
The Effectiveness of Differentiated E-LKPD Using Liveworksheets on Junior High School Students' Statistical Literacy in Data Presentation

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Abstract

Indonesian students' low statistical literacy, as revealed by PISA 2022 with only 18% achieving Mathematics competency at level 2, presents an urgent educational challenge. The dominant use of printed teaching materials limits students' digital learning experiences with varying levels of initial understanding. This study developed differentiated E-LKPD (Electronic Student Worksheets) using Liveworksheets on Data Presentation topics through Research and Development with ADDIE model. Participants were 7th grade students of SMP Gunungjati 1 Purwokerto in the 2024/2025 academic year. Data collection instruments included interview instruments, needs analysis questionnaires, validation questionnaires, student response questionnaires, and statistical literacy tests. The product achieved very high validity based on Aiken's index for content (0.91), media (0.94), and language (0.90). Practicality received 86% with very practical criteria. The product's effectiveness showed statistical literacy improvement with N-Gain of 0.60 (moderate). The differentiated E-LKPD using Liveworksheets proved valid, practical, and effective in enhancing statistical literacy skills of junior high school students. This digital, interactive approach successfully accommodates diverse student readiness levels, providing an innovative solution for personalized mathematics learning that bridges the gap between traditional instruction and students' digital learning needs.

Keywords: E-LKPD, differentiated based instruction, Liveworksheets, statistical literacy, junior high school students

1. Introduction

Kurikulum Merdeka is a government policy aimed at realizing the intelligence of the nation's generation as well as an effort to recover learning after pandemic (Rahmadayanti & Hartoyo, 2020). This policy designs learning that focuses on essential materials, including literacy (Wahyudin et al., 2024). Mastering literacy is a fundamental key to understand the world, which is full of various forms of information, such as text, number, visual, audio, video, or other combinations (Heryana et al., 2019; Widya & Sukoriyanto, 2023). Kurikulum Merdeka equips students with a competence to collect, present, and interpret various forms of data through Statistics learning (Sari et al., 2022). Understanding statistical concepts is necessary to assess the validity of information in daily decision-making (Prasetyo, 2018). This competence is known as statistical literacy in mathematics learning.

Statistical literacy is individuals' ability to understand their role critically in comprehending complex problems involving data, verifying the accuracy of information, and making decisions (Dewi et al., 2021). It is not only about numerical knowledge within educational aspect but also encompasses other aspects of life such as social, economic, political, and technical domains. In the digital era, this ability has become crucial for modern society to navigate data-based decision-making and identify opportunities across various life domains (Hidayati et al., 2020). Responding those demands, Kurikulum Merdeka integrates Data and Probability Analysis elements into mathematics learning. Students are trained to master understanding, communicating, analyzing, and drawing conclusions skill about data (Fadillah & Munandar, 2021). Statistical literacy needs to be systematically developed from elementary education preparing the next generations, which are capable to think critically and adaptively in the digital era.

Despite its importance, a low level of statistical literacy persists among junior high school students in Indonesia. Statistical literacy, which is related to statistical symbols, data presentation, and measures of central tendency, is one of the components measured in PISA by the OECD at the international level and ANBK (Computer-Based National Assessment) by the Ministry of Education, Culture, Research, and Technology at the national level (Irwandi et al., 2021). The results of PISA 2022 show that Indonesian students only reached level 2 in mathematics competence, with a percentage of around 18%, far below the OECD average. At this level, students only interpret and recognize simple situations without direct instructions. Several studies have documented persistent challenges in statistical literacy among Indonesian junior high school students. The mathematical literacy of junior high school students in statistics questions with PISA characteristics is still dominated by low levels, with 50% of students falling below level 1 (Oktaviranda & Asmara, 2021). Low statistical literacy is also identified in research by Dwindi et al. (2023) on 8th grade junior high school students, with an initial average score of around 56.9. The study by Yoviana & Murwaningtyas (2023) revealed that mastery of mathematical literacy in the Statistics topic among 8th grade students participating in ANBK 2023 was considered low, with an average score of 33.3. Students are often less careful in reading data and understanding

concepts. Similar findings were reported by Fransiska et al. (2024), where 8th grade students at SMP Negeri 7 Bengkulu obtained an initial ability score of 31.92 in AKM model tests based on mathematical literacy processes.

The problem is particularly evident at SMP Gunungjati 1 Purwokerto. Based on the Education Report 2024, data understanding, as measured by the indicator of data and uncertainty, shows a score of only 63.06%. Only 48.89% of students reached the minimum competency level in numeracy skills. In addition, the learning quality indicator's score has decreased to 58.71 compared to the previous year. This condition reveals critical issues within the learning process, directly impacting students' statistical literacy achievements. Moreover, preliminary analysis of student characteristics at this school reveals significant heterogeneity in learning readiness. Students enter seventh-grade mathematics classrooms with varied prior knowledge and skills in statistics, ranging from those who struggle with basic data identification to those capable of more complex analytical tasks (Tomlinson, 2001). Current teaching practices at the school predominantly employ uniform printed materials that do not systematically address these varying readiness levels. The minimal integration of digital learning tools further limits teachers' ability to provide individualized learning pathways, leaving students with explanations that often lack relevance and visualization. The condition reveals issues within the learning process that directly impact students' statistical literacy achievements.

The diversity necessitates differentiated instructional approaches. Differentiated instruction offers a solution by adjusting content, process, and product based on students' readiness, interests, and learning styles (Tomlinson, 2001). This approach aligns perfectly with 'Merdeka Belajar' paradigm, as it provides students with the freedom to learn based on their characteristics while focusing on competency development (Maulidia et al., 2023). Differentiated instruction allows teachers to effectively facilitate the diversity of students' characteristics and needs (Lukitoaji & Komalasari, 2023). Consequently, this approach creates learning, which is more responsive and meaningful for students, regardless of their varying cognitive abilities. Furthermore, the integration of technology into differentiated instruction, particularly through digital learning materials like E-LKPD, shows potential for creating more responsive and meaningful learning experiences (Joshi et al., 2022).

Despite growing recognition of the importance of statistical literacy and the potential of differentiated instruction, significant gaps remain in research and practice. Previous studies have explored differentiated instruction (Marlina, 2020) and digital learning materials separately (Bombang et al., 2022; Noviyanti et al., 2024; Triyani et al., 2024). Most existing differentiated E-LKPD studies focus on one or two differentiation aspects. Triyani et al. (2024) developed E-LKPD using Liveworksheets that differentiated primarily based on learning styles. Studies by Dwindi et al. (2023), Yoviana & Murwaningtyas (2023), and Fransiska et al. (2024) have identified low statistical literacy among junior high school students but have not investigated targeted interventions that accommodate diverse student readiness through technology-enhanced differentiated instruction. Additionally, Liveworksheets has been utilized in mathematics education

(Bombang et al., 2022; Noviyanti et al., 2024; Triyani et al., 2024), its potential to support comprehensive differentiated instruction specifically for enhancing statistical literacy competencies, such as understanding, communicating, analyzing, and drawing conclusions about data, remains underexplored. Previous studies using Liveworksheets have primarily focused on general mathematical problem-solving abilities or employed limited differentiation strategies, rather than targeting the specific competencies of statistical literacy through systematically differentiated content, process, and product. Furthermore, the specific intersection of low statistical literacy achievement, diverse learning readiness, and minimal digital learning exposure, as evidenced in contexts like SMP Gunungjati 1 Purwokerto, presents a complex challenge that requires integrated solutions.

Liveworksheets is one suitable platform for developing attractive and interactive e-LKPD, equipped with interactive features (Bombang et al., 2022). Bombang et al. (2022) developed ethnomathematics-based E-LKPD using guided discovery with Liveworksheets. The study demonstrated the material's validity, practicality, and effectiveness in enhancing junior high school students' problem-solving abilities in geometry topic. Consistent with the findings of Triyani et al. (2024), e-LKPD created with Liveworksheets proves effective and practical for supporting differentiated instruction based on junior high school students' learning styles in Statistics. Another study by Noviyanti et al. (2024) shows that scientific-based E-LKPD developed using Liveworksheets validly, effectively, and practically facilitates the improvement of students' mathematical abilities in Statistics.

This study aims to develop and evaluate a differentiated E-LKPD using Liveworksheets that integrates content, process, and product differentiation based on students' learning readiness, specifically to enhance statistical literacy in data presentation. It generates evidence on the validity, practicality, and effectiveness of differentiated E-LKPD in addressing diverse learning readiness levels and enhancing statistical literacy outcomes among junior high school students. Specifically, the research addresses three questions: (1) What is the level of validity of the differentiated based learning E-LKPD using Liveworksheets for enhancing students' statistical literacy? (2) What is the level of practicality of the differentiated based learning E-LKPD using Liveworksheets from students' perspectives? (3) What is the level of effectiveness of the differentiated based learning E-LKPD using Liveworksheets in enhancing students' statistical literacy?

2. Methods

This study employed the Research and Development method using ADDIE model, selected for its systematic approach where each stage builds upon previous findings to ensure product quality. The research involved 7th grade students at SMP Gunungjati 1 Purwokerto during the 2024/2025 academic year. The Analysis stage examined Kurikulum Merdeka (Phase D), assessed student readiness through pre-tests categorized (resulting in high, medium, and low groups), and analyzed learning environment through questionnaires and interviews. The Design stage created differentiated e-LKPD prototypes addressing content (varying complexity), process (differentiated

scaffolding), and product (diverse outputs) based on readiness levels. The Development stage involved creating e-LKPD via Canva and Liveworksheets, followed by validity testing with three expert validators (content, media, language), and practicality testing with 10 students. The Implementation stage applied the validated product to 29 class VII C students across four sessions, with pre-tests and questionnaires measuring initial abilities, differentiated group activities based on readiness, and post-tests measuring outcomes. The Evaluation stage conducted formative evaluation throughout development based on expert and user feedback, and summative evaluation analyzing effectiveness through N-Gain confirming significant improvements. This interconnected ADDIE process ensured that analysis informed design decisions, design specifications guided development, development outputs were tested during implementation, and evaluation validated the entire cycle while providing continuous refinement through formative feedback loops, thereby establishing product's validity, practicality, and effectiveness.

3. Result and Discussion

3.1. Analysis Stage

The analysis stage aims to identify the curriculum, students' characteristics, and learning environment. Curriculum analysis involves reviewing the Mathematics Learning Outcomes (MLO) for Phase D, especially Data Analysis and Probability element. This element focuses on developing statistical literacy (data), which allows students not only reading numbers but also understanding the meanings (Sugiyarti et al., 2022). Identifying competencies and contents contained in MLO elements, simplifies mapping the material to be taught and defining the competencies to be achieved (Ndiung et al., 2023). Data presentation was identified as one of the contents within this element. Learning Objectives (LO) and Learning Sequences (LS) were then formulated operationally and measurably, focusing on three competencies: explaining, using, and creating data presentations (Wardani & Setiawan, 2021). These competencies are interconnected and form a logical and structured learning sequence from conceptual understanding to practical application. The formulation of LO and LS in Data Presentation is shown in Table 1.

Table 1.

<i>Learning Sequences in Data Presentation</i>			
Topic	Learning Objectives	Grade/ Term	LH
Data Presentation	Students can explain the definition of data	VII/2	2
	Students can identify data based on its type Students can determine examples of data		
	Students can explain the information in data presentation Students can use the information from a data presentation to solve problems	VII/2	4
	Students can create data presentations in the form of table and diagrams	VII/2	2

Based on Table 1, LO of Data Presentation material can be formulated by focusing on three competencies, such as explaining, using, and creating (Wardani & Setiawan, 2021). These competencies are interconnected and create a logical and structured LS from conceptual understanding to practical application. Specific operational verbs should be considered when formulating LO. Curriculum Alignment is essential to ensure that every activity contributes to achieve the LO (Wijngaards-de Meij & Merx, 2018).

Student characteristics analysis involved pre-test given to 29 students of VII C. This test revealed various learning readiness categories, yielding an average score of 46.90 and a standard deviation of 7.72. Student learning readiness was categorized using the Mean and Standard Deviation method, according to Azwar (2012).

Table 2.

Distribution of Learning Readiness

Cate gory	Interval	Number	Percentage	Pre-test Mean
High	$x \geq 50,76$	4	13,80%	62,50
Medi um	$43,03 \leq x < 50,76$	15	51,72%	47,67
Low	$x < 43,03$	10	34,48%	40,00

Based on Table 2, the results showed 4 students in high category, 15 students in medium category, and 10 students in low category. The majority of students have medium learning readiness around 51,72%. Low-category students showed minimum statistical literacy in understanding symbols and visual representations, thereby experiencing difficulty in data identification. According to Suparman et al. (2021), these students generally struggle in with interpreting visual data. Medium-category students are able to identify, read, and utilize explicit information. Budiman & Jailani (2021) revealed that these students generally have conceptual foundation but still require conceptual reinforcement for complex contexts. Only small percentage about 13,80% have a strong foundation in statistical literacy. Setiawan & Rizki (2021) stated that high-category students show strong proficiency in reading and interpreting information critically.

Learning environment analysis was conducted through need analysis questionnaire and interview with five students of VII C. The results indicate that school has digital facilities, however teachers mainly rely on printed resources and have not capitalized on digital resources like E-LKPD. Herawati & Muhtadi (2021) stated that predominance of print-based materials may cause students to resist adopting learning technology, as they have established a comfort zone with that particular learning method. Due to limited digital learning experience, students are unaware that digital teaching materials offer flexible access, are potentially more attractive, and relevance to students' learning styles (Pratama & Surahman, 2020). Meanwhile, students showed great interest in learning materials that could be accessed using gadget, like E-LKPD. This indicates a positive response,

showing that students are attempting to be open to digital instructional material innovations. Nursyahidah et al. (2022) asserted that digital material development based on students' needs and curriculum analysis can improve learning outcomes more effectively.

3.2. Design Stage

The design stage translated analysis result into E-LKPD prototype by considering the material, media, and linguistic aspect. E-LKPD was designed with content, process, and product differentiation based on learning readiness, in order to accommodate students' diverse levels of comprehension and mastery ability. According to Marlina (2020), differentiated instruction that simultaneously incorporates all aspects of content, process, and product, is more effective in accommodating students' heterogeneity. The same essential material is delivered to all students, in order to construct strong basic concepts and understandings. Anggraini & Yulianti (2021) emphasized that providing the same essential material can guarantee a solid conceptual base for all students before students proceed to differentiated learning activities based on individual needs. The design of differentiated E-LKPD based on students' learning readiness is shown in Table 3.

Table 3.

Design of differentiated E-LKPD

Aspect	Learning Readiness		
	Low	Medium	High
Content	Single table/diagram (one type), simple and clear information, requires basic reasoning	Combination of 2 simple diagram types, semi-complex information, requires intermediate reasoning	Complex diagram (many variables), complex information, requires advanced reasoning
Process	Full guidance, immediately and detailed feedback, teacher as Mentor	Guidance with self-practice opportunity, periodic feedback, teacher as Motivator	Self-guidance, reflective feedback, teacher as Observer
Product	Present a single type of data presentation for a simple data variable	Present 2 types of data presentation for semi-complex data variables	Present 2 types of the most effective for complex data variables

Based on Tabel 3, low-category students receive simple content with step-by-step guided instructions, medium-category students receive more comprehensive content with instructions that encourage greater independence, while high-category students receive complex content that foster independent or collaborative discussion. A consistent, subtle color palette combined with high contrast between the text and background is intended to minimize visual fatigue. Furthermore, the language aspect was designed to be straightforward, communicative, and interactive. By utilizing straightforward and effective sentences, students can more easily comprehend the information.

Tomlinson & Imbeau (2020) affirmed that differentiated instruction systematically designed based on students' readiness, can create inclusive learning, where every student receives appropriate challenges to their ability in order to achieve optimal academic growth.

3.3. Development Stage

The development stage was conducted in two development processes. In the first process, the product framework was designed using Canva and the content layout was organized to be structured and attractive, consisting of three main components, such as introduction, core, and closing. Nurfadhillah et al. (2021) affirmed that considering the principles of color psychology and students characteristics, can enhance students' interest to the subject matter. In the second process, the framework was integrated with Liveworksheets features, enabling students to fill E-LKPD interactively. These features not only enhance students' engagement and motivation but also facilitate teachers to accommodate students' diversity. After the product was completely developed, validation and practicality tests were conducted. Both tests served as the basis for improvements and finalization before its widespread educational use.

3.3.1 Validity

The validity tests involved three validators, such as two expert lecturers and a mathematics teacher holding a Master's degree (S2 qualification). The data were analyzed using descriptive statistics based on the scores and improvement suggestions from the questionnaire. The result was indicated that the product was valid across the aspects of content, media, and language based on the Aiken's index, according to Retnawati (2016).

Table 4.

Validity Result

Aspect	Components	Aiken's Index	Average	criteria
Content	Material content	0,93	0,91	Very high
	Differentiated learning	0,90		
	Content delivery	0,86		
Media	Design display	0,93	0,94	Very high
	Content display	0,97		
	Feature interaction	0,94		
Language	Straightforward	0,90	0,90	Very high
	Communicative	0,92		
	interactive	0,89		

Based on Tabel 4, the product achieved a very high validity criteria, including content validity score achieved 0,91, media validity score achieved 0,94, and language validity score achieved 0,90.

Effective learning can be facilitated by developing valid E-LKPD which integrate technology and quality pedagogical content (Purnama & Suparman, 2020). The component of material content in validity obtained the highest Aiken's index score. The high content validity confirmed that E-LKPD successfully met the quality standards of learning content, including conceptual accuracy, curriculum alignment, and material depth (Asrial et al., 2020). The average Aiken's index score for media validity was 0,94. This high media validity indicated that E-LKPD was good visual design, navigation, interactivity, and ease of use (Kurniawan et al., 2021). The content display achieved the highest Aiken's index score. Media quality significantly influences the effectiveness of material delivery because good visual representation can facilitate conceptual understanding and data interpretation (Andyani et al., 2020; Ben-Zvi & Garfield, 2020). The average Aiken's V index score for language validity was 0,90. The high language validity confirmed that E-LKPD successfully fulfills readability, instruction clarity, appropriateness for student characteristics, and the application of sound and correct linguistic principles (Wijayanti et al., 2021). The communicative component achieved 0,92 as the highest Aiken's index score in language validity. Highly communicative language is crucial for fostering statistical literacy, as it enables students to grasp necessary terminology, mathematical symbols, and the context of the problem. (Gould, 2023; Schmid et al., 2021).

3.3.2 Practicality

The practicality test involved a small group of 10 students. During the trial, students used their personal devices to access E-LKPD and engage directly to the content and Liveworksheets's interactive features. The data were analyzed using descriptive statistics based on the percentage and students' suggestions from the response questionnaire. The result was indicated that the product was practical based on the percentage calculation, according to Akbar (2011).

Table 5.

Practicality Result

Aspect	Percentage	Criteria
Content	82,67%	Very practical
Appearance	87,33%	Very practical
Language	86%	Very practical
Usage	88%	Very practical
Average	86%	Very practical

Based on Tabel 5, the product achieved very practical criteria. The E-LKPD's practicality reflected its quality concerning implementation ease and user acceptance of the learning innovation (Supriadi, 2024). The content aspect scored 82,67%, showing the content was relevant and comprehensible. The appearance aspect scored 87,33%, meaning the visual design was highly attractive and non-confusing. The language aspect scored 86%, indicating straightforward, communicative, and interactive. Furthermore, the usage aspect scored 88%, confirming that the

features in E-LKPD were user-friendly. Despite the product being validated, several comments and suggestions were gathered from student responses that must be considered before conducting a limited field trial. The evaluation of practicality from the user's perspective is crucial to ensure the product's effective implementation in learning (Haviz, 2022).

3.4. Implementation Stage

The implementation stage commenced with a statistical literacy pre-test on the Data Presentation topic to identify students' initial abilities, and ended with a post-test. Subsequently, the product was implemented into four instructional sessions. This involved 29 students from VII C of SMP Gunungjati 1 Purwokerto using Liveworksheets, which allowed students to learn interactively. Every session is dedicated to achieved some specific learning objectives. The implementation successfully fostered positive student perception of mathematics. through process differentiation. Through content differentiation, students demonstrated resilience and concentration when solving data reading problems appropriate for their individual readiness. Santangelo and Tomlinson (2021) found that students enhance persistence in facing challenges when practice problems match their zone of proximal development. Through product differentiation, students showed enthusiasm in creating data presentations, helping them understand that mathematics is fundamentally a creative process. Bray and McClaskey (2022) stated that digital-based differentiated instruction increases student engagement, enabling students to experience success in learning.

3.5. Evaluation Stage

The evaluation stage involved both formative and summative methods to determine effectiveness of the product. Formative evaluation was conducted throughout the development process, utilizing feedback from both validators and students to ensure continuous refinement and quality improvement. Summative evaluation measured the product's effectiveness through N-Gain analysis and statistical tests, disaggregated by student readiness levels to evaluate the impact of differentiation.

3.5.1. Formative Evaluation

Based on validator suggestions and student feedback, several improvements were implemented across content, media, and language aspects. Content aspect improvements included designing open-ended exercises to encourage deeper analysis and interpretation of statistical findings (Arnold et al., 2020; Gould, 2020), adjusting differentiated activity instructions to better match each readiness level, and presenting various specific question templates. Differentiated exercises allow every student to develop according to their ability, consequently enhancing self-confidence and motivation (Tomlinson & Moon, 2023; Smale-Jacobse et al., 2021).

Media aspect improvements included selecting appropriate fonts for readability, separating the product into three distinct E-LKPD for each learning readiness level (A, B, and C versions), adding

page numbers for easier navigation, simplifying drag-and-drop features for easier operation, and adding video source citations. Separating E-LKPD according to learning readiness level is consistent with the individualized scaffolding approach to optimize the development of students' statistical literacy (Marks et al., 2021; Watson & Callingham, 2020). Language aspect improvements included aligning operational verbs with learning goals, simplifying communicative language to suit students' perspective by replacing technical terms with more accessible language (e.g., replacing compass directions with left/right), and varying question forms to stimulate critical thought. Delivering content with interactive and communicative linguistic style is effective in stimulating student interaction and encouraging deeper understanding (Vygotsky & Cole, 2020; Mercer & Dawes, 2022).

3.5.1. Summative Evaluation

Summative evaluation was conducted to measure the product's effectiveness through N-Gain analysis. The result of the N-Gain calculation for statistical literacy test data is shown in Table 6, according to Hake (1999).

Table 6.

<i>N-Gain Score</i>				
Component	Pre-test	Post-test	N-Gain Score	Criteria
Number of students	29	29		
Maximum score	40	55	0,60	Medium
Minimum score	70	90		
Average	46,90	78,45		

Based on Table 6, the average of statistical literacy score improved significantly, which pre-tests scored 46,90 increasing post-tests scored 78,45. The N-gain score achieved 0,60 placing in the medium criteria. The score showed that students' statistical literacy improved after the product was implemented. This outcome supported by Suryani et al (2021), who confirmed that development of E-LKPD featuring visual representations and interactive activities with Liveworksheets, was proven effective in facilitating students' deeper understanding. Furthermore, E-LKPD that accommodates diversity of learning readiness is effectively facilitating students to construct and manipulate visual representations of data (Kazak et al., 2021).

3.5.3. Effectiveness by Learning Readiness Level

Comprehensively understanding E-LKPD effectiveness, N-Gain analysis was conducted based on student learning readiness categories. This analysis is essential to evaluate whether the differentiation applied effectively accommodates student diversity. Table 7 presents the N-Gain scores disaggregated by learning readiness category for statistical literacy.

Table 7.*N-Gain Score for Statistical Literacy by Learning Readiness Category*

Learning Readiness	Pre-test	Post-test	N-Gain	Criteria
High	62,50	87,50	0,69	
Medium	47,67	78,00	0,61	Medium
Low	40,00	73,50	0,55	

Based on Table 7, the improvement in statistical literacy occurred across all categories with medium criteria: high category (N-Gain 0.69), medium (0.61), and low (0.55). Although the high category showed the highest improvement, the N-Gain differences between categories were relatively small (0.14 range), indicating that E-LKPD successfully provided equitable learning impact. This aligns with differentiated learning principles emphasizing optimal growth for all ability levels (Tomlinson & Moon, 2023). The consistent improvement across categories validates the effectiveness of the differentiation approach applied. E-LKPD not only accommodates ability differences but also ensures no category is left behind (Marks et al., 2021).

The relatively lower improvement in the low category for statistical literacy (N-Gain 0.55) compared to high category (0.69) suggests that students with minimal initial understanding require additional scaffolding beyond the differentiated content provided. This finding has important implications for instructional design. While differentiation successfully prevented the achievement gap from widening, closing it entirely may require supplementary interventions such as peer tutoring, additional teacher-led sessions, or adaptive digital supports that provide real-time feedback (Budgett et al., 2021; Kazak et al., 2021). This study suggests that E-LKPD is most effective for constructive tasks where students actively create representations, but less effective for complex data extraction tasks that require sophisticated interpretive skills (Sharma, 2017).

Differentiated E-LKPD using Liveworksheets is a well-researched and proven method for inclusive mathematics education. The research demonstrates that digital differentiation is not merely a technological application of existing pedagogical principles, but represents a qualitatively distinct instructional approach with unique affordances. It helps diverse students develop statistical literacy skills, and how it improves both their thinking abilities. These findings provide a starting point for future research on using technology for differentiated instruction in other subjects and school settings. The results support Pozas et al.'s (2020) claim that differentiated instruction effectively responds to student diversity and increases engagement.

4. Conclusion

This research successfully developed differentiated E-LKPD using Liveworksheets for Data Presentation topics, demonstrating high quality and effectiveness in enhancing junior high school students' statistical literacy and mathematical disposition. The product achieved very high validity across all aspects (content 0.91, media 0.94, language 0.90) and very high practicality (86%),

confirming its quality and implementation feasibility. In terms of effectiveness, N-Gain's score achieved 0,60 with medium criteria. This result indicated that differentiated E-LKPD using Liveworksheets, accommodating the diversity of students' learning readiness, is an effective solution for inclusive and meaningful learning practices in advancing statistical literacy.

This study provides practical evidence that differentiation (integrating content, process, and product) works effectively in digital environments. This validates and extends Tomlinson & Imbeau's (2020) framework into the realm of technology-enhanced learning. The findings demonstrate that when scaffolding is adapted to student levels, it helps develop statistical literacy, offering a more detailed understanding of how students learn. Moreover, it establishes digital differentiation as a unique teaching approach that improves knowledge (cognitive). The differentiated E-LKPD using Liveworksheets represents a validated, theoretically grounded approach to inclusive mathematics education that successfully enhances statistical literacy across diverse learner. While implementation challenges remain, particularly regarding teacher capacity, the demonstrated effectiveness and equitable impact across readiness levels establish this approach as a promising direction for mathematics education.

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