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Design of Canva-Assisted Assessment as Learning Instruments in the Problem Based Learning Model to Train High School Students' Physics Problem-Solving Skills

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ABSTRACT

Assessment as Learning (AaL) is an assessment approach that plays a role in training students' problem-solving and metacognitive skills. However, a Canva-assisted Assessment as Learning instrument integrated with the Problem-Based Learning (PBL) model for physics learning on the topic of Heat and Heat Transfer is not yet available. Therefore, this study aimed to develop a Canva-assisted Assessment as Learning instrument integrated with the Problem-Based Learning model and to analyze the product's quality based on validity and practicality aspects. This research is a Research and Development (R&D) study using the Dick and Carey model up to the ninth stage, namely product revision. The research subjects consisted of three expert validators, one physics teacher, and twelve Grade XI (Phase F) students from SMA Negeri 1 Kubung who were involved in a small-group practicality test. Data were collected using validation sheets and practicality questionnaires. Validity data were analyzed using Moment Kappa, while practicality data were analyzed using percentage analysis. The results showed that the developed instrument integrates Problem-Based Learning syntax, Polya's four problem-solving steps, as well as self-assessment, self-reflection, and feedback features. The instrument achieved a highly valid category with an average Moment Kappa value of 0.93 and a highly practical category with an average practicality percentage of 89.58% based on the teacher's evaluation and 87.67% based on the students' evaluation. Thus, the developed instrument is declared valid and practical, making it suitable for use as an alternative Assessment as Learning instrument in physics learning to train students' problem-solving skills.

Keywords : Assessment as Learning; Canva; Problem Based Learning; physics problem-solving skills; Heat and Heat Transfer.

I. INTRODUCTION

Problem-solving skills are among the essential competencies that students are expected to develop in physics learning, as physics requires learners not only to understand scientific concepts but also to apply scientific reasoning to solve real-world problems systematically [1], [2], [3]. In line with this expectation, the Merdeka Curriculum emphasizes student-centered learning and encourages the integration of assessment into the learning process as a means of supporting learning rather than merely measuring learning outcomes [4]. Accordingly, assessment should function as an integral part of instruction, enabling students to monitor their learning progress, identify conceptual difficulties, and improve their learning strategies through continuous reflection and feedback [5], [6]. Such an assessment approach is expected to foster not only conceptual understanding but also students' problem-solving and metacognitive skills, which are essential for meaningful physics learning [5], [7].

However, classroom practices have not fully reflected these ideal expectations [9]. Based on preliminary investigations, classroom observations, and interviews with a physics teacher at SMA Negeri 1 Kubung, assessment practices remain predominantly oriented toward Assessment of Learning (AoL), with limited opportunities for students to engage in Assessment as Learning (AaL) activities [5]. Furthermore, no Canva-assisted Assessment as Learning instrument integrated with the Problem-Based Learning (PBL) model was

available for physics learning on the topic of Heat and Heat Transfer. Consequently, students rarely have structured opportunities to monitor and evaluate their own learning processes, resulting in limited metacognitive awareness [10]. They tend to focus on obtaining correct final answers rather than understanding the reasoning process required for systematic problem solving. Preliminary diagnostic tests also revealed that students experienced difficulties in understanding problems, devising solution strategies, carrying out calculations, and evaluating their answers according to Polya's problem-solving stages [8], [1]. These findings indicate the need to develop a Canva-assisted Assessment as Learning instrument integrated with the Problem-Based Learning model to facilitate systematic problem solving and metacognitive reflection.

The advancement of educational technology offers promising opportunities to transform traditional assessment into more interactive and student-centered learning tools [10]. Among various educational technology platforms, Canva has emerged as a versatile digital application that enables teachers to develop visually engaging learning resources, including digital worksheets, self-assessment forms, reflective journals, and interactive feedback activities [11]. These features provide considerable potential for supporting the implementation of *Assessment as Learning* (AaL) in physics learning. Through continuous self-assessment and reflection, AaL encourages students to monitor, evaluate, and regulate their own learning, thereby promoting metacognitive awareness and independent learning [5], [7]. Despite this potential, the application of Canva as a platform for implementing *Assessment as Learning* in physics education remains limited, indicating the need for further development of digital assessment instruments that effectively support students' learning processes.

Problem Based Learning (PBL) provides an appropriate pedagogical framework for implementing *Assessment as Learning* because both approaches emphasize active student participation, authentic inquiry, reflection, and the construction of knowledge through problem-solving activities [10], [11]. Through contextual problem scenarios, PBL encourages students to investigate physical phenomena, identify possible solutions, collaborate with peers, and evaluate their problem-solving processes while teachers act as facilitators throughout the learning process [10]. Integrating *Assessment as Learning* into the PBL syntax enables assessment to become an integral component of learning rather than merely a tool for measuring achievement at the end of instruction [5], [13]. This integration also creates opportunities for students to continuously monitor their learning progress, reflect on their problem-solving processes, and improve their strategies, thereby fostering both problem-solving and metacognitive skills.

Previous studies have demonstrated the effectiveness of *Assessment as Learning* in promoting students' metacognitive skills, while Canva has been widely utilized to develop interactive digital learning media. In addition, *Problem Based Learning* has consistently been reported to improve students' problem-solving skills in physics learning [7], [9], [12]. However, these approaches have generally been investigated separately. Studies integrating Canva-assisted *Assessment as Learning*, the *Problem Based Learning* model, and Polya's four problem-solving stages into a single digital assessment instrument for physics learning remain limited. Furthermore, limited research has specifically developed such an instrument for the topic of Heat and Heat Transfer by integrating *self-assessment*, *self-reflection*, and *feedback* features into a unified digital assessment framework. Therefore, the novelty of this study lies in the development of a Canva-assisted *Assessment as Learning* instrument that integrates the *Problem Based Learning* model, Polya's four problem-solving stages, and metacognitive assessment features to facilitate students' problem-solving skills in learning Heat and Heat Transfer.

Based on the identified research gap, this study aims to develop a Canva-assisted *Assessment as Learning* instrument integrated with the *Problem Based Learning* model for physics learning on the topic of Heat and Heat Transfer. Furthermore, this study evaluates the quality of the developed instrument in terms of its validity and practicality. The developed instrument is expected to provide teachers with an alternative digital assessment tool for supporting students' problem-solving skills and metacognitive development in physics learning.

II. METHOD

A. Research Design

This study employed a Research and Development (R&D) approach to develop a Canva-assisted *Assessment as Learning* (AaL) instrument integrated with the *Problem Based Learning* (PBL) model for physics learning on the topic of Heat and Heat Transfer. The development process adopted the Dick and Carey instructional design model, which consists of ten stages. However, this study was conducted only up to the ninth

stage, namely product revision, while the tenth stage (summative evaluation) was beyond the scope of this research.

B. Development Procedure

The development procedure followed the first nine stages of the Dick and Carey model: (1) identifying instructional goals; (2) conducting instructional analysis; (3) analyzing learners and learning contexts; (4) writing performance objectives; (5) developing assessment instruments; (6) developing instructional strategies; (7) developing and selecting instructional materials; (8) designing and conducting formative evaluation; and (9) revising the product based on the formative evaluation results. The overall development procedure adopted in this study is presented in Fig. 1.

Fig. 1. Development procedure based on the Dick and Carey instructional design model.

C. Research Participants

This study was conducted at SMA Negeri 1 Kubung, Solok Regency, West Sumatra, Indonesia. The expert validation involved three lecturers from the Department of Physics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang. The practicality evaluation was conducted through a small-group trial involving one physics teacher and twelve Grade XI (Phase F) students.

D. Developed Product

The product developed in this study was a Canva-assisted Assessment as Learning instrument integrated with the Problem Based Learning model. The instrument was designed to facilitate students' active participation through contextual physics problems and systematically incorporated Polya's four problem-solving stages: understanding the problem, devising a plan, carrying out the plan, and looking back. Furthermore, the instrument incorporated self-assessment, self-reflection, and feedback features to provide opportunities for students to practice metacognitive awareness throughout the learning process.

E. Research Instruments

The research instruments consisted of validation sheets and practicality questionnaires. The validation sheets were used to evaluate four aspects of the developed instrument: (1) content feasibility, (2) integration of the *Problem Based Learning* syntax, (3) construction and language, and (4) visual design. Meanwhile, the practicality questionnaires were administered to both teachers and students to evaluate four aspects: ease of use, visual attractiveness, implementation efficiency, and usefulness of the developed instrument.

F. Data Collection

Data collection was conducted sequentially through expert validation, product revision, and small-group practicality testing. Suggestions and feedback obtained from the expert validators were used to revise and improve the developed instrument before it was implemented in the practicality evaluation.

G. Data Analysis

The validity of the developed instrument was analyzed using the Moment Kappa formula as shown in Equation (1).

$$k = \frac{P - P_e}{1 - P_e} \quad (1)$$

where (k) represents the Moment Kappa coefficient, (P) is the proportion of realized agreement, and (P_e) is the proportion of unrealized agreement. The obtained kappa values were interpreted according to the validity criteria presented in Table 1.

Table 1. Validity Categories

Kappa Interval	Validity Criteria
0.81 – 1.00	Very Valid
0.61 – 0.80	Valid
0.41 – 0.60	Fairly Valid
0.21 – 0.40	Less Valid
0.01 – 0.20	Very Less Valid

(Source: Ref [14])

The practicality data obtained from the teacher and students were analyzed using percentage analysis as presented in Equation (2).

$$P = \frac{f}{N} \times 100\% \quad (2)$$

where (P) represents the practicality percentage, (f) is the total score obtained, and (N) is the maximum possible score. The practicality level was interpreted according to the criteria presented in Table 2.

Table 2. Practicality Categories

Percentage Interval	Practicality Category
80% < P ≤ 100%	Very Practical
60% < P ≤ 80%	Valid
40% < P ≤ 60%	Fairly Practical
20% < P ≤ 40%	Less Practical
0% < P ≤ 20%	Not Practical

(Source: Ref [15]; [16])

III. RESULTS AND DISCUSSION

A. Product Development

This study developed a Canva-assisted *Assessment as Learning* (AaL) instrument integrated with the *Problem Based Learning* (PBL) model for physics learning on the topic of Heat and Heat Transfer. The instrument was developed following the first nine stages of the Dick and Carey instructional design model, with the development process concluding in product revision based on the results of expert validation.

The developed instrument was designed as an interactive digital assessment using Canva. It consists of an introductory page, learning objectives, user instructions, contextual problem scenarios, and problem-solving worksheets based on Polya's four problem-solving stages, with each stage followed by a self-reflection activity. The instrument also includes feedback pages. All of these components were systematically integrated into the five phases of the Problem Based Learning (PBL) model to facilitate students in solving physics problems while monitoring and reflecting on their own learning processes.

Unlike conventional assessment instruments that primarily focus on measuring learning outcomes, the developed instrument emphasizes the principles of *Assessment as Learning* by encouraging students to continuously monitor, evaluate, and improve their understanding through *self-assessment* and *self-reflection*. The integration of the *Problem Based Learning* model, Polya's problem-solving stages, and Canva's interactive digital features enables assessment to function not only as a tool for measuring learning outcomes but also as a means of supporting students' learning processes and fostering their problem-solving and metacognitive skills.

Fig. 2. Initial page of the developed product.

B. Product Validity

Physics Education, Universitas Negeri Padang. The validation evaluated seven aspects: content feasibility, *Problem Based Learning* (PBL) syntax, *Assessment as Learning* (AaL) principles, Polya's problem-solving stages, Canva media and technical quality, language, and answer keys.

During the validation process, the validators provided several suggestions to improve the instrument. The recommendations included integrating Polya's problem-solving stages into the learning objectives, aligning the assessment activities with the learning objectives, improving the consistency of the PBL syntax, providing answer keys and scoring rubrics, and enhancing text readability by adjusting the color contrast. These suggestions were incorporated into the product revision before the practicality test.

The results of the product validity analysis are presented in Table 3.

Table 3. Product Validity Results

Aspect	k	Category
Content feasibility	0.92	Highly Valid
Problem Based Learning syntax	0.96	Highly Valid
Assessment as Learning principles	0.87	Highly Valid
Polya's problem-solving stages	0.96	Highly Valid
Canva media and technical quality	0.96	Highly Valid
Language	0.89	Highly Valid
Answer keys	0.91	Highly Valid
Average	**0.93**	**Highly Valid**

As shown in Table 3, all validation aspects obtained Moment Kappa values above 0.81, indicating that the developed instrument met the Very Valid category. The highest validity values were obtained for the integration of the *Problem Based Learning* syntax, Polya's problem-solving stages, and the Canva media and technical quality (k = 0.96). Meanwhile, the *Assessment as Learning* principles received the lowest validity value (k = 0.87). However, this value still falls within the Very Valid category, indicating that the instrument is appropriate for implementation after minor revisions.

The high validity scores indicate that the developed instrument is well aligned with the learning objectives and successfully integrates the principles of *Assessment as Learning*, the syntax of the *Problem Based Learning* model, Polya's four problem-solving stages, and interactive Canva features. Furthermore, the validators considered the language, content organization, and technical quality of the instrument to be appropriate for Grade XI students. The revisions made based on the validators' suggestions further improved the quality and usability of the instrument before it proceeded to the practicality evaluation. The product validity graph is presented in Fig. 3.

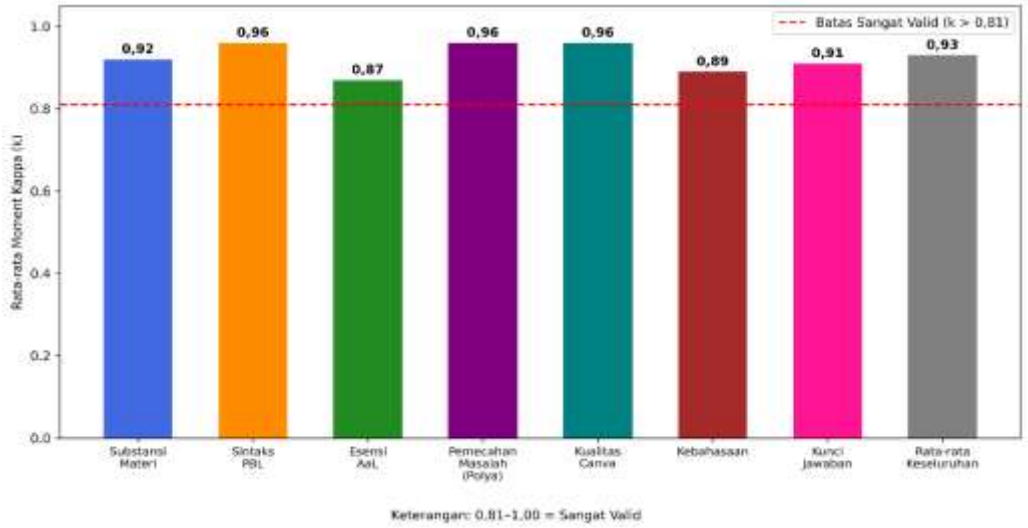

Fig. 3. Product Validation Results Graph.

C. Product Practicality

The practicality assessment evaluated four aspects, namely ease of use, visual attractiveness, implementation efficiency, and usefulness. The results of the teacher and student practicality evaluations are presented in Tables 4 and 5.

Table 4. Theacher Practicality Results

Aspect	(%)	Category
Ease of use	91.67	Highly Practical
Visual attractiveness	87.50	Highly Practical
Implementation efficiency	87.50	Highly Practical
Usefulness	91.67	Highly Practical
Average	**89.58**	**Highly Practical**

The teacher practicality evaluation obtained an average score of 89.58%, indicating that the developed instrument is Highly Practical. The highest scores were obtained in the ease of use and usefulness aspects (91.67%), while visual attractiveness and implementation efficiency each obtained 87.50%. These results indicate that the instrument is easy to implement and beneficial for facilitating Assessment as Learning activities in physics classrooms. Fig 4

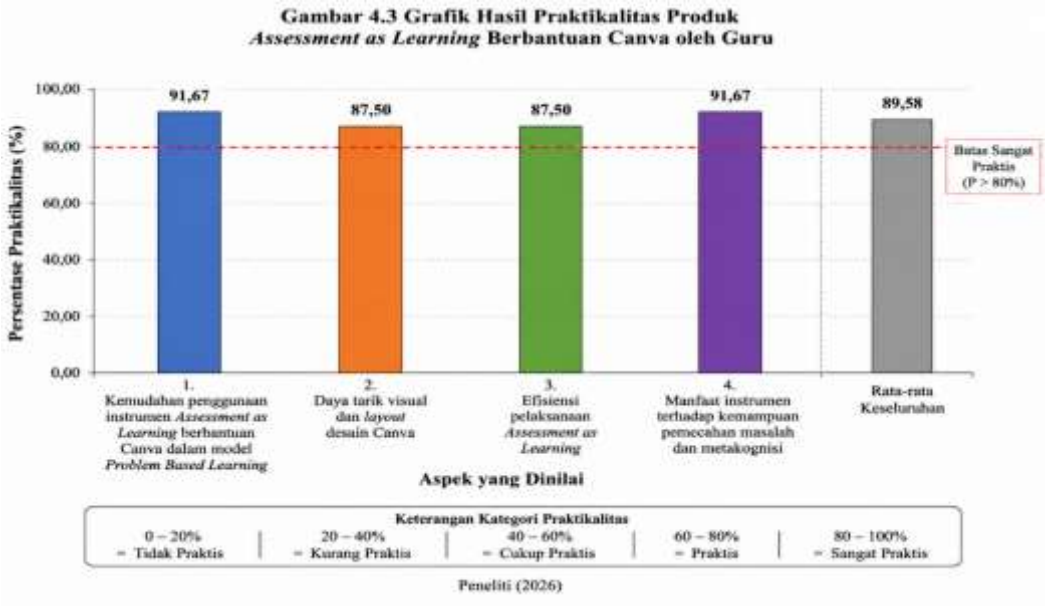

Fig. 4. Teacher Practicality Graph.

The student practicality results are presented in Table 5.

Table 4. student Practicality Results

Aspect	(%)	Category
Ease of use	85.07	Highly Practical
Visual attractiveness	88.02	Highly Practical
Implementation efficiency	89.06	Highly Practical
Usefulness	88.54	Highly Practical
Average	**87.67**	**Highly Practical**

The student practicality evaluation obtained an average score of 87.67%, which also falls into the Highly Practical category. The highest percentage was achieved in implementation efficiency (89.06%), followed by usefulness (88.54%), visual attractiveness (88.02%), and ease of use (85.07%). These findings indicate that students responded positively to the developed instrument and considered it easy to use, visually engaging, and beneficial for supporting their learning. Figure 5. Student Practicality Graph

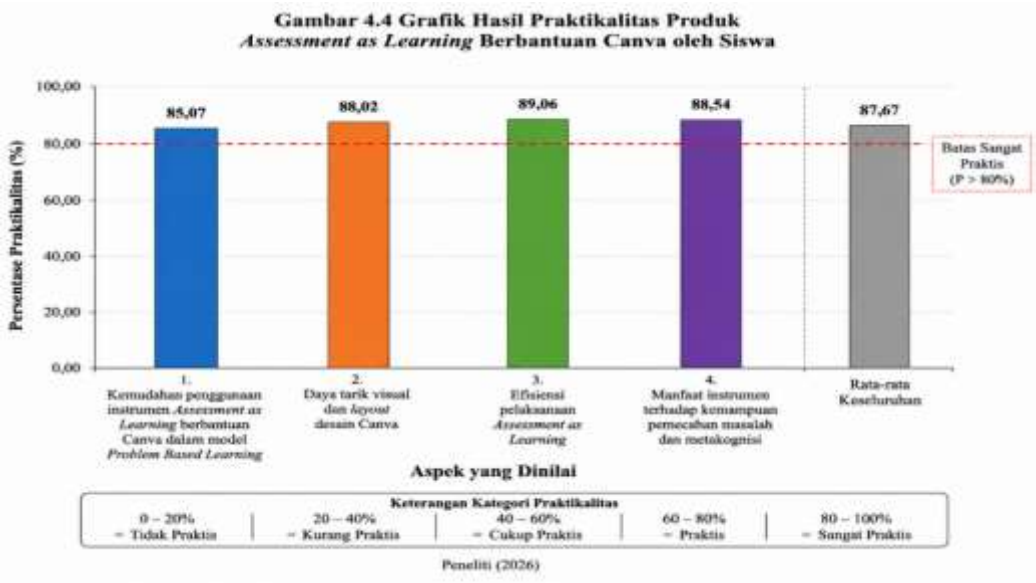

Fig. 5. Student Practicality Graph.

Overall, the practicality results demonstrate that the Canva-assisted Assessment as Learning instrument can be effectively implemented in physics learning. The integration of contextual problems, Polya's problem-solving stages, self-assessment, and reflection activities encourages students to become more actively involved in monitoring and evaluating their own learning processes while improving their problem-solving skills.

IV. CONCLUSION

This study successfully developed a Canva-assisted Assessment as Learning (AaL) instrument integrated with the Problem Based Learning (PBL) model using the Dick and Carey instructional design model. The developed product integrates the syntax of the Problem Based Learning model, Polya's four problem-solving stages, self-assessment, self-reflection, and feedback activities, and was designed in accordance with the Learning Outcomes (CP) and Learning Objectives (TP) of the Merdeka Curriculum for the topic of Heat and Heat Transfer in Grade XI (Phase F). Furthermore, the developed instrument met the criteria of Highly Valid and Highly Practical, with an average Moment Kappa value of 0.93, a teacher practicality score of 89.58%, and a student practicality score of 87.67%. Therefore, the developed instrument is considered suitable for use as an alternative assessment tool in physics learning to facilitate Assessment as Learning and support the development of students' problem-solving skills.

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