

Research Article

# Developing Differentiated e-LKPD Products: A TPACK Approach for Grade X/Fase E

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## ABSTRACT

This study aims to develop e-LKPD (Electronic Student Worksheets) products integrated with the TPACK (Technological, Pedagogical, and Content Knowledge) approach for Grade X/E Phase as part of the implementation of the Kurikulum Merdeka. The research employs the 4D development model, which includes the phases of define, design, develop, and disseminate. The define phase identifies instructional needs, while the design phase produces an e-LKPD design focused on differentiated learning. During the develop phase, the product is validated by experts using assessment sheets for content, media, and language aspects. The disseminate phase involves sharing links to enhance the visibility of the research product. Expert validation results indicate excellent feasibility ratings: 91% for media, 96% for content, and 95% for language. These findings confirm that the developed e-LKPD is effective and ready for classroom implementation. The product not only enhances student learning outcomes but also fosters inclusive participation and critical thinking. This study makes a significant contribution to the advancement of educational technology and instructional design, providing a valuable resource for educators in implementing innovative teaching strategies.

**Keywords:** Differentiated; e-LKPD; TPACK Approach; 4D Model

## 1. INTRODUCTION

The Indonesian educational curriculum has undergone significant revisions to address the dynamic needs of students and societal expectations. These changes are aimed at adapting to the demands of 21st-century education while fostering holistic student development. The overarching objectives of these curriculum developments focus on integrating cultural values into student learning and cultivating creative, innovative, and constructive character traits among students (Agustina & Asshidiqi, 2021). These goals align with the broader vision of equipping students with the competencies needed to navigate complex global challenges.

The Kurikulum Merdeka framework, as a recent innovation, embodies three key characteristics: 1) Soft skills and character development, which emphasizes the nurturing of essential life skills and values that extend beyond academics; 2) Focus on essential materials, which involves prioritizing relevant, in-depth learning that allows sufficient time for students to engage in creativity and innovation through literacy and numeracy activities (Anggelia et al., 2022); and 3) Flexible learning, which grants teachers autonomy to tailor instruction to meet students' unique developmental needs and progress levels (Qurniawati, 2023). By embracing these principles, the Kurikulum Merdeka encourages educators to implement differentiated and student-centered teaching approaches effectively. One prominent strategy that aligns with the flexible and student-focused ethos of the Kurikulum Merdeka is differentiated instruction. Research highlights its positive impacts on both students and teachers. For students, differentiated instruction fosters engaging learning experiences, boosts enthusiasm, and enhances creativity (Sulistiyosari et al., 2022). For teachers, it supports the creation of inclusive, student-centered learning environments and allows them to address diverse student needs. These elements collectively create a supportive and effective learning ecosystem.

In this context, instructional materials play a pivotal role in actualizing the principles of differentiated instruction. One such material is the Student Worksheet (LKPD), which is designed to enhance student learning outcomes by aligning activities with students' needs and abilities (Notalia et al., 2023). The integration of technology has further revolutionized the development of such materials, especially in the era of the New Normal. The use of technology not only enhances pedagogical effectiveness but also improves accessibility and engagement in the learning process (Firmansyah & Kardina, 2020). Developing LKPD in alignment with advancements in information technology supports differentiated instruction by enabling customization to cater to varied learning styles.

Several studies underscore the importance of leveraging differentiated instructional methods in tandem with technological tools. For instance, Susilo et al. (2024) demonstrate that incorporating differentiated instruction based on learning styles promotes inclusive participation, fosters tailored comprehension, and enhances critical thinking skills. Similarly, Zuhanda et al. (2024) highlight the role of differentiation in nurturing student talents and potential, emphasizing its capacity to support diverse learner profiles.

The TPACK (Technological, Pedagogical, and Content Knowledge) framework is a vital foundation for integrating technology effectively into differentiated instruction. Research emphasizes its significance in enhancing teacher effectiveness, fostering instructional innovation, and promoting student engagement (Ajizah & Huda, 2020). TPACK equips educators to design responsive, student-centered learning environments that align with the demands of 21st-century education. By providing a structured framework, TPACK supports deeper conceptual understanding, cultivates independent learning skills, and streamlines the acquisition of knowledge, making educational content more intelligible and practical (Mardhiati, 2023; Putri & Harinaredi, 2023). However, challenges persist in implementing differentiated instruction, particularly in terms of preparing diverse learning materials and addressing resource limitations. A study conducted at SMA Negeri 5 Jember revealed that students predominantly utilize printed Student Worksheets (LKPD), which may not fully accommodate differentiated learning needs. In response to these challenges, this research aims to develop differentiated e-LKPD products using the TPACK approach. These e-LKPDs are expected to provide flexible, technology-enhanced instructional solutions that cater to varied learning styles, enhance engagement, and promote deeper learning outcomes.

## 2. RESEARCH METHOD

The study utilizes the 4D Research and Development model, integrating definition, design, development, and dissemination phases to facilitate systematic innovation. The initial Definition phase facilitates needs assessment, gathering insights into instructional requirements for the proposed educational product. The Design phase aims to develop differentiated e-LKPD products grounded in TPACK. The Development phase produces a validated product through expert review. The final Dissemination phase employs link sharing to broaden research visibility. According to Sugiyono (2010), data analysis involves systematic organization and interpretation of research data for clarity. This study employs expert validation using assessment sheets for content, media, and language. Validation results yield suitability assessments of Developing Differentiated e-LKPD Products: A TPACK Approach for Grade X/Fase E. Validation results were analyzed using the following methodological steps:

- a. Converting qualitative assessments to quantitative with the following conditions

**Table 1.** Likert Scale Criteria

Criteria	Value/Score
Highly Suitable	5
Suitable	4
Moderately Suitable	3
Unsuitable	2
Highly Suitable	1

- b. Suitability percentage calculation

$$\text{Percentage (\%)} = \frac{\text{Cumulative Score}}{\text{Maximum Score}} \times 100\%$$

**Explanation:**

Cumulative Score : Cumulative Score from Entire Sample

Maximum Score : Maximum Validation Score × Respondent Count

- c. Criteria for interpreting percentage suitability:

**Table 2.** Suitability Interpretation Criteria

Percentage (%)	Criteria
0 – 20	Highly Unsuitable
21 – 40	Unsuitable
41 – 60	Moderately Suitable
61 – 80	Suitable
81 – 100	Highly Suitable

Source: (Riduwan, 2012).

## 3. RESULTS AND DISCUSSION

### RESULTS

Developing Differentiated e-LKPD Products: A TPACK Approach for Grade X/Fase E Generated through a 4D research and development methodology, involving definition, Design, development, and Disseminate phases.

#### 3.1 Definition

The definition phase involves research activities aimed at defining and determining learning needs to gather various information about the requirements for learning related to the product being developed. This phase consists of several stages: preliminary analysis to identify existing school problems, notably inadequate instructional materials aligned with the implemented Kurikulum Merdeka.

**Table 3.** Student Learning Outcome

No.	Student Learning Outcomes	Learning Objectives
1.	Students demonstrate understanding of payment systems and monetary exchange concepts.	a. Explain the concept of payment systems in economics. b. Describe the role of Indonesia's Central Bank in payment systems. c. Explain non-cash payment system implementation by the Central Bank. d. Describe money as a medium of exchange. e. Understand payment systems and money's role as a medium of exchange. f. Analyze the relationship between payment systems and exchange mediums.
2.	Students acquire understanding of non-cash payment systems and practices in Indonesia	a. Describe non-cash payment instruments in Indonesia. b. Explain usage of various non-cash payment methods. c. Understand non-cash payment instruments and usage in Indonesia. d. Summarize non-cash payment options in Indonesia
3.	Students acquire knowledge of financial institutions, banking concepts, and product offerings, fostering financial literacy.	a. Understand banking and non-banking financial systems. b. Identify financial literacy-promoting products. c. Integrate financial industry knowledge. d. Evaluate regulatory relationships. e. Assess economic impacts. f. Design investment strategies.

**3.2 Design**

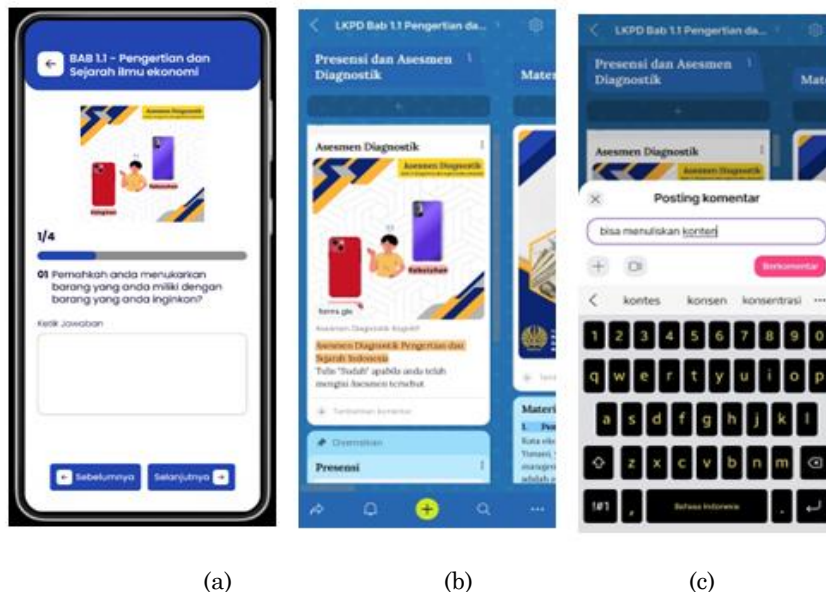
In the second stage, planning involves formulating the e-LKPD (Electronic Learning Implementation Plan Document) outline and content design aligned with the Merdeka Curriculum. The e-LKPD commences with diagnostic assessments to identify students' foundational competencies, bridging academic materials with personal experiences. This study's e-LKPD components encompass: Diagnostic assessments, Attendance records, Instructional materials, Bibliography, Activity sheets, Practice exercises and Learning reflection.

**3.3 Development**

During the development phase, e-LKPD is developed based on the planned design. This stage aims to produce the initial e-LKPD product. It commences with expert review of media, content, and language to gather feedback for visual and functional improvements, content depth aligned with learning objectives, and linguistic accuracy. The subsequent stage involves analyzing data gathered from expert reviews of media, content, and language. Feedback is incorporated to refine the e-LKPD according to reviewers' suggestions. Following data analysis, validation of media, content, and language ensues. This phase evaluates product suitability, influencing media development. Products scoring above desired criteria thresholds are deemed suitable for research purposes.

Expert evaluations revealed necessary improvements:

1. Media Expert: The developed media lacked content editing capabilities, which were subsequently added.
2. Language Expert: Foreign terms were not italicized; corrections ensured proper formatting.
3. Content Expert: Learning activity instructions were incomplete; additional guidance enhanced student understanding.



**Figure 1.** (a) Pre-revision e-LKPD activities; (b) and (c) Revised activities based on media expert feedback.

**1. Xenophone dan Adam Smith**  
 Salah satu karya pertama tentang ekonomi ditulis oleh Xenophon yang hidup sekitar 350 tahun SM. Karyanya adalah *oeconomicus* yang berarti manajemen rumah tangga. Isinya dialog Socrates dan Critobulus mengenai peraturan manajemen rumah tangga, termasuk pembagian pekerjaan dan pentingnya Pendidikan bagi semua anggota rumah tangga untuk meningkatkan produksi pertanian (S & W, 2022).  
 Ilmu ekonomi kemudian makin berkembang, posisi ekonomi sebagai ilmu pengetahuan kian penting, khususnya setelah penerbitan buku *The Wealth of Nations* oleh Adam Smith pada tahun 1776. Terbitannya buku ini ditandai dengan perubahan pada Masyarakat melalui revolusi industri.

(a)

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(b)

Figure 2. (a) Pre-revision e-LKPD activities; (b) Revised activities incorporating language expert feedback.



(a)

(b)

Figure 3. (a) Pre-revision e-LKPD activities; (b) Revised activities based on content expert feedback

### 3.4 Disseminate

During the dissemination phase, e-LKPD development was differentiated through media distribution products utilizing Instagram content (@efeducation.ig).



Figure 4. Instagram-Based Dissemination

### 3.5 Suitability of Product-Based Differentiated e-LKPD Development

Expert Validation Outcomes. This study's developmental research underwent rigorous validation by three experts, yielding outstanding suitability ratings. Mean validity scores were: Media expert (91%): very suitable; Content expert (96%): very suitable; Language expert (95%): very suitable. These findings confirm the product's readiness for student testing. The validation results from media, content, and language experts can be summarized as follows:

**Table 4.** Validation Results Summary

Category	Score
Media Expert	91%
Content Expert	96%
Language Expert	95%

Source: Compiled by the Researcher (2024)

Table 3 reveals that the differentiated e-LKPD development, integrating TPACK for Grade X/E Phase, achieves 'Highly Suitable' status, endorsing its instructional effectiveness.

#### DISCUSSION

The findings from this study indicate the successful development of differentiated e-LKPD products, designed using the TPACK (Technological, Pedagogical, and Content Knowledge) framework, specifically for Grade X/E Phase. These instructional materials align with the principles of the Kurikulum Merdeka, emphasizing flexibility, inclusivity, and responsiveness to diverse student needs. The e-LKPD products were validated through expert reviews, which yielded exceptional ratings: 91% for media suitability, 96% for content quality, and 95% for language appropriateness. These results confirm the readiness of the products for classroom implementation and their alignment with educational standards. The integration of the TPACK framework in the development of the e-LKPD ensures that the materials leverage technological advancements to enhance pedagogical practices. This approach allows for the creation of engaging, accessible, and adaptable learning experiences tailored to diverse learning styles. The ability to address such variations is particularly critical in modern education, where the diversity in student abilities, learning preferences, and developmental stages is increasingly apparent. The findings demonstrate that the developed e-LKPD effectively supports enhanced learning outcomes, promotes inclusive participation, and fosters critical thinking skills among students.

Furthermore, the differentiated e-LKPD represents a meaningful contribution to the fields of educational technology and instructional design. By integrating digital tools into the creation and delivery of instructional materials, the e-LKPD aligns with the demands of 21st-century education while providing educators with innovative teaching strategies. These materials not only facilitate a learner-centered approach but also empower students to take an active role in their education, fostering autonomy and deeper engagement. The broader implications of this research extend beyond its immediate application in the classroom. The use of differentiated e-LKPDs highlights their potential to address systemic educational challenges, such as equitable learning opportunities and the accommodation of diverse learner profiles. These materials bridge gaps in traditional teaching methods by providing a flexible, adaptive platform that meets individual student needs. This capacity to cater to diverse requirements is particularly significant in preparing students for real-world challenges that demand critical thinking, problem-solving, and collaboration.

Additionally, this study offers valuable insights for future research and practice in the domains of educational technology and curriculum development. It underscores the importance of designing instructional tools that are both pedagogically robust and technologically advanced, ensuring their relevance and effectiveness in dynamic learning environments. The research findings advocate for further exploration of the integration of differentiated instruction with technology, paving the way for innovative solutions that can transform teaching and learning practices. In summary, the development of differentiated e-LKPD products using the TPACK framework exemplifies the synergy between advanced instructional design and educational technology. These materials address the core goals of the Kurikulum Merdeka while setting a standard for future instructional resources. Their ability to enhance learning outcomes, foster inclusivity, and support critical thinking underscores their potential as a transformative tool in modern education. The findings of this study contribute significantly to the ongoing discourse on innovative, student-centered teaching methodologies and their role in shaping the future of education.

#### 4. CONCLUSION

This developmental research successfully produced differentiated e-LKPD products that integrate the TPACK (Technological, Pedagogical, and Content Knowledge) framework for Grade X/E Phase, aligning with the principles of the Kurikulum Merdeka. These products are tailored to accommodate diverse student needs, supporting the flexibility and inclusivity emphasized by the current curriculum. The validation process conducted by experts confirmed the high quality and applicability of the developed e-LKPD. Media experts provided an outstanding suitability rating of 91%, content experts rated it at 96%, and language experts gave a 95% rating, collectively indicating the product's readiness for classroom implementation. The findings highlight the effectiveness of the e-LKPD in fostering enhanced learning outcomes, inclusive participation, and critical thinking skills among students. By leveraging the TPACK framework, the e-LKPD products integrate technology seamlessly into pedagogical practices, ensuring that learning materials are engaging, accessible, and adaptable to various learning styles. This alignment with differentiated instruction principles allows educators to create a

supportive learning environment that caters to individual student needs, thereby addressing one of the primary challenges in modern education—diversity in student abilities and preferences. Moreover, the developed e-LKPD demonstrates a significant contribution to the advancement of educational technology and instructional design. The incorporation of digital tools into the design and delivery of these materials not only aligns with the demands of 21st-century education but also empowers educators to adopt innovative teaching strategies. These strategies foster a learner-centered approach, enabling students to take an active role in their educational journey. The research serves as a valuable resource for educators seeking effective and innovative solutions to enhance student engagement and academic performance. Beyond its immediate classroom application, this study underscores the potential of integrating differentiated instruction with technology to address broader educational challenges. The use of differentiated e-LKPDs has shown promise in bridging the gap between diverse learner profiles, ensuring equitable learning opportunities, and preparing students for complex real-world scenarios. The findings also provide insights for future researchers and practitioners in the fields of educational technology and curriculum development, emphasizing the importance of designing tools that are both pedagogically sound and technologically advanced. In conclusion, this research exemplifies the synergy between innovative instructional design and technological integration, demonstrating how differentiated e-LKPDs can transform teaching and learning processes. The products developed not only meet the standards of the Kurikulum Merdeka but also set a benchmark for future educational materials. This study paves the way for further exploration into the use of technology to support differentiated instruction, highlighting its potential to foster meaningful and impactful learning experiences for students across diverse educational contexts.

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