Developing problem-based learning model integrated with Quizizz application to enhance science learning in SMP Pulau Bunaken, Indonesia

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Abstract

This research aimed to develop a Problem-Based Learning (PBL) model integrated with the Quizizz application for science instruction in SMP Pulau Bunaken, Indonesia. The study employed the ADDIE development model, encompassing Analysis, Design, Development, and Evaluation stages, to produce and validate the instructional media. Data collection instruments included validation sheets completed by experts in content and media, as well as student response questionnaires. The findings revealed that the developed PBL-based Quizizz instructional media demonstrated a high degree of validity, with content experts rating it at 98% and media experts at 97%, categorizing the media as highly valid and feasible for classroom implementation. Moreover, small- and large-scale trials indicated a very positive student response (97% and 97%, respectively), signifying that the media effectively enhances student engagement and learning interest in science. The study recommends the integration of innovative technology-based media to foster interactive learning environments that align with the Merdeka Curriculum framework in Indonesian education.

Keywords: Problem-Based Learning, Quizizz Application; Instructional Media Development; Science Education; ADDIE Model

1. Introduction

Education is a means through which individuals can achieve a better quality of life (Suryanarayana, *et al*., 2024) [48]. Indonesia recognizes three pathways of education: formal, non-formal, and informal education (Rottger, 2024) [43]. Formal education refers to systematic, structured, and tiered educational activities that commence at the elementary level and extend to higher education, whereas non-formal education provides lifelong learning opportunities for all individuals to enrich their knowledge. Meanwhile, informal education (family-based education) refers to the first education an individual receives within the family environment, such as being taught politeness and moral values (Li & Li, 2023; Siregar, *et al*., 2019) [17, 45].

According to Pramana *et al*. (2021) [37], education is a conscious and planned effort to create an atmosphere of learning and the learning process so that students can actively develop their potential, attain spiritual and religious strength, self-control, personality, noble character, and the necessary skills for themselves and society.

SMP Negeri 12 Manado was the research site chosen by the researcher, where the Merdeka Curriculum has been implemented. The subject of the study was science education (IPA), which under the Merdeka Curriculum is integrated rather than taught as a standalone subject.

The Merdeka Curriculum, introduced by the Indonesian Minister of Education and Culture, Mr. Nadiem Makarim, promotes the concept of independent learning, aiming to create a joyful learning environment. The objective of independent learning is to create an enjoyable atmosphere for teachers, students, and parents, as the principle of Merdeka learning emphasizes that education should foster a pleasant environment (Nasution, 2021, p. 139) [24].

The role of teachers is defined by the Indonesian Law No. 14 of 2005 concerning Teachers and Lecturers, Article 1, Paragraph 1, which states that teachers are professional educators whose primary responsibilities include educating, teaching, guiding, directing, training, assessing, and evaluating students in formal early childhood education, primary education, and secondary education (Loeneto, *et al*., 2022; Leasa, Rengkuan, & Batlolona, 2024) [18, 24].

A professional teacher is capable of developing instructional content and mastering various teaching methods, models, and media to create an engaging learning atmosphere.

Within the learning process, teachers play a crucial role in creating learning conditions that encourage student participation and comprehension. Efforts to establish learning conditions that engage students actively require teachers' ability to implement appropriate and varied teaching models, enabling students to participate actively and achieve the expected learning outcomes (Kusmawan, *et al*., 2025; Mokalu, *et al*., 2023; Rengkuan, *et al*., 2022) [14, 22, 40].

Learning interest serves as a fundamental factor for students to achieve optimal learning outcomes; as interest increases, students find it easier to comprehend the material presented during instruction. (Harefa, *et al*., 2023; Tumbel, *et al*., 2022; Paat, *et al*., 2019) [10, 53, 32].

Based on preliminary observations conducted by the researcher and the seventh-grade teacher on February 12, 2025, in Grade VII at SMP Negeri 12 Manado, it was found that students' interest and learning outcomes in science were relatively low.

According to the gathered information, students at SMP Negeri 12 Manado demonstrated low learning interest, as they often lacked focus during the teacher's explanation. This was attributed to inappropriate and infrequent use of instructional models and media by the teacher.

The low science learning outcomes were caused by the students' lack of interest in participating in the learning process. Furthermore, the lack of student interest in science was due to the inappropriate and infrequent use of instructional models and media by the teacher during the learning process. (Harefa, *et al*., 2023; Mokalu, Wowor, & Tumewu, 2022) [10, 23].

Some seventh-grade teachers at SMP Negeri 12 Manado rarely utilized instructional models and media, relying instead on conventional, teacher-centered teaching methods such as lectures. Teachers seldom engaged students in discussions, questions, or opinions about the material being studied. Consequently, students merely sat passively listening to the teacher's explanation and were then directed to answer questions from the textbook, which made the learning process monotonous and unengaging.

Problem-Based Learning (PBL) is an instructional model that uses real-world, unstructured, and open-ended problems as contexts for students to develop critical thinking, problem-solving skills, and new knowledge. During the learning process, students—individually or in groups—address authentic problems using their own strategies and prior knowledge, emphasizing active knowledge construction rather than passive reception from the teacher. (Odeh, 2021; Paat, *et al*., 2023; Kembuan, *et al*., 2019) [25, 34, 12].

The homeroom teacher of Grade VII at SMP Negeri 12 Manado observed similar issues.

To address these challenges, innovative and effective instructional approaches are needed, including engaging instructional models and media. One potential instructional model is Problem-Based Learning, while one relevant instructional medium is the Quizizz application. According to Hotimah (2020, p. 5) [11], Problem-Based Learning is an instructional method that is triggered by problems, encouraging students to learn collaboratively in groups to find solutions, think critically and analytically, and effectively identify and utilize appropriate learning resources to solve the presented problems. In summary, Problem-Based Learning is a problem-oriented instructional model situated in authentic contexts.

Instructional media are essentially designed to create an environment that supports the teaching and learning process and serves as a conduit for delivering messages to achieve learning objectives (Eva *et al*., 2020, p. 2) [7]. Therefore, teachers should leverage technology-based instructional media to motivate and engage students in the learning process.

Technology-based instructional media have become essential in modern education as they enhance the delivery of content in a more engaging manner. The integration of technological media can significantly increase students' interest and curiosity in comprehending the learning material presented by the teacher (Thelma, *et al*., 2024; Paat, *et al*., 2024) [52, 29]. In this regard, to foster a pleasant and conducive classroom atmosphere, teachers should utilize engaging instructional media that have the potential to enhance students' learning interest, thereby making the material more accessible and easier to understand (Ramzan, *et al*., 2023; Solung, 2021) [38, 46]. One technology-based instructional medium that teachers can integrate into the learning process is the Quizizz application. According to Ardiansyah (2022, p. 419) [2], Quizizz is a platform designed as an interactive and enjoyable learning exercise. The use of Quizizz facilitates easier, more engaging, and less monotonous learning experiences for students.

Quizizz has proven to be an effective educational game that captures students' interest in completing exercises or quizzes, making the teaching and learning process more dynamic and facilitating the implementation of instructional activities (Annisa & Erwin, 2021, p. 3662) [1]. In conclusion, the Quizizz application is a game-based instructional platform that features interactive quizzes that engage students, make learning activities more appealing, simplify the implementation of the learning process, and support teachers in conducting assessments.

2. Materials and methods

A) Problem-Based Learning (PBL) model

a) Definition of the Problem-Based Learning (PBL) model

The Problem-Based Learning (PBL) model is an instructional approach in which students collaborate in groups to identify a problem and work together to find a solution. This model facilitates students in collaboratively identifying problems and developing the skills to address real-world issues that are closely connected to their everyday lives (S. S. Dewi *et al*., 2022, p. 979) [6]. Problem-Based Learning presents contextually relevant problems that stimulate students to engage in learning. This approach is considered effective for helping students process information and construct their own knowledge about the social world and their surroundings. Describe Problem-Based Learning as a model that begins with presenting real-world problems, actively involving students in solving those problems, thereby increasing their motivation and curiosity. This model serves as a platform for students to develop higher-order thinking skills and critical thinking abilities. (Magdalena, *et al*., 2021; Manein, *et al*., 2025; Lelamula, *et al*., 2022; Paat, *et al*., 2021) [19, 20, 28].

In summary, Problem-Based Learning is an instructional model that enables students to work collaboratively with their peers to solve context-based problems using their existing knowledge and experiences, fostering the development of critical thinking skills.

b) Steps of the Problem-Based Learning (PBL) model

The steps of the Problem-Based Learning model, are as follows:

- Orienting students to the problem;
- Organizing students to learn;
- Guiding individual and group investigations;
- Developing and presenting work products;
- Analyzing and evaluating the problem-solving process.

Furthermore, Sugiyanto, as cited in S. S. Dewi *et al*. (2022, p. 381) [6], outlines the steps of Problem-Based Learning as follows:

- Orienting the problem by forming groups of 4–5 students;
- Organizing students and guiding them in conducting case analyses;
- Collecting resources as materials to solve the case;
- Developing and presenting the results of discussions in either discussion or presentation formats;
- Analyzing and evaluating the process and outcomes of the case solution.

Based on these frameworks, teachers can design contextually relevant problem-based learning steps for implementation in the classroom.

c) Advantages of the Problem-Based Learning (PBL) model

The advantages of the Problem-Based Learning model include:

- More meaningful student learning;
- Increased student capacity for critical thinking;
- Easier comprehension of concepts taught;
- Enhanced student activity and creativity in problem-solving;
- Improved student collaboration in groups.

Additionally, Hotimah (2020, p. 7) [11] identifies the following advantages:

- Increased student motivation and learning activities;
- Assistance in transferring knowledge to understand real-world problems;
- Opportunities for students to develop new knowledge;
- Enhanced critical thinking skills;
- Opportunities for students to apply their knowledge in real-world contexts;
- Facilitation of concept mastery for solving authentic problems.

d) Limitations of the Problem-Based Learning (PBL) model

The limitations of the Problem-Based Learning model include:

- It cannot be applied to every subject matter;
- Some teachers may be overly active in delivering content;
- It is more suitable for subjects that emphasize specific problem-solving skills;
- In classes with high student diversity, it may be challenging to assign tasks effectively.

Similarly, outlines the following limitations:

- Some subject matter is very difficult to teach using the Problem-Based Learning model;
- It requires considerable time allocation;
- Instruction is primarily based on problem-solving. (Hasanah & Fitria, 2021; Tengor, *et al*., 2023; Kindangen, *et al*., 2023; Pasaribu LT, *et al*., 2024; Tauri, 2023; Tangdilian, 2023; Rengkuan, *et al*., 2024) [9, 51, 13, 35, 50, 49, 39].

B) Instructional media

a) Definition of Quizizz as instructional media

Instructional media plays a crucial role in the learning process. Instructional media refers to tools used by teachers to facilitate the delivery of information or instructions to students during the learning process and can be tailored to meet the needs of students throughout the teaching and learning activities to achieve learning objectives. (Haddar & Juliano, 2021; Pertiwi, *et al*., 2023; Sanudin, *et al*., 2023) [8, 36, 44].

Quizizz is an educational game application that is both narrative and flexible, serving not only as a medium to deliver learning material but also as an engaging and enjoyable tool for formative assessment. By utilizing Quizizz as instructional media, teachers can create a more dynamic learning atmosphere that enhances the achievement of learning objectives. According to Citra and Rosy (2020, p. 264) [4], Quizizz is an educational game-based learning platform that includes interactive quizzes commonly used for activities such as pre-tests, post-tests, practice exercises, content reinforcement to assess student understanding, remedial activities, and homework assignments, featuring diverse answer choices with images and colors.

In summary, the Quizizz application as instructional media is an educational game-based application that serves as both a platform for delivering learning material and an engaging and enjoyable tool for formative assessment. It can be used in learning activities such as pre-tests, post-tests, and practice exercises, with answer choices that include varied images and colors.

Research methodology

Based on its purpose and objectives, this study is classified as development research, which aims to develop instructional media to facilitate students' comprehension of learning materials. The research and development method is a research approach employed to produce a specific product and to test its effectiveness (Sugiyono, 2014, p. 297). Research and development refers to a process or set of steps used to develop a new product or improve an existing product in a way that is accountable. Such products are not limited to tangible objects or hardware, such as books, modules, or teaching aids for classroom or laboratory use, but may also include software, such as computer programs for data processing, classroom learning, libraries or laboratories, or models of education, learning, training, guidance, evaluation, and management. Based on the aforementioned perspectives, it can be concluded that development research is an approach used to develop a product or improve an existing one, which is then subject to validation to determine its effectiveness for use in schools. In accordance with the ADDIE development model, the researcher chose to modify the process by using only four stages, as this study focuses solely on the revisions provided by the validators. (Richey & Klein, 2014; Sondakh., *et al*., Mokalu, *et al*., 2024) [41, 21].

1. Analysis

- The researcher identified problems occurring at the school through interviews with teachers.
- The researcher formulated solutions to the problems faced by the teachers at the school.

2. Design

- The researcher designed instructional materials using computer-based slides for each session, including interactive quiz questions accessible via a Quizizz link embedded at the end of each slide. Students could click the link to access the Quizizz application. During this stage, the researcher also developed validation sheets for expert validators (media experts).

3. Development

- In this stage, the researcher revised the validation sheets and developed the final product based on the validators' feedback. The revisions were incorporated into the slides, resulting in the finalized instructional media.

4. Evaluation (Feedback)

- This stage involved calculating the validation scores from the validators (media experts). The results consisted of the mean scores or averages derived from each validator who completed the validation sheets designed by the researcher. (Richey & Klein, 2014; Tampinongkol, *et al*., 2022; Umar, *et al*., 2022; Lahutung, *et al*., 2021) [41, 54, 15].

This study was conducted during the even semester, from early March to mid-April, during which validation was sought from expert validators. The research site was SMP Negeri 12 Manado, located in the Bunaken Kepulauan subdistrict. The research was conducted during the 2024/2025 academic year. The subject of the field trial was the Problem-Based Learning (PBL) model integrated with the Quizizz application at SMP Pulau Bunaken.

The research instrument refers to tools used to collect data in a research study. The primary instrument utilized was a validation sheet. A validation sheet is designed to assess the accuracy and appropriateness of a product and to test the feasibility of the instructional product developed by the researcher. An instrument is considered valid if it accurately measures what it is intended to measure.

Accordingly, the instrument employed in this study was a validation sheet used to determine the validity of the instructional media developed.

This study used several instruments to collect data, namely:

- Questionnaires (completed by media experts and content experts);
- Interviews;
- Observations. (Colton & Covert, 2007; Roebianto, *et al*., 2023) [5, 42].

In this study, the data collection technique used to assess the validity of the instructional media was the validation sheet. The rating scale on the validation sheet was completed by expert validators using a Likert scale. The Likert scale is a psychometric scale commonly employed in research to capture individuals' perceptions of a given phenomenon, with response options ranging from "strongly disagree" to "strongly agree". The Likert scale used in this study is presented in the table below:

Table 1: Validation sheet categories

No.	Validation Category	Description
1.	Very Good	5
2.	Good	4
3.	Fair	3
4.	Poor	2
5.	Very Poor	1

(***Source:*** Roebianto, *et al*., 2023) [42]

Data analysis technique

The collected data were analyzed using descriptive analysis. Descriptive analysis focuses on issues that arise during the implementation of the study, thus the findings are applicable to that specific context. The researcher revised the instructional media based on feedback and comments provided by the validators. The validation of the assessment instrument was determined by calculating the mean score assigned by the validators and the results of the student response questionnaires (Sudjana, 2014, p. 64; Onsu, *et al*., 2023) [26].

According to Arikunto (2010), the interpretation of scores is as follows:

- 0% – 20% = Very Weak
- 21% – 40% = Weak
- 41% – 60% = Fair
- 61% – 80% = Strong
- 81% – 100% = Very Strong

(Total Score Achieved)/(Maximum Score) × 100% = %

3. Results & Discussion

a. Initial page

The initial page refers to the introductory screen displayed when the Quizizz-based instructional media is opened and operated. The first slide contains the opening section and material for the first session. The second slide outlines the learning objectives.

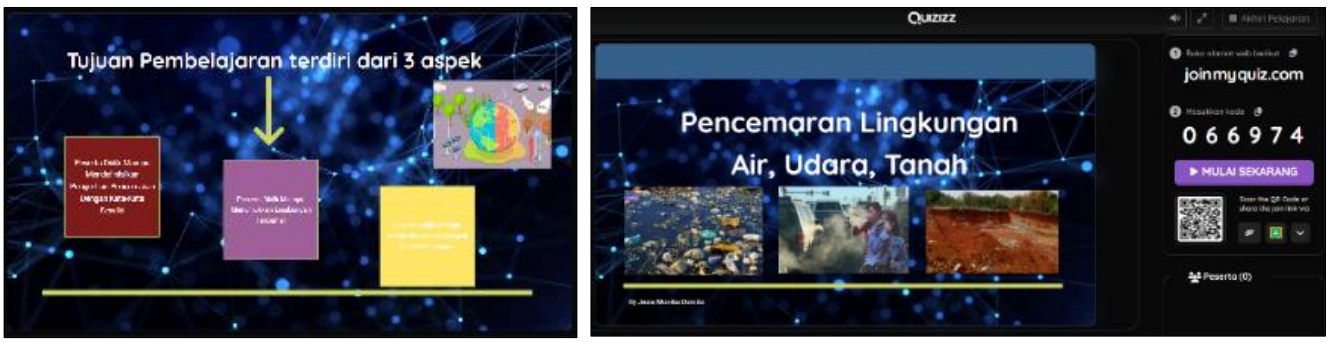

Fig 1: Initial slide display and second slide with learning objectives

b. Material presentation (student orientation to the problem)

On the third slide, the material is presented in alignment with the Problem-Based Learning (PBL) model by providing a barcode that links to an instructional video and concise learning material, continuing through to the sixth slide.

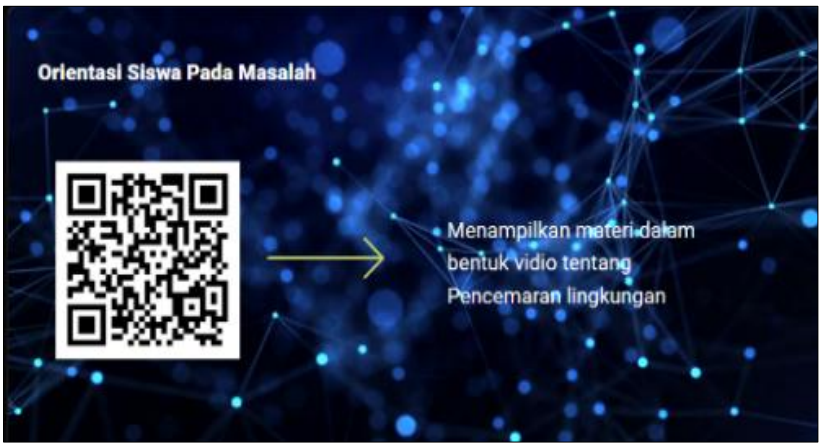

Fig 2: Slides three to six: material presentation

Step two (organizing students for learning)

These slides guide students to think critically about identifying problems that may arise based on the video content, which can be accessed via a barcode, thereby enabling them to comprehend the material using the instructional media.

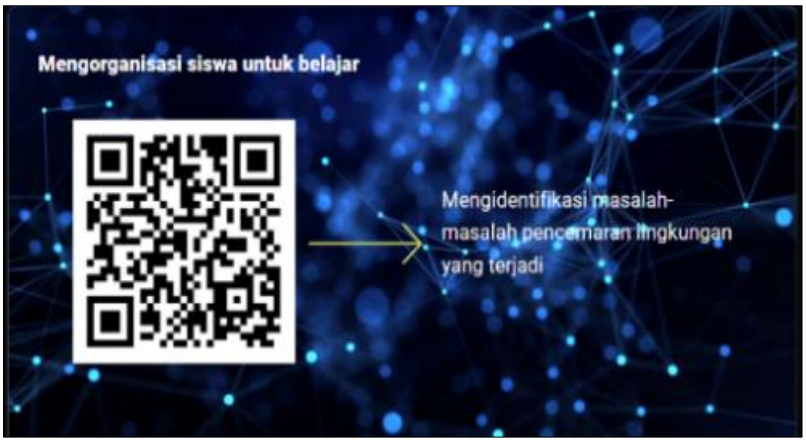

Fig 3: Slide seven: problem identification

Steps three and four (guiding individual and group investigation) and (developing and presenting work products)

This slide displays a barcode-linked worksheet (LKPD) that organizes students into study groups to discuss, gather information, and present the outcomes of their group discussions regarding the learning material.

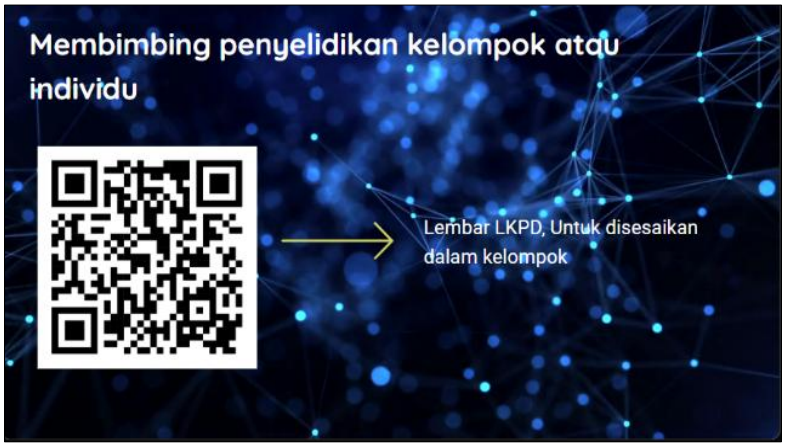

Fig 4: Slide Eight: Worksheet (LKPD)

Step five (analyzing and evaluating the problem-solving process)

Slides ten through nineteen feature a quiz in the form of questions for students to complete.

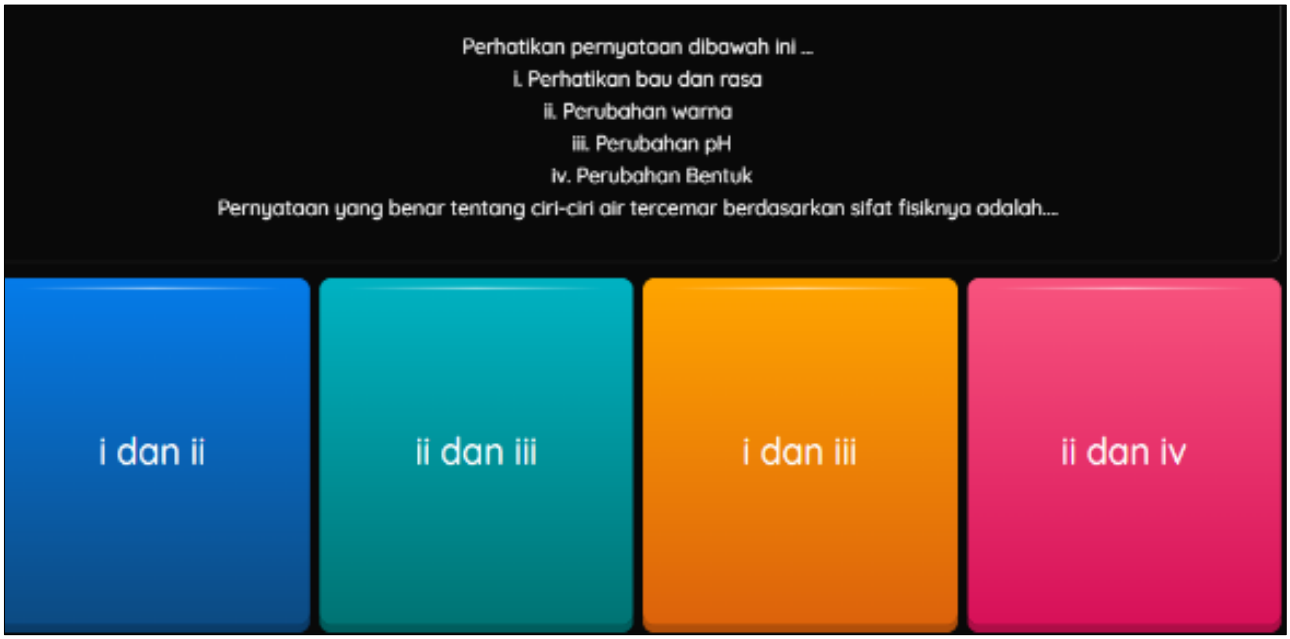

Fig 5: Quiz-based evaluation slide

At this stage, the researcher also designed a validation sheet to be assessed by expert validators regarding the developed product. This validation sheet was designed by the researcher as follows:

Development of instructional media

The instructional media were designed and subsequently developed. Based on the development of the PBL model integrated with technology, this instructional media was created using the Quizizz application. The content of the instructional media comprises materials on environmental pollution, sourced from YouTube videos relevant to Grade VII science.

Product feasibility validation

Upon completion of the instructional media, product feasibility validation was conducted. This validation was performed by expert validators who provided both theoretical and practical considerations. Expert validators consisted of media experts and content experts.

Results of the development stage validation sheet utilized by validators

During the development stage, the researcher revised the validation sheet based on expert feedback and proceeded to the validation phase with media and content experts. The revised validation sheet was distributed to validators as follows:

Validation by content experts

In the process of validating the instructional media, content expert validation was conducted twice using the Quizizz application. The content experts assessed the relevance of the material. In addition to evaluating feasibility, content experts also provided comments and suggestions for improving the media. The results of the content expert validation are presented in Table 4.1:

Table 2: Results of content expert validation

No.	Indicator and assessment item	Rating scale
		5
1.	Alignment of Material Description with Core Competencies and Basic Competencies (KI & KD):	√
	▪ Completeness of the material based on Learning Outcomes (CP)	√
	▪ Alignment of the material with Learning Objectives (ATP)	√
2.	Material Accuracy:	√
	▪ Accuracy of presented material	√
	▪ Clarity of concepts and definitions	√
	▪ Factual accuracy	√
	▪ Image accuracy	√
	▪ Symbol accuracy	√
	▪ Reference accuracy	√

3.	Proportionality: ▪ Balance between core and supporting material ▪ Balance between comprehensiveness and depth of content	√ √ √
4.	Language: ▪ Sentence structure ▪ Sentence effectiveness ▪ Grammatical accuracy ▪ Spelling accuracy	√ √ √ √ √

Total Score: 74

Based on Table 4.1, the analysis refers to the scoring interpretation by Arikunto (in Lutaan, 2014):

- 0% – 20% = Very Weak
- 21% – 40% = Weak
- 41% – 60% = Fair
- 61% – 80% = Strong
- 81% – 100% = Very Strong (Total Score Achieved)/(Maximum Score) × 100% = (74/75) × 100% = 98%

According to the content expert assessment, the relevance of the material achieved a very strong score of 98%, categorizing it as highly feasible for use. Overall, the Quizizz-based instructional media developed by the researcher is ready for field testing. The content experts provided several recommendations, including adjustments to sentence structure to ensure clarity and coherence, which the researcher subsequently revised.

Validation by media experts

Media experts conducted two rounds of validation using the Canva application to evaluate media display aspects. Besides assessing feasibility, media experts also provided feedback and suggestions for improvement. The results of the media expert validation are presented in Table 4.2:

Table 3: Results of media expert questionnaire

No.	Indicator and assessment item	Rating scale
		5
1.	Cover: ▪ Visual focal point ▪ Composition and layout ▪ Color scheme ▪ Cover image	√ √ √ √ √
2.	Typography/Font: ▪ Font selection and usage ▪ b. Text arrangement, color, and size	√ √ √
3.	Display: ▪ Layout ▪ Background selection ▪ Image placement ▪ Text composition ▪ Design neatness ▪ f. Design attractiveness	√ √ √ √ √ √ √
4.	Images: ▪ Support of content ▪ Image harmony ▪ c. Image attractiveness	√ √ √ √

Total Score: 73

The analysis of Table 4.2 follows the scoring interpretation by Arikunto (2010):

- 0% – 20% = Very Weak
- 21% – 40% = Weak
- 41% – 60% = Fair
- 61% – 80% = Strong
- 81% – 100% = Very Strong (Total Score Achieved)/(Maximum Score) × 100% = (73/75) × 100% = 97%

According to the media expert assessment, the media aspect scored 97%, indicating it is very strong and highly feasible for use. Consequently, the Quizizz-based instructional media developed by the researcher is ready for field testing. The media experts suggested improvements to ensure the use of operational and measurable language.

Prior to implementation with all seventh-grade students at SMP Negeri 12 Manado, the Quizizz-based learning model and instructional media underwent small-scale testing in one class with similar characteristics, involving 10 students. The results of the small-scale test are presented in the following table:

Student responses in small-scale trial

Table 4: Student response questionnaire – small group trial

No.	Indicator	SS (Strongly Agree)	S (Agree)	R (Neutral)	TS (Disagree)	STS (Strongly Disagree)
1	Balanced cover design with appealing visuals	10 (100%)	0	0	0	0
2	Use of simple, comprehensible language	10 (100%)	0	0	0	0
3	Appropriate font usage and sizing	8 (80%)	2 (20%)	0	0	0
4	Neat instructional material layout	10 (100%)	0	0	0	0
5	Clear image captions within instructional materials	8 (80%)	1 (10%)	1 (10%)	0	0
6	Clear image captions within instructional materials	7 (70%)	3 (30%)	0	0	0
7	Organized design of Quizizz media	9 (90%)	1 (10%)	0	0	0
8	Material is quickly understood and easily remembered	10 (100%)	0	0	0	0
9	Harmonious presentation of Quizizz media with supporting images	9 (90%)	1 (10%)	0	0	0
10	Quizizz instructional materials enhance learning outcomes	8 (80%)	1 (10%)	1 (10%)	0	0

Percentage summary

- Strongly Agree (SS): 89%
- Agree (S): 9%
- Neutral (R): 2%
- Disagree (TS): 0%
- Strongly Disagree (STS): 0%

Interpretation

The data indicates that the majority of students in the small group trial responded positively to the instructional materials. Specifically, 89% of responses fell into the "Strongly Agree" category, suggesting high levels of satisfaction and perceived effectiveness. This positive reception implies that the Quizizz-based instructional media on environmental pollution is both suitable and effective for educational use, albeit with minor revisions based on feedback.

Implementation phase

Following the development phase, the revised instructional media were implemented in a larger group setting. The media, delivered via Quizizz, were accessed by students through a barcode link provided before the commencement of lessons. The instructional sessions employed a Problem-Based Learning (PBL) model and were conducted by the researcher. Upon completion of the instructional sessions, students were asked to complete a questionnaire to gauge their responses to the Quizizz-based instructional media.

Table 5: Student response questionnaire – large group implementation

No.	Indicator	SS (Strongly Agree)	S (Agree)	R (Neutral)	TS (Disagree)	STS (Strongly Disagree)
1	Balanced cover design with appealing visuals	16 (88%)	2 (11%)	0	0	0
2	Use of simple, comprehensible language	18 (100%)	0	0	0	0
3	Appropriate font usage and sizing	17 (94%)	1 (6%)	0	0	0
4	Neat instructional material layout	15 (83%)	3 (17%)	0	0	0
5	Harmonious presentation of PBL module with supporting images	16 (88%)	1 (6%)	1 (6%)	0	0
6	Clear image captions within instructional materials	14 (77%)	2 (11%)	2 (11%)	0	0
7	Organized design of Quizizz media	16 (88%)	1 (6%)	1 (6%)	0	0
8	Material is quickly understood and easily remembered	11 (61%)	6 (33%)	1 (6%)	0	0
9	Harmonious presentation of Quizizz media with supporting images	15 (83%)	3 (17%)	0	0	0
10	Quizizz instructional materials enhance learning outcomes	10 (55%)	7 (39%)	1 (6%)	0	0

Percentage Summary:

- Strongly Agree (SS): 82%
- Agree (S): 15%
- Neutral (R): 4%
- Disagree (TS): 0%
- Strongly Disagree (STS): 0%

Interpretation

The implementation phase results demonstrate a strong positive response from students, with 82% expressing strong agreement with the effectiveness and quality of the instructional media. The high levels of agreement suggest that the Quizizz-based instructional materials are effective in enhancing student engagement and learning outcomes in a larger classroom setting.

Evaluation

The evaluation phase, the final stage of the ADDIE model, focused on assessing the implementation's effectiveness. Feedback collected from students during the trial informed the final revisions to the instructional media. The overwhelmingly positive responses indicate that the Quizizz-based instructional materials are well-received and effective in facilitating learning.

Discussion

Designing instructional media

The instructional media were designed using Quizizz to create an interactive learning environment that promotes student autonomy. The content focused on environmental pollution, supplemented with quizzes and video materials accessible via barcodes embedded in the slides. Following expert reviews and revisions, the media were tested in a limited trial with 10 seventh-grade students from SMP Negeri 12 Manado. The trial yielded positive results, with students expressing enthusiasm and increased engagement. The integration of Quizizz with students' learning accounts allowed for unrestricted access to high-quality quizzes, enhancing the learning experience. The positive feedback, with a 97% approval rate, underscores the media's effectiveness.

Advantages of the developed instructional media

a) **Enhanced engagement:** The structured and accessible content makes learning more appealing and manageable, addressing time constraints and simplifying complex concepts through clear language and engaging visuals.
b) **Versatility:** The media can be adapted for various science topics beyond environmental pollution.
c) **Accessibility:** Quizizz is compatible with multiple devices, including smartphones, tablets, and computers, and is readily available on major app platforms.
d) **Convenient access:** The instructional materials can be accessed through various means, such as Google Drive links, barcodes, and numerical codes, facilitating flexible learning environments.

Limited trial results

The limited trial results indicate a 97% positive response rate from students, aligning well with the Problem-Based Learning approach. Both students and teachers reported that the Quizizz-based media made the material more relatable and easier to comprehend, transforming the learning process into an engaging and enjoyable experience.

4. Conclusions

Based on the research findings, it can be concluded that the development of the Problem-Based Learning (PBL) model integrated with the Quizizz application, as designed by the researcher, has demonstrated a very high level of validity, placing it within the “Very Valid” category. This finding indicates that the instructional media and learning model developed are feasible and suitable for practical implementation in classroom settings, with the potential to effectively enhance student engagement, motivation, and learning outcomes in the context of science education.

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