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DEVELOPMENT OF INTERACTIVE E-LKPD USING WIZER.ME TO IMPROVE STUDENTS' SELF-EFFICACY

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Abstract :

This study aimed to develop an interactive web-based e-LKPD using Wizer.me on fluid topics and to examine its eligibility , students' responses, and effectiveness in enhancing high school students' self-efficacy. A research and development approach based on the ADDIE model was employed. Product eligibility was evaluated through expert validation, while students' responses and self-efficacy were measured using questionnaires. The results showed that the developed e-LKPD was categorized as Very eligibility, with an average validity score of 97.69%, and received very good student responses, with an average score of 98.16%. Furthermore, students' self-efficacy significantly improved, indicated by a high N-Gain score of 0.92. In this study, the term *deep learning* is used in a pedagogical context to refer to meaningful, reflective, and conceptually integrated learning, rather than to machine learning. The novelty of this research lies in the systematic integration of Problem-Based Learning and a pedagogical deep learning approach within a Wizer.me-based e-LKPD specifically designed to enhance students' self-efficacy in physics learning.

Keywords: Fluid, Interactive e-LKPD, Self-efficacy

INTRODUCTION

Physics learning in high schools, particularly on fluid topics, still faces persistent challenges related to students' conceptual understanding and affective development. Fluid concepts such as pressure, Pascal's law, Archimedes' principle, continuity, and Bernoulli's equation require students to integrate mathematical reasoning with real-world physical phenomena. However, many students struggle to establish this connection, resulting in misconceptions and low confidence in solving physics problems (Ilmi, 2020). This condition is further aggravated by the dominance of conventional instructional methods that rely heavily on lectures and procedural printed worksheets, which limit student engagement and meaningful learning experiences. Consequently, students tend to develop low self-efficacy, manifested in avoidance of challenges, low persistence, and weak motivation in physics learning (Rahmawati et al., 2025).

Self-efficacy, defined as individuals' belief in their ability to organize and execute actions required to achieve specific goals (Bandura, 1997), plays a critical role in students' academic success. High self-efficacy has been shown to enhance motivation, cognitive engagement, perseverance, and learning achievement (Yolantia et al., 2021). In physics learning, students with strong self-efficacy demonstrate greater resilience in problem solving and higher conceptual mastery. Conversely, students with low self-efficacy are more likely to disengage, give up easily, and experience anxiety when encountering complex concepts. Therefore, improving students' self-efficacy is not merely an affective objective but a strategic effort to enhance overall learning quality.

Recent advances in educational technology have opened new opportunities to design interactive learning environments that promote active learning, conceptual understanding, and affective development. Digital learning media, particularly electronic student worksheets (e-LKPD), enable the integration of multimedia, interactive tasks, and real-world problem contexts to foster student engagement and deeper understanding. Platforms such as Wizer.me have demonstrated strong potential in facilitating the development of interactive learning materials with automatic feedback and learning analytics features (Andini et al., 2025). Previous studies have reported that technology-assisted learning media can increase students' motivation, engagement, and conceptual understanding in physics (Fauziah & Sulisworo, 2022; Septiana et al., 2023). However, most existing e-LKPD designs remain focused on procedural problem solving and cognitive outcomes, with limited emphasis on structured affective development, particularly self-efficacy.

Several studies have explored the use of Wizer.me as an interactive learning platform and the development of e-LKPD in physics learning. These studies mainly emphasize improvements in students' conceptual understanding, learning outcomes, and learning interest (Andini et al., 2025; Septiana et al., 2023). Separately, other studies have examined the impact of digital learning media on students' self-efficacy (Saputri & Suyatna, 2024). Nevertheless, existing research tends to treat interactive media, instructional models, and affective outcomes as separate domains. Comprehensive learning designs that integrate interactive digital media, pedagogical models, and affective targets—especially self-efficacy—remain scarce, particularly in the context of fluid materials.

More specifically, prior Wizer.me-based studies generally utilize the platform as a tool for delivering exercises and formative assessments, without systematically embedding structured learning models such as Problem-Based Learning (PBL) or deep learning principles. Likewise, existing e-LKPD developments often incorporate problem-based tasks but do not fully implement the complete PBL syntax, nor do they apply deep learning principles such as constructive alignment, contextual inquiry, reflection, and self-evaluation. Moreover, the majority of physics e-LKPD studies primarily target cognitive outcomes, while affective constructs such as self-efficacy are rarely positioned as the central instructional objective. This reveals a clear research gap in the development of integrated digital learning media that systematically combine interactive technology, pedagogical frameworks, and affective enhancement.

This study introduces a distinct approach that fills the identified gaps in existing literature. Unlike previous studies that primarily focus on cognitive outcomes or utilize Wizer.me merely as a digital worksheet platform, this study explicitly positions self-efficacy as the central instructional objective and integrates it systematically within the instructional design. The novelty of this research lies in the deliberate combination of three elements that have rarely been integrated simultaneously: (1) the full implementation of the Problem-Based Learning (PBL) syntax, (2) the application of deep learning principles through constructive alignment and reflective processes, and (3) the intentional design of interactive e-LKPD activities to progressively strengthen students' self-efficacy. By embedding affective enhancement within a structured pedagogical and technological framework, this study offers a more comprehensive model of digital physics learning compared to prior e-LKPD or Wizer.me-based research.

To address this gap, the present study introduces an integrated design of interactive web-based e-LKPD using the Wizer.me platform, grounded in deep learning principles and operationalized through the PBL model, with self-efficacy as the primary instructional target. The novelty of this study lies in three focused contributions. First, it develops an interactive e-LKPD that fully exploits Wizer.me's multimedia, interactive, and feedback features to support independent and inquiry-based learning. Second, it systematically integrates deep learning principles into each phase of the PBL syntax, ensuring alignment among learning objectives, activities, assessments, and reflection processes. Third, and most importantly, it intentionally designs all learning activities to progressively strengthen students' self-efficacy through structured scaffolding, real-world problem contexts, constructive feedback, and measurable challenges.

Based on these considerations, this study aims to develop an interactive web-based e-LKPD using Wizer.me on fluid material and to evaluate its feasibility, student responses, and effectiveness in improving high school students' self-efficacy. The findings are expected to contribute theoretically to the development of digital physics learning media and pedagogical integration models, as well as practically to support teachers in creating more meaningful, interactive, and student-centered physics learning environments.

RESEARCH METHOD

Research design

This study employed a research and development (R&D) approach aimed at developing an interactive web-based e-LKPD using the Wizer.me platform for physics learning to enhance students' self-efficacy. The development process followed the revised ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages, with evaluation conducted continuously at each stage to ensure product quality and effectiveness (Bouchrika, 2024).

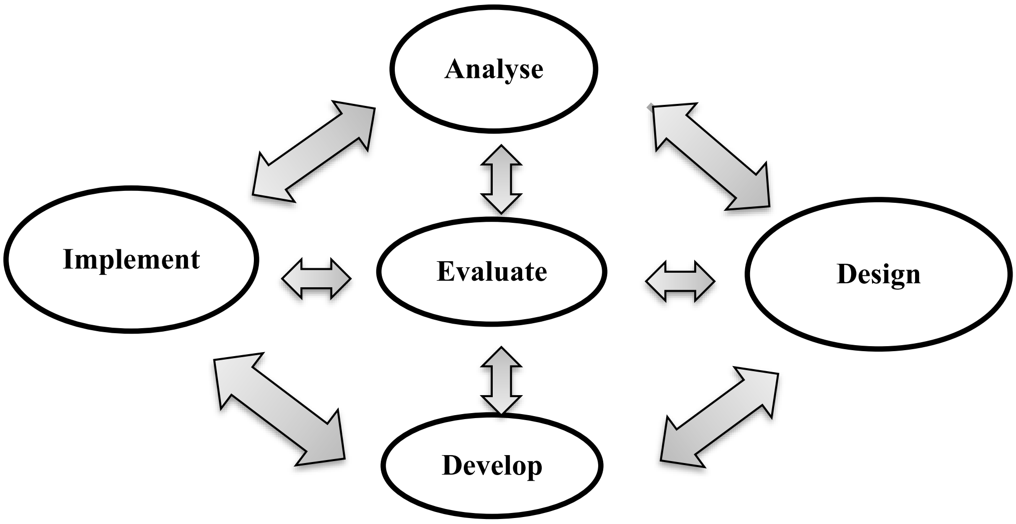


Figure 1. Steps of the ADDIE Model (adapted from Dick & Carey, 2005 in Bouchrika, 2024)

The interactive e-LKPD based on the Wizer.me website is designed to support student-centered physics To examine the effectiveness of the developed e-LKPD, this study applied a one-group pretest–posttest design, in which students' self-efficacy was measured before and after the intervention without a comparison group. This design was selected to identify learning gains and changes in students' self-efficacy attributable to the use of the developed media within the scope of limited trials.

The interactive e-LKPD was designed by integrating the Problem-Based Learning (PBL) model and deep learning principles, including joyful, mindful, and meaningful learning. Learning activities were structured according to the PBL syntax, beginning with contextual problem orientation, followed by problem investigation, data analysis, solution presentation, and reflection. These stages were intended to promote conceptual understanding, critical thinking, and meaningful engagement.

To support conceptual exploration and experimentation, the e-LKPD was integrated with PhET interactive simulations, enabling students to visualize abstract physics concepts, manipulate variables, and conduct virtual experiments. Additionally, the instructional design intentionally embedded self-efficacy development strategies, aligned with Bandura's four sources: mastery experience, vicarious experience, verbal persuasion, and emotional arousal, through scaffolding tasks, feedback, motivational reinforcement, and an engaging interface.

Research Subject/Target

This study was conducted during the even semester of the 2024/2025 academic year. Product development and expert validation were carried out at the researcher's institution, while the limited field trial was conducted at SMA Negeri 2 Kota Bengkulu, selected based on facility readiness and curriculum compatibility. The research subjects consisted of 41 participants, including two physics education lecturers as expert validators, one physics teacher as a practitioner validator, and 38 eleventh-grade students who participated in the limited trial.

Research Procedure

The research procedure followed the ADDIE development stages. The analysis stage involved identifying learning problems and needs through classroom observations, teacher interviews, and student needs analysis. The design stage focused on formulating learning objectives, developing learning scenarios based on PBL and deep learning principles, and designing the initial structure of the e-LKPD. The development stage included producing the e-LKPD prototype, expert validation, and revisions. The implementation stage involved conducting limited trials with students. Finally, the evaluation stage examined the feasibility, students' responses, and effectiveness of the developed media in improving students' self-efficacy.

Instruments and Data Collection Techniques

Data were collected using expert validation sheets, student response questionnaires, and self-efficacy questionnaires. Expert validation instruments assessed content quality, language clarity, instructional design, and media presentation. Student response questionnaires measured perceptions of usability, appearance, content clarity, usefulness, and support for self-efficacy. The self-efficacy questionnaire consisted of 24 items representing four dimensions: mastery experience, vicarious experience, verbal persuasion, and emotional arousal. All instruments used a 4-point Likert scale to minimize central tendency bias and encourage definitive responses. Prior to implementation, the instruments underwent expert validation to establish content validity, ensuring alignment with research objectives, learning indicators, and theoretical constructs. The consistency of expert judgments toward the instruments was analyzed using Cronbach's alpha coefficient to examine internal consistency among validators. An alpha coefficient greater than 0.70 indicated acceptable consistency, suggesting that the instruments were considered reliable based on expert evaluation.

Data Analysis Techniques

Data analysis in this study was conducted both quantitatively and qualitatively. Qualitative data were obtained from observations and interviews, which were then analyzed descriptively to enrich the interpretation of the findings. Meanwhile, quantitative data were obtained from questionnaires filled out by expert validators, teachers, and students, which were then analyzed descriptively in the form of percentages. Measurement in this study used a 4-point Likert scale for all questionnaires, including expert validation questionnaires, student responses, and self-efficacy. This scale was chosen to avoid neutral answers (central tendency bias) and to encourage respondents to take a more definite position in their answers (Purwanto & Risdianto, 2022). Scoring on the Likert scale is done with weights of 4, 3, 2, and 1 for positive statements, and the scores are reversed to 1, 2, 3, and 4 for negative statements. The reversal of scores for negative statements aims to maintain consistency in data interpretation so that higher scores still reflect a higher level of attitude or self-efficacy (Sukardi, 2021). Then, validation was conducted by three experts on the e-LKPD and the research instruments. The validation results were analyzed by calculating the percentage of scores for each assessment aspect using the formula:

$$\boldsymbol{Validation\ Score\ Percentage} = \frac{\boldsymbol{Score\ Obtained}}{\boldsymbol{Total\ Score}} \times \mathbf{100}\% \qquad \dots (1)$$

The percentage results are then interpreted based on the criteria presented in Table 1. The interpretation of the percentage scores must take into account the minimum possible score. When using a 1-4 Likert scale with n items, the minimum score is n × 1, and the minimum percentage is (n × 1)/(n × 4) × 100%.

Table 1. Validation Result Criteria

Percentage (%)	Category
25 - 43	Very Ineligible
44 - 62	Ineligible
63 - 81	Eligible
82 - 100	Very Eligible

Source: Sugiyono (2019)

Self-efficacy was measured through a questionnaire consisting of 24 statements divided into four indicators based on Bandura's theory (1997), namely: Mastery Experience (6 items), Vicarious Experience (6 items), Verbal Persuasion (6 items), and Emotional Arousal (6 items). The questionnaire was administered before the media trial and after the e-LKPD media trial. The increase in self-efficacy was analyzed using the N-Gain test with the following formula:

$$\boldsymbol{N-Gain} = \frac{\boldsymbol{Score\ After\ Trial - Score\ Before\ Trial}}{\boldsymbol{Ideal\ Score - Score\ Before\ Trial}} \quad \ldots (2)$$

The ideal score is the maximum score that can be achieved. The N-Gain calculation results are then interpreted based on the criteria in Table 2.

Table 2. N-Gain Index Criteria

N-Gain	Category
$(g) > 0.7$	High
$0.3 \leq (g) \leq 0.7$	Medium
$(g) < 0.3$	Low

Source. Hake (1998)

Students' responses to the use of e-LKPD were measured through a questionnaire covering aspects of language, appearance, content, usefulness, and support for self-efficacy. The data were analyzed by calculating the response score percentage using the formula:

$$Percentage\ of\ student\ response\ score = \frac{\sum Obtained\ Score}{Maksimum\ Score} \times 100\% \quad \ldots (3)$$

The interpretation of percentage scores must take into account the minimum possible score. If using a 1–4 Likert scale with n items, then the minimum score is n×1, and the minimum percentage is (n×1)/(n×4)×100%. The percentage results are then categorized based on Table 3.

Table 3. Criteria for Assessing Student Response Results

Percentage (%)	Student Response Categories
25 - 43	Very Poor
44 - 62	Poor
63 - 81	Good
82 - 100	Very Good

Source. Sugiyono (2019)

These findings are consistent with the studies of Marcelinda et al. (2024) and Septiana et al. (2023), which state that Wizer.me-based e-LKPD has a high level of validity and is feasible for use in physics learning. In addition to the product, the research instruments in the form of self-efficacy questionnaires and student response questionnaires were also declared highly feasible. This indicates that the instruments used were able to measure affective aspects accurately and consistently, in accordance with the self-efficacy construct proposed by Bandura (1997). The results of the validation of the self-efficacy questionnaire are presented in Table 5, and the categories were determined based on the validation criteria shown in Table 1.

Table 5. Validation Results of the Self-Efficacy Questionnaire Instrument

No	Indicator	Number of Items	Result (%)	Category
1	Mastery Experience	6	100	Very Eligible
2	Vicarious Experience	6	91.67	Very Eligible
3	Verbal Persuasion	6	100	Very Eligible
4	Emotional Arousal	6	95.83	Very Eligible
	Average		96.88	Very Eligible

Furthermore, the validation results of the student response questionnaire instrument are presented in Table 6, and the categories were determined based on the validation criteria shown in Table 1.

Table 6. Validation Results of the Student Response Questionnaire Instrument

No	Assessment Aspect	Number of Items	Result (%)	Category
1	Language	3	100	Very Eligible
2	Appearance	5	100	Very Eligible
3	Content	1	91.67	Very Eligible
4	Usefulness	6	97.22	Very Eligible
5	Self-efficacy	5	96.67	Very Eligible
	Average		97.11	Very Eligible

The learning media developed in this study is an interactive e-LKPD based on the Wizer.me platform, accessible via computers and mobile devices. It provides structured and interactive activities, including problem-based tasks, multimedia integration, and automatic feedback, to support the implementation of the Problem-Based Learning (PBL) model and deep learning principles. Each learning activity begins with contextual real-life problems, followed by visual supports such as illustrations and short videos to facilitate conceptual understanding and reduce the abstraction of fluid concepts.

RESULTS AND DISCUSSION

This study developed an interactive Wizer.me-based e-LKPD on fluid topics to support physics learning and enhance students' self-efficacy. The product was developed using the ADDIE model and implemented in a limited trial to evaluate feasibility, student responses, and improvements in self-efficacy. The results are presented systematically, including expert validation, student feedback, and self-efficacy gains, and are discussed in relation to relevant theories and previous studies to provide a comprehensive understanding of the effectiveness of the developed e-LKPD.

Feasibility of the Developed e-LKPD

The validation of the e-LKPD was conducted through three stages of expert review to ensure product quality. In the first stage, validators recommended dividing the material into two main sections, namely Static Fluids and Dynamic Fluids, to improve content organization, as well as adding clear references, particularly for integrated YouTube videos, to strengthen academic accountability. In the second stage, feedback focused on refining the formulation of Learning Objectives using the ABCD format (Audience, Behavior, Condition, Degree) to enhance clarity and measurability, along with the inclusion of key fluid equations such as hydrostatic pressure, Pascal's law, Archimedes' principle, and capillarity to enrich conceptual understanding. In the final stage, after revisions were implemented, validators suggested adding a bibliography to provide clear references and fulfill academic citation standards.

All feedback was incorporated through gradual revisions, resulting in a more comprehensive and systematic e-LKPD that meets learning media feasibility standards. Validation data were analyzed using equation (1), and feasibility levels were determined based on the criteria in Table 1. The overall results of the e-LKPD feasibility assessment are presented in Table 4.

Table 4. Expert Validation Results of the Interactive e-LKPD

NO	Assessment Aspects	Items	Result (%)	Category
1.	Content Suitability	4	95.83	Very Eligible

2.	Language	2	100	Very Eligible
3.	Media	3	97.22	Very Eligible
Average			97.69	Very Eligible

Table 4 shows that the interactive Wizer.me-based e-LKPD achieved a very feasible category across all assessment aspects, including content suitability, language, and media, with an average score of 97.69%. These results indicate that the developed product meets high-quality standards as digital instructional material suitable for high school physics learning.

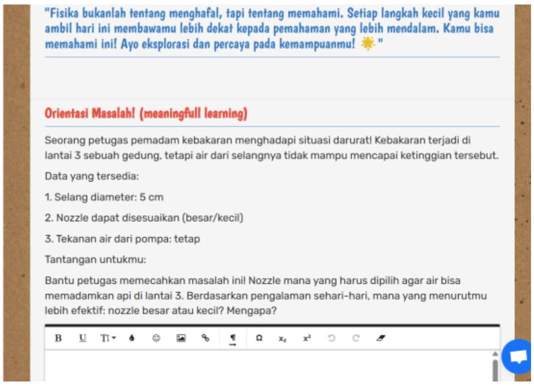
The content aspect, categorized as very feasible, demonstrates that the fluid material aligns with learning objectives, student characteristics, and the demands of the Merdeka Curriculum. This is consistent with Aprilia et al. (2020), who emphasized that effective learning materials must fulfill curriculum relevance, conceptual depth, and learner suitability. Additionally, Saputri and Suyatna (2024) highlighted that systematic and contextual presentation of content supports deeper conceptual understanding, which forms a foundation for enhancing students' self-efficacy in physics learning.

The language aspect also obtained a very feasible category, indicating that the instructions and explanations are clear, communicative, and easy to understand. Clear language reduces students' cognitive load and supports independent learning, thereby increasing learners' confidence in completing tasks, in accordance with Bandura's self-efficacy theory (1997) and the findings of Anggoro (2023).

From the media aspect, the e-LKPD was assessed as very feasible, reflecting the appropriateness of visual design, layout, and interactive features. Engaging digital media has been shown to enhance students' motivation and active participation (Azhari & Huda, 2022), which aligns with the findings of Marcelinda et al. (2024) and Septiana et al. (2023), who reported high validity and effectiveness of Wizer.me-based e-LKPD in physics learning.

The developed e-LKPD integrates multimedia features such as problem-based tasks, short-answer and multiple-choice questions, image and video integration, and automatic feedback, supporting the implementation of the Problem-Based Learning (PBL) model and deep learning principles. Through the PBL stages, students actively engage in exploration, investigation, and reflection, enabling them to construct conceptual understanding independently and develop higher confidence in solving physics problems (Safithri & Huda, 2021; Firmansyah et al., 2020). Moreover, deep learning-oriented activities facilitate meaningful connections between new concepts and prior knowledge, contributing positively to both cognitive and affective outcomes, including self-efficacy (Wahyudi et al., 2025).

Each learning activity begins with contextual problems related to real-life fluid phenomena, followed by visual supports such as illustrations and short videos. This design stimulates curiosity, facilitates conceptual visualization, and reduces the abstract nature of fluid concepts, thereby enhancing students' understanding and learning confidence.



"Fisika bukanlah tentang menghafal, tapi tentang memahami. Setiap langkah kecil yang kamu ambil hari ini membawamu lebih dekat kepada pemahaman yang lebih mendalam. Kamu bisa memahami ini! Ayo eksplorasi dan percaya pada kemampuanmu! 🌟"

Orientasi Masalah! (meaningfull learning)

Seorang petugas pemadam kebakaran menghadapi situasi darurat! Kebakaran terjadi di lantai 3 sebuah gedung, tetapi air dari selangnya tidak mampu mencapai ketinggian tersebut.

Data yang tersedia:

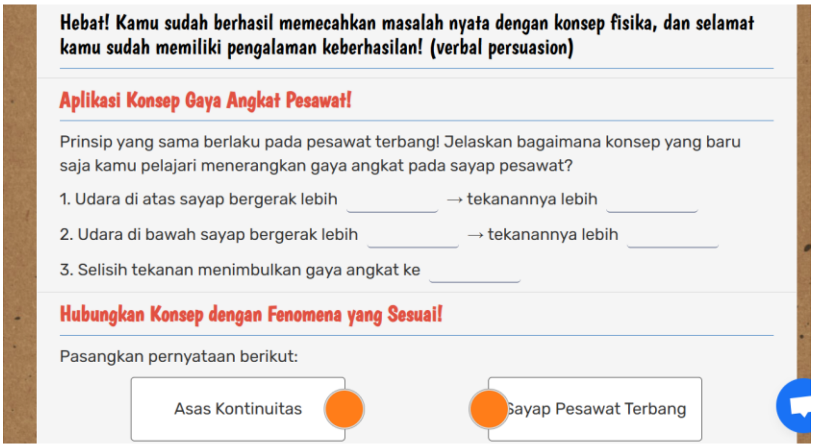
1. Selang diameter: 5 cm
2. Nozzle dapat disesuaikan (besar/kecil)
3. Tekanan air dari pompa: tetap

Tantangan untukmu:

Bantu petugas memecahkan masalah ini! Nozzle mana yang harus dipilih agar air bisa memadamkan api di lantai 3. Berdasarkan pengalaman sehari-hari, mana yang menurutmu lebih efektif: nozzle besar atau kecil? Mengapa?

Figure 2. Problem orientation display in the interactive e-LKPD on fluid material.

Additionally, the e-LKPD is equipped with immediate feedback for each learning activity, allowing students to know their level of success in real time. This feedback plays an important role in building mastery experiences and providing verbal persuasion that supports the enhancement of students' self-efficacy. The e-LKPD interface is designed to be simple, consistent, and visually appealing so that it is easy for students to use and does not impose an excessive cognitive load.



Hebat! Kamu sudah berhasil memecahkan masalah nyata dengan konsep fisika, dan selamat kamu sudah memiliki pengalaman keberhasilan! (verbal persuasion)

Aplikasi Konsep Gaya Angkat Pesawat!

Prinsip yang sama berlaku pada pesawat terbang! Jelaskan bagaimana konsep yang baru saja kamu pelajari menerangkan gaya angkat pada sayap pesawat?

1. Udara di atas sayap bergerak lebih ________ → tekanannya lebih ________
2. Udara di bawah sayap bergerak lebih ________ → tekanannya lebih ________
3. Selisih tekanan menimbulkan gaya angkat ke ________

Hubungkan Konsep dengan Fenomena yang Sesuai!

Pasangkan pernyataan berikut:

Figure 3. The appearance of the web-based interactive e-LKPD on Wizer.me for fluid material, which includes problem-based learning activities and immediate feedback.

Improving Student Self-efficacy

The improvement in students' self-efficacy was analyzed using the N-Gain formula as presented in Equation (2). The results showed a high increase in students' self-efficacy, with an average N-Gain score of 0.92, which falls into the high category based on Hake's criteria (Table 2). As presented in Table 7, the average self-efficacy score increased substantially from 46.71 before the intervention to 92.28 after the implementation of the interactive e-LKPD, indicating a substantial positive change following the implementation of the interactive e-LKPD.

Table 7. N-Gain Results of Student Self-efficacy Improvement (n = 38)

Average before using e-LKPD	Average after using the e-LKPD	N-Gain	Category
46.71	92.28	0.92	High

An N-Gain score of 0.92 indicates a very large learning gain, meaning that 92% of the maximum potential improvement in students' self-efficacy was achieved. According to Hake (1998), N-Gain values above 0.70 reflect strong instructional effectiveness. However, this very high N-Gain value should be interpreted cautiously. Since the study employed a one-group pretest–posttest design without a control group, the observed improvement cannot be fully attributed solely to the intervention. Other external factors may also have influenced the results. Additionally, because self-efficacy was measured using a self-report instrument, the findings may be subject to response bias or social desirability bias. Furthermore, the posttest mean score 92.28 approaches the upper limit of the measurement scale, indicating a possible ceiling effect that could inflate the N-Gain value.

This substantial improvement may be associated with the instructional design of the e-LKPD, which integrates structured problem-solving activities, immediate feedback, multimedia elements, and student-centered learning. These features provide repeated learning success, strengthening students' mastery experience, the most influential source of self-efficacy (Bandura, 1997). Additionally, vicarious experience is fostered through guided examples and demonstrations, while verbal persuasion and emotional arousal are supported through motivational feedback, clear instructions, and engaging visual design.

Consistent with Yulianto (2019), students with higher self-efficacy exhibit better self-regulation, persistence, and engagement. The interactive features of the e-LKPD promote sustained attention, strategic problem-solving, and reflective learning, collectively contributing to enhanced learning confidence and academic resilience. This increase is also consistently reflected across all self-efficacy indicators, indicating that the strengthening of students' self-confidence occurs comprehensively, not just in certain aspects, as shown in Table 8.

Table 8. N-Gain of Student Self-efficacy (n = 38) per Indicator

Item	Indicator	Students' self-efficacy before using the media	Students' self-efficacy after using media	N-Gain*	Category
1.2.3.4.5.6	Mastery Experience	52	96	0.91	High
7.8.9.10.11.12	Vicarious Experience	54	96	0.91	High
13.14.15.16.17.18	Verbal Persuasion	52	97	0.93	High
19.20.21.22.23.24	Emotional Arousal	35	95	0.92	High
Average				0.92	High

Note*: determined based on the N-Gain index criteria table (Table 2)

The improvement in students' self-efficacy observed in this study is stronger and more comprehensive than that reported in several previous studies. While Saputri and Suyatna (2024) found a moderate-to-high improvement in students' self-efficacy through the implementation of a Learning Cycle 7E-based e-LKPD, the present study achieved a very high N-Gain score of 0.92, indicating a substantially greater learning impact. This difference may be attributed to the integration of deep learning principles and a structured Problem-Based Learning (PBL) model, which provides students with more intensive mastery experiences, reflective activities, and immediate feedback, all of which are essential for strengthening self-efficacy.

Similarly, Hayati and Junus (2021) reported that students' self-efficacy improved through the use of interactive digital media; however, the improvement was mainly associated with cognitive engagement and motivation. In contrast, the current study systematically designed learning activities to target all four sources of self-efficacy simultaneously, namely mastery experience, vicarious experience, verbal persuasion, and emotional arousal. This comprehensive integration enables a more balanced and sustained development of students' confidence, particularly in learning abstract physics concepts such as fluid dynamics.

In comparison with the findings of Septiana et al. (2023), who demonstrated that Wizer.me-based e-LKPD effectively improved learning outcomes and student engagement, this study extends their results by providing empirical evidence of a significant psychological impact, specifically on self-efficacy. While Septiana et al. primarily focused on cognitive gains and motivation, the present research highlights that interactive e-LKPD can also play a critical role in shaping students' affective domains, which are essential for long-term academic success.

Furthermore, research by Marcelinda et al. (2024) emphasized the feasibility and usability of Wizer.me-based e-LKPD, yet did not quantitatively measure changes in psychological constructs. The present study fills this gap by demonstrating that beyond feasibility and usability, the integration of deep learning-oriented PBL activities within e-LKPD significantly enhances students' self-efficacy, as reflected in the exceptionally high N-Gain score. This indicates that effective instructional media design should not only focus on technical quality but also on intentional psychological scaffolding.

Overall, compared to previous studies that tended to examine either learning outcomes, engagement, or media feasibility in isolation, this research provides a more holistic contribution by simultaneously addressing instructional effectiveness, psychological development, and pedagogical integration. These findings suggest that the systematic incorporation of deep learning principles into PBL-based interactive e-LKPD represents a meaningful advancement in digital physics learning design.

Student Response to e-LKPD

In addition to measuring the increase in self-efficacy, this study also analyzed students' responses to the use of interactive e-LKPD based on the Wizer.me website. A student response questionnaire was given after the learning process to find out students' feedback on the aspects of language, appearance, material, usefulness, and self-efficacy in the developed e-LKPD. The data from students' responses to the e-LKPD were processed using equation (3) and then categorized based on the assessment criteria of student response results (Table 3). The results are presented in Table 9.

Table 9. Student Responses (n = 38) to the Use of Interactive e-LKPD Based on Wizer.me

No.	Assessment Aspects	Item	Average Percentage (%)	Category
1.	Language Aspect	3	97.59	Very Good
2.	Appearance Aspect	5	100	Very Good
3.	Material Aspect	1	93.42	Very Good
4.	Benefit Aspect	6	96.16	Very Good
5.	Self-efficacy Aspect	5	98.42	Very Good

Students' responses to the use of interactive e-LKPD based on Wizer.me are categorized as very good based on the overall average score. This result indicates that the e-LKPD is positively received by students in terms of appearance, ease of use, usefulness, and its support for increasing self-efficacy. Students' positive responses indicate that the e-LKPD is capable of creating an engaging and enjoyable learning experience. According to Mayer et al. (2020), interactive and visual digital learning media can enhance students' motivation and engagement, which ultimately supports meaningful learning. This finding is also in line with research by Melianti et al. (2020) and Septiana et al. (2023), who reported that electronically designed LKPDs with interactive features received very good responses from students.

Affectively, students' positive responses reinforce the findings of increased self-efficacy, as students' acceptance of learning media plays an important role in building self-confidence and a positive attitude toward physics learning (Aprilia et al., 2020). In the development of digital learning tools, students' affective responses and engagement are key indicators showing that the media is not only easy to use but can also create meaningful learning experiences and support the formation of self-confidence. Thus, interactive e-LKPD based on Wizer.me is not only technically feasible but also pedagogically effective in supporting student-centered learning.

Novelty and Contribution of This Research

This study provides a strong contribution to physics education and educational technology by integrating Deep Learning principles (fun, meaningful, and mindful learning) into interactive e-LKPD design using the Wizer.me platform. Unlike previous studies that primarily employed Wizer.me within Problem-Based Learning frameworks (Septiana et al., 2023), this research offers a more holistic instructional model that simultaneously enhances cognitive understanding, affective engagement, and metacognitive awareness. Moreover, the findings extend Bandura's self-efficacy theory into digital learning contexts by empirically demonstrating that technology-based platforms can effectively foster mastery experience, verbal persuasion, and positive emotional engagement, as reflected in the very high N-Gain score (0.92). Practically, this study proposes a scalable, low-cost, and accessible model for implementing interactive digital worksheets in physics learning, thereby supporting equitable access to high-quality education across diverse school settings.

Research Limitations

This study has several limitations. Primarily, the one-group pretest–posttest design without a control group limits the ability to isolate the e-LKPD's impact from external influences. Additionally, the small sample size (n = 38) from a single school and the short intervention period restrict the generalizability of the findings. The study also focused solely on self-efficacy without examining higher-order thinking skills, and its implementation depended on stable technological infrastructure.

Despite these limitations, the findings provide practical implications for physics teachers in implementing interactive e-LKPD. Teachers are encouraged to systematically align learning objectives with digital tasks and assessment strategies, integrate Problem-Based Learning stages with structured scaffolding and reflective activities, and conduct prior technical audits of the school's technological infrastructure to ensure seamless classroom implementation.

CONCLUSION

The findings indicate that the Wizer.me-based interactive e-LKPD on fluid topics is highly feasible and effective for use in high school physics learning. Expert validation confirmed its academic and pedagogical quality, while the significant increase in students' self-efficacy demonstrates its effectiveness in supporting affective development. Students also showed very positive responses, indicating that the e-LKPD provides an engaging and student-centered learning experience. The main contribution of this study lies in demonstrating that the systematic integration of Problem-Based Learning and a pedagogical deep learning approach within an interactive digital worksheet can effectively strengthen students' self-efficacy in physics learning. For future research, it is recommended to employ a quasi-experimental or experimental design with a control group to better isolate the intervention effects, involve larger and more diverse samples to enhance generalizability, examine impacts on higher-order thinking skills, and implement longer intervention periods to assess sustained effects. Conduct trials with a larger and more diverse sample to improve the generalization of findings. Investigate the impact of e-LKPD on higher-order thinking skills such as critical thinking and problem-solving. Conduct longitudinal studies to observe the long-term impact of e-LKPD use on self-efficacy and learning outcomes. Develop e-LKPD with more varied features such as interactive simulations or integration with other technologies to enhance learning flexibility. Consider the technological infrastructure readiness of schools in the implementation of digital learning media.

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