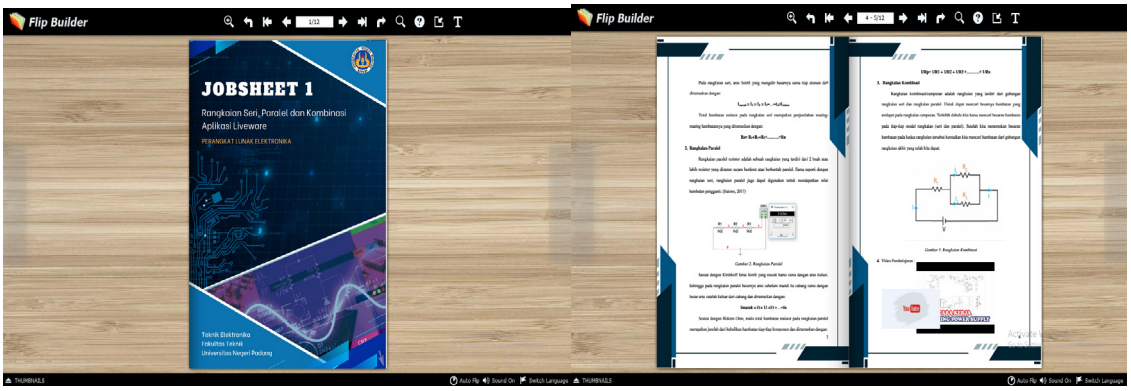


Figure 3. Digital Media Supported by Jobsheets with the Flip Pdf Application

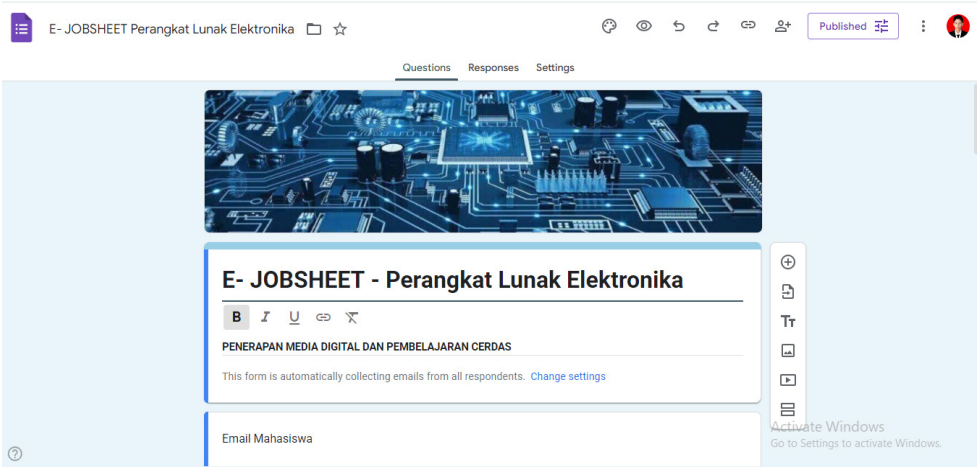


Figure 4. Digital Media Using Google Forms

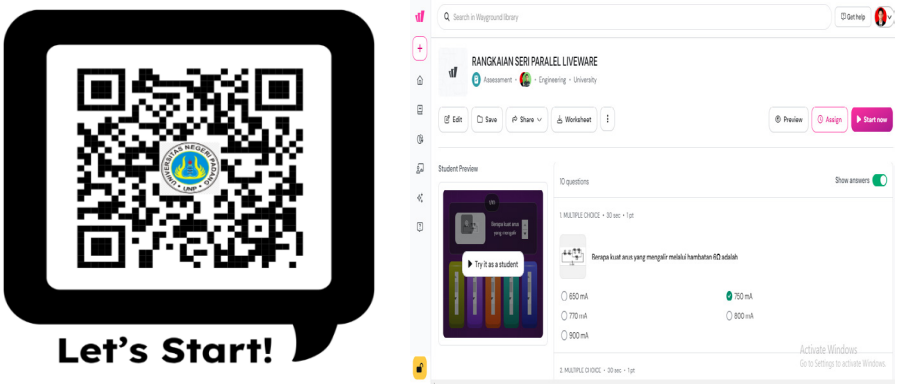


Figure 5. Digital Media Using QR Code Applications and Quizizz

Table 2. Summary of Relevant Literature

Digital Media	Research Focus	Key Findings
Flip PDF	Effectiveness of the flipped classroom model	Flip teaching improves academic performance through preparation and class discussion
Google Forms	Repeated formative assessment	Retaking quizzes increases motivation and mastery of the material.
QR Code	Quick access to independent learning resources	Supporting contextual and flexible learning
Quizizz	Gamified assessment for cognitive learning outcomes	Significant improvement in scores and motivation; consistent with experimental and quasi-experimental research

Product validity analysis shows that jobsheet-based digital media obtained an average score of 85,68 % (subject matter experts 87,41 %; media experts 88,09 %; language experts 81,54 %), thus categorized as highly valid according to the criteria used.

Table 3. Average score of product validity percentage by experts

Module Feasibility Apects	Evaluator Score	Maximum Score	Validator
Content Feasibility	118	135	87,41
Presentation feasibility			
Linguistic feasibility	53	65	81,54
Graphic Feasibility	207	235	88,09
Total	378	435	257,04
Average			85,68

The practicality test showed an average score of 86,33 % (lecturers) and 84,05 % (students), with an overall average of 85,09 %, which falls into the very practical category.

Table 4. Average score for the practicality of lecturers and students

Aspect	Percentage
Practicality by Lecturers	86,33
Practicality by Students	84,05
Average	85,19

In the effectiveness test with a One Group Pretest–Posttest design (n = 14), the pretest mean score was 65,36 (SD = 16,463) and the posttest mean score was 82,14 (SD = 12,203). The paired t-test yielded t(13) = −5,830, p = 0,006, which means that there was a significant increase in learning outcomes after the intervention. The average normalized gain (N Gain) calculation = 0,46 (≈46,5 %), which is classified as moderate according to [33]. Quantitative data were obtained from the processing of pretest and posttest scores and the validation/ practicality sheets of this study.

Table 5. Summary of descriptive statistics, paired t-tests, and N-Gain values of student learning outcomes

Paired Samples Test									
		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95 % Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pretest Media Digital - Posttest Media Digital	-16,786	18,974	5,071	-27,741	-5,830	-3,310	13	0,006

The results of statistical analysis in table 5 show a pretest average score of 65,36 (SD = 16,463) and a posttest average score of 82,14 (SD = 12,203). The paired t-test produced a t(13) value of -5,830 with p = 0,006 < 0,05, indicating a significant improvement after the application of jobsheet-based digital media. The average N-Gain value of 0,465 is in the moderate category according to a study criteria, indicating the effectiveness of the media in improving student learning outcomes.[33]

In addition to reporting statistical significance (p = 0,006) and normalized gain (N-Gain = 0,46), effect sizes (Cohen's d) were calculated to assess the practical significance of the intervention, resulting in paired effect size values of: Cohen's dz = 0,885 and Hedges' g = 0,833 (large-medium effect). A graph of the score distribution comparing the pretest and posttest results is presented in the figure below to provide a richer interpretation as recommended by recent methodological studies.

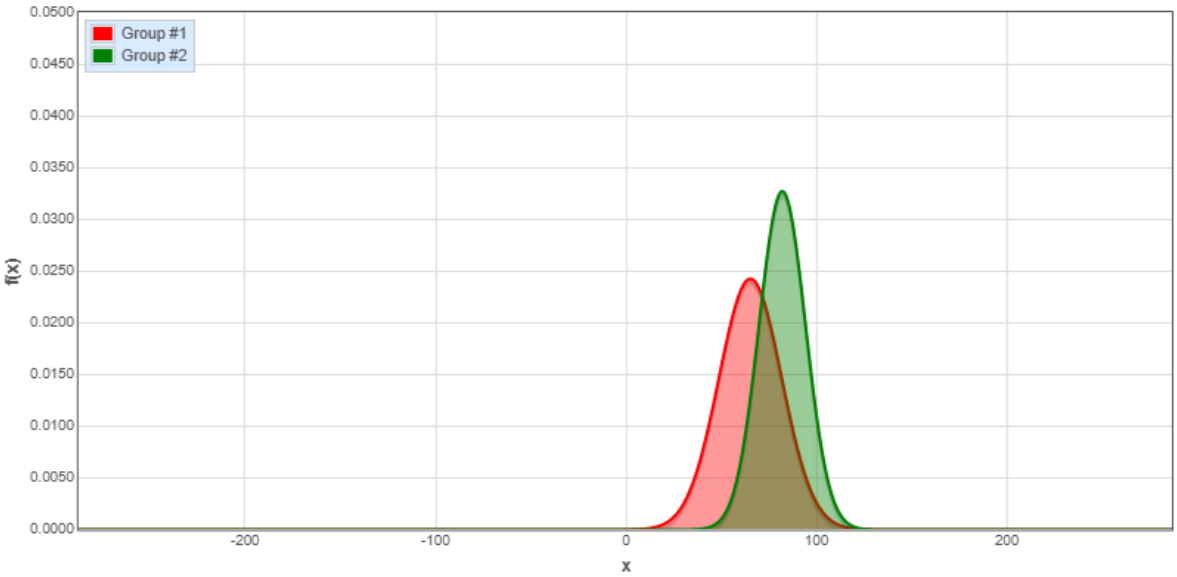
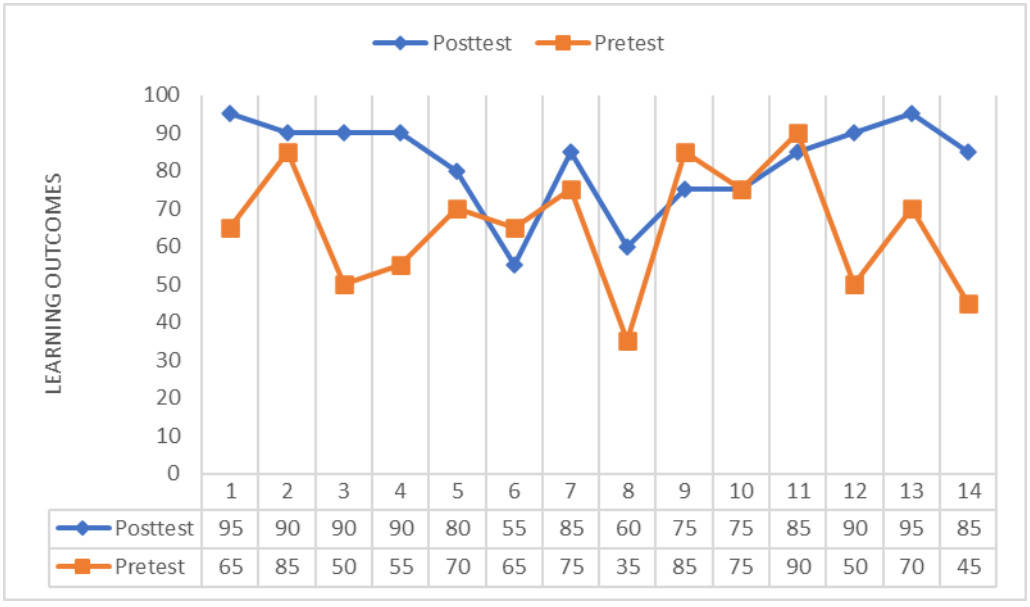


Figure 6. Grafik Efek size (Cohen's d)

Furthermore, score distribution graphs comparing pretest and posttest results are provided to offer additional context in interpreting the improvement, as recommended by recent methodological literature.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Posttest	95	90	90	90	80	55	85	60	75	75	85	90	95	85
Pretest	65	85	50	55	70	65	75	35	85	75	90	50	70	45

Figure 7. Comparison of the average pretest and posttest scores of students on jobsheet-based digital media

Visualization in figure 7 emphasizes the significant increase between the average pretest and posttest scores. The posttest bar is higher than the pretest bar, in line with the literature which shows that the use of e-jobsheets and interactive multimedia has a positive impact on student learning outcomes in the context of vocational and technological education.[32,34,35,36,37]

DISCUSSION

Product Validity and Practicality

The high validity scores obtained in this study indicate that the product meets the criteria for content, language, and media display suitability a finding consistent with studies on the development of e-jobsheets and interactive flipbooks that report high feasibility when the design follows systematic instructional and multimedia learning principles (e.g., navigation design, use of video, and clarity of instructions). Recent studies on the development of new flipbooks/e-modules report improvements in readability, accessibility, and user acceptance when UI/UX aspects are considered from the design stage.[35,38]

The practicality that is considered very practical by lecturers and students is in line with other research

findings which show that e-worksheets/e-jobsheets integrated with online collection tools (e.g., Google Sheets) and formative assessments (e.g., Quizizz) facilitate the implementation of practical learning and reduce the administrative burden on lecturers, making adoption into lecture practices more likely. The use of Google Workspace for assignment collection and progress tracking is also reported to increase the managerial efficiency of learning.[18,25,39]

Learning Effectiveness: Statistical Significance and Effect Size

The results of the paired t-test (p = 0,006) indicate a statistically significant increase in the average score after using the media. These findings support the hypothesis that instructional digital job sheets can improve students' conceptual mastery and practical skills, as reported in a number of similar R&D studies in STEM and vocational contexts that show significant pretest–posttest differences after e-job sheet/e-module intervention.[36,40]

However, statistical significance does not always reflect the magnitude of practical pedagogical change. Therefore, N Gain is calculated to assess the proportion of improvement relative to the maximum potential increase; the average N Gain value of 0,46 places the improvement in the moderate category according to Hake's criteria. The interpretation of N Gain as a practical indicator of effectiveness has been widely used, but recent literature also highlights the limitations of N Gain especially when the distribution of initial scores is highly variable or the sample size is small so that the assessment of effects needs to be supplemented with effect size measures and analysis of individual score distributions. New methodological studies recommend reporting N Gain alongside distribution graphs and effect sizes for richer interpretation. In this study, the sample was relatively small (n = 14), so the moderate N Gain results indicate promising potential effectiveness but need to be confirmed in a larger sample.[41]

Mechanism of Influence — Why Digital Jobsheets Work

Several mechanisms that may explain the improvement in learning outcomes in this study can be summarized as follows: (1) Multimedia integration (video tutorials) supports dual channel processing and reduces cognitive load when designed according to Mayer's principles; (2) the step by step structure of the jobsheet facilitates procedural transfer in RPL practice; (3) Repeated formative assessment (Quizizz) provides immediate feedback that encourages rapid improvement and learning reflection; (4) The use of Google Sheets facilitates task tracking and collaboration. Experimental literature and implementation studies in the last decade show that a combination of these features increases learning engagement and retention when applied in a practical context.[10]

The Role of Quizizz and Formative Assessment.

The practicality and effectiveness results of this study are consistent with research showing that Quizizz contributes to motivation, attention, and learning outcomes when combined with a clear instructional flow. Meta findings and recent empirical studies report that gamified formative assessment (such as Quizizz) reduces test anxiety, provides instant feedback, and increases participation factors that support the increase in posttest scores in this study. However, the effectiveness of Quizizz tends to be mediated by question design, feedback frequency, and pedagogical integration not simply platform use. Therefore, learning objective based quiz design remains critical.[17,18,42]

Methodological Limitations and Implications

There are several limitations that must be considered. First, the one group pretest–posttest design is vulnerable to threats to internal validity (maturation effects, history, testing effect). Although procedural controls (intervention duration, instruction uniformity) were attempted, further studies with control designs (e.g., control/randomized groups) would strengthen the cause-and-effect claims. Second, the small sample size (n = 14) limits generalizability; replication with larger samples and across classes/instructors is needed. Third, moderate N Gains should be read in conjunction with other metrics (effect size, distribution of individual scores) to capture heterogeneity in student responses an approach emphasized by modern learning evaluation studies.[41]

Contributions to Higher Education Practice and Recommendations

The results of this study provide empirical evidence that digital media based on jobsheets developed through the ADDIE model can be a practical solution for RPL practical learning, especially if: (a) the design follows multimedia learning principles; (b) gamified formative assessments are prepared to provide periodic feedback; (c) the online assignment collection mechanism is simplified (Google Sheets/Google Classroom). Larger ADDIE implementation studies recommend an iterative validation process (expert → validate → revise) to ensure contextual appropriateness—a principle that has been applied in this study. For further development, researchers are advised to add a simple analytics module (e.g., Quizizz/Sheets dashboard) to support real-time measurement of engagement and instructional adaptation.[24,34,43]

Overall, the combination of quantitative evidence (statistically significant, moderate N Gain) and qualitative/practical evidence (expert and user assessments) supports the conclusion that the developed jobsheet-based digital media is valid, practical, and has real potential effectiveness for RPL practical learning. However, to strengthen claims of long-term effectiveness and scalability, further studies with stronger experimental designs, larger sample sizes, and more comprehensive reporting of effect metrics are needed.

CONCLUSIONS

The results of this preliminary study indicate that the jobsheet-based digital media developed with the ADDIE model is potentially valid, practical, and effective for supporting software engineering learning in vocational higher education. However, these findings are limited by the absence of a control group and small sample size. Thus, broader claims must await further studies with rigorous experimental design and larger scope to ensure causality and generalization.

From a pedagogical perspective, these findings confirm that digital media innovation not only serves as a visual aid, but also as an active learning strategy that bridges the gap between theory and practice. The integration of digital worksheets with online collection platforms (Google Sheets) and interactive quizzes (Quizizz) accelerates the assessment process and makes it easier for teachers to monitor student learning progress. However, the limitations of this study should be noted, such as the one-group pretest–posttest design, which is prone to internal validity threats, and the relatively small sample size. Further studies are recommended using quasi experimental or randomized experimental designs with larger sample sizes to strengthen the evidence of effectiveness and generalization. In addition, further development can integrate learning analytics to monitor student engagement in real-time, as recommended by recent research. Overall, this study contributes to vocational education practices in the digital era by showing that the development of digital job sheet-based learning media that is systematically designed can be a sustainable innovation that is relevant to the demands of 21st century learning.

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FINANCING

The author would like to thank Padang State University for providing research funding through the Padang State University PNBP Fund for Fiscal Year 2025 in accordance with UNP Rector's Decree No. 2104/UN35.15/LT/2025 dated April 21, 2025.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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