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Development of Interactive E-Booklet to Improve Scientific Explanation Skills on Respiratory System Topic

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ABSTRACT

A study on the development of an Interactive E-Booklet for the respiratory system topic was carried out to produce a digital learning resource that integrates Problem Based Learning (PBL) with scientific explanation skills indicators. Data were collected using a scientific explanation test, feasibility questionnaires (content, media, and language), a practicality questionnaire, and a student response questionnaire. The ADDIE-based R&D model guided development. During the evaluation phase, a quasi-experimental pretest-posttest control group design was used to examine product effectiveness. Two classes with equivalent characteristics were selected through purposive sampling. The experimental class used the PBL-based Interactive E-Booklet, whereas the control class received PBL instruction without the E-Booklet. Feasibility assessments from material, media, and language experts yielded scores of 96.67%, 90%, and 91.54%, categorized as "very feasible." Practicality evaluation produced a CVI of 0.94 for instructional use. Effectiveness results showed an N-Gain of 0.39 in the experimental class (moderate) and 0.22 in the control class (low). Student responses categorized the Interactive E-Booklet as "very effective," with the visual component scoring 94.44%. These findings demonstrate that the Interactive E-Booklet is a practical evidence-based resource that improves scientific explanation skills and provides teachers with student centered instructional media for classroom implementation

Keywords: e-booklet, scientific explanation skills, problem based learning, respiratory system, interactive

INTRODUCTION

Education can be regarded as a structured human process intended to cultivate personality traits that reflect the social and cultural values prevalent within a particular community and its environment Maryam et al., (2024). The purpose of education is to promote constructive personal development so that individuals are equipped to make meaningful contributions to society Apriyani et al., (2021). In the context of the Industrial Revolution 4.0, the field of education is urged to incorporate technology into instructional practices so that students are equipped with the competencies needed for future careers Hidayati et al., (2019). Learning media are one of the key factors that influence instructional activities. They serve as a support and intermediary in the

process of delivering information from teachers to students, helping to achieve the intended learning objectives. In addition, reasoning skills are an essential competency for addressing various challenges and solving problems. Reasoning involves the process of drawing conclusions or forming judgments based on available facts or on premises that have been proven to be valid Apriyani et al., (2021). From this perspective, reasoning can be understood as students' ability to draw conclusions or express their viewpoints based on verifiable evidence or factual information. By cultivating this skill, students become better equipped to communicate their ideas and thought processes in a clear, evidence-based manner. In turn, this enhances their capacity to provide coherent and scientifically grounded explanations.

Scientific explanation skills involve cognitive processes that enable students to address problems by analyzing real-world evidence and supporting their conclusions with well-reasoned arguments Rojikin et al., (2022). Scientific explanation skills represent a fundamental competency that should be cultivated during instruction, as they enable students to comprehend and internalize key concepts in science learning Sulistiana et al., (2021). The higher students' scientific explanation skills, the better their ability to comprehend learning materials. To construct scientific explanations, students must possess reasoning skills supported by evidence or facts, which they can then articulate as well-founded conclusions to address a particular problem.

According to McNeill & Krajcik, (2012), the framework for scientific explanation skills consists of three components: claim, evidence, and reasoning. A claim is a statement or conclusion that responds directly to the initial question or problem. Evidence refers to data produced from students' investigations or obtained from other sources such as observations, readings, or archived information. To adequately support a claim, the data must be both sufficient in quantity to persuade others and relevant to the question or problem at hand. Reasoning connects the claim and the evidence by demonstrating why the data are appropriate and necessary to substantiate the claim. Scientific explanation skills play a vital role in biology education, especially when studying the respiratory system. This topic contains abstract concepts that can be difficult for students to visualize. By cultivating scientific explanation skills, students can enhance their logical thinking, deepen their mastery of biological concepts, and ultimately improve their scientific reasoning abilities (Mandella et al., 2020).

Scientific explanation skills play a crucial role in biology learning, particularly in topics such as the respiratory system. This topic contains abstract concepts that can be challenging for students to visualize. In practice, many students still struggle with these skills. Current observations indicate that most students can formulate or state claims, but they face difficulties in providing appropriate evidence and reasoning to support those claims (Braaten & Windschitl, 2011). The Organization for Economic Co-operation and Development (OECD) conducts a global evaluation of education through the Programme for International Student Assessment (PISA), which aims to assess the quality of education systems worldwide. Lestari & Ma'ruf, (2020) emphasize that PISA items demand students to possess advanced problem-solving and reasoning skills. The 2018 PISA results placed Indonesia seventh from the bottom, reflecting the

insufficient development of students' reasoning abilities. This issue is further corroborated by a preliminary needs analysis conducted for the development of an E-Booklet learning medium designed to enhance students' scientific explanation skills on the respiratory system in a Grade XI Biology class at MAN 3 Cirebon. The findings indicated that 62% of the students reported difficulties in responding to tasks that required reasoning, suggesting the urgent need for targeted instructional interventions.

A preliminary study was conducted through semi structured interviews with two Biology teachers using an interview guideline. The teachers reported that students' learning motivation was generally low; many appeared disengaged during lessons, showed minimal participation, or even felt drowsy in class. Although various instructional models, methods, and media had been implemented, students' responsiveness remained limited. Such conditions impede the development of students' scientific explanation skills, as insufficient motivation reduces their willingness to engage meaningfully in learning activities.

Previous studies have shown that digital learning media can improve the quality of learning. Several research projects developed digital modules or e-booklets that were validated in terms of feasibility and practicality, and were positively perceived by students. These studies emphasized improvements in aspects such as critical thinking, learning motivation, readability, or learning outcomes, suggesting that digital media can foster student engagement and support learning. However, existing digital learning resources generally focus on content delivery and do not explicitly integrate scientific explanation indicators within the learning sequence, nor adopt Problem-Based Learning (PBL) as an organizing pedagogical framework.

Accordingly, the development of a digital learning resource that not only presents content effectively but also scaffolds students in constructing scientific explanations is necessary. Therefore, this study develops an interactive E-Booklet using the ADDIE model that integrates PBL and scientific explanation indicators in the context of the respiratory system. The study aims to (1) to analyze the stages involved in developing an interactive E-Booklet using the ADDIE development model; (2) to evaluate the feasibility of the interactive E-Booklet in enhancing students' scientific explanation skills in the respiratory system topic; (3) to assess the practicality of the interactive E-Booklet in supporting students' scientific explanation skills in the respiratory system topic; and (4) to determine the effectiveness of the interactive E-Booklet in improving students' scientific explanation skills in the respiratory system topic.

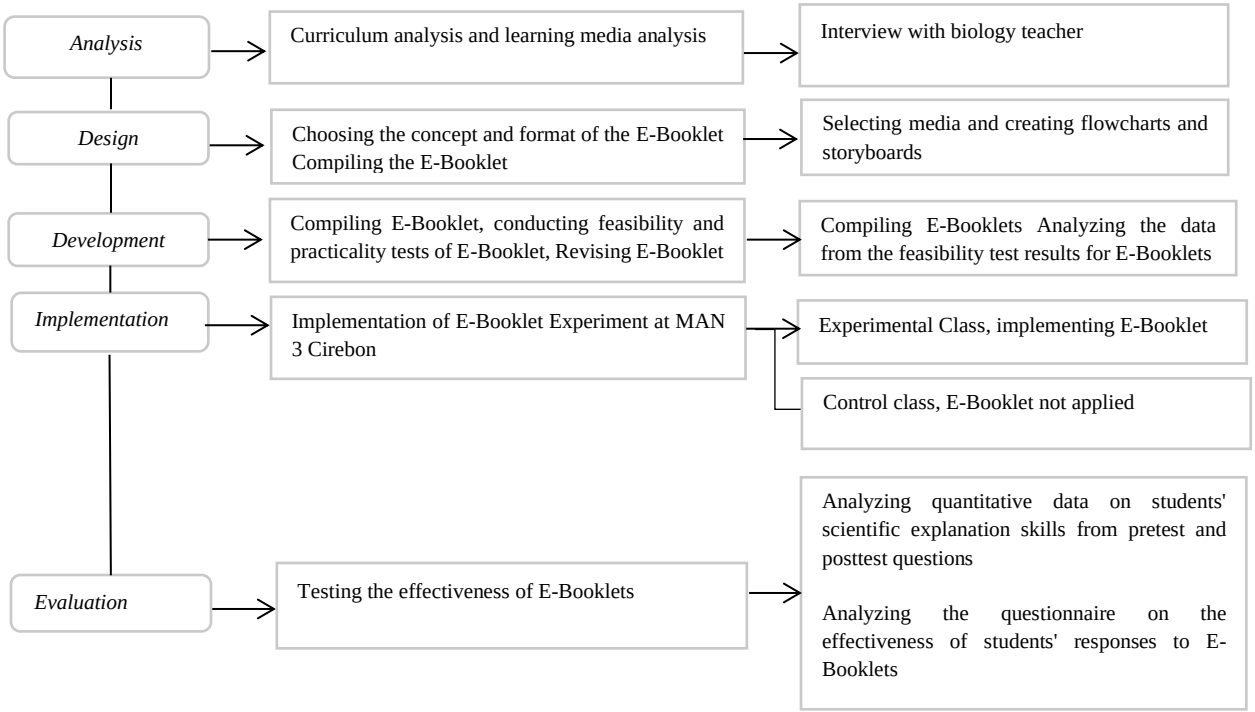
METHOD

This research and development (R&D) study employs the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) (Dick&Carey, 1996). The procedural steps undertaken in this study are outlined in Figure 1.



Figure 1. ADDIE Model Development Stages

The development of the Interactive E-Booklet of the Respiratory System is explained in Figure 2.



Modified from Dewi et al., (2022)

Figure 2. ADDIE Model E-Booklet Development Chart

This developmental research employed the ADDIE model to guide the systematic development and evaluation of the Interactive E-Booklet. The model was selected because it provides a structured and iterative framework for producing effective learning materials (Hidayat & Nizar, 2021). Qualitative data were collected during the analysis, design, and development phases, while quantitative data were obtained during the implementation phase. During the development phase, the feasibility of the E-Booklet was evaluated by subject-matter experts in biology (n = 2), language experts (n = 2), and media/design experts (n = 2). Each group assessed different aspects: biological content accuracy, linguistic appropriateness based on Indonesian grammar standards, and visual/technical design quality. The interpretation criteria for feasibility assessment scores are presented in Table 1. This table provides a reference for categorizing the

E-Booklet items based on expert evaluation across content, language, and media aspects. These criteria were used to determine the eligibility of the E-Booklet for instructional use.

Table 1. Feasibility Criteria

Scale	Criteria
81-100	Very feasible
65-80	Feasible
45-64	Less feasible
0-44	Not feasible

(Hakim et al., 2020)

At the development stage, the practicality of the Interactive E-Booklet was evaluated by five Biology teachers who served as expert judges. Each teacher assessed the E-Booklet based on criteria such as clarity, ease of use, visual presentation, and suitability for classroom implementation. The assessments were quantitatively analyzed using the Content Validity Ratio (CVR) and Content Validity Index (CVI) to determine the degree of agreement among the experts regarding the E-Booklet's appropriateness. Interpretation of CVR and CVI values followed established guidelines (Lawshe, 1975), as summarized in Table 2. This approach ensures a systematic and evidence-based evaluation of the E-Booklet's feasibility and practicality prior to classroom implementation.

Table 2. Minimum Values of CVR

No. of Panelists	Min. Value
5	.99
6	.99
7	.99
8	.75
9	.78
10	.62
11	.59
12	.56
13	.54
14	.51
15	.49
20	.42
25	.37
30	.33
35	.31
40	.29

(Lawshe, 1975)

In the implementation phase, students' scientific explanation skills were measured using an open-ended test constructed based on the Claims–Evidence–Reasoning (CER) framework McNeill & Krajcik, (2012) The instrument underwent expert judgment and statistical validation prior to use and demonstrated strong construct and content validity with high reliability. An independent-samples t-test was applied to compare differences in scientific explanation skills between the experimental and control groups.

RESULT AND DISCUSSION

The interactive E-Booklet developed in this study was designed following the ADDIE model. This model was selected due to its systematic approach, which guides the design and development of learning media tailored to students' specific needs. The development process involved the five key stages of the ADDIE model: analysis, design, development, implementation, and evaluation. The analysis stage was conducted through interviews with biology teachers at MAN 3 Cirebon to identify the existing curriculum and learning media in use. The aim of this stage was to explore the current instructional practices at the school, allowing the researcher to identify gaps between existing learning media and the proposed E-Booklet. The findings indicated that the school implements the independent curriculum and that technology-based media, such as E-Booklets, had not yet been adopted in the biology learning process.

Following the analysis stage, the design stage was conducted. This stage focused on conceptualizing the E-Booklet intended to enhance students' scientific explanation skills, informed by the results of the curriculum and learning media analyses. During this stage, the structure and format of the E-Booklet were carefully designed to support students in gaining a deeper understanding of the respiratory system and in developing their capacity to construct coherent scientific explanations. To achieve these goals, the learning activities embedded in the E-Booklet were aligned with the Problem-Based Learning (PBL) model and integrated with the scientific explanation skill indicators. The relationship between PBL and the scientific explanation skills within the E-Booklet is summarized in Table 3.

Table 3. Integration of PBL and Scientific explanation skills

No	Syntax of the Problem Based Learning (PBL) Model	Scientific explanation skills indicator
1.	Problem Orientation	Claim
2.	Organizing students for learning	
3.	Guiding the investigation	Evidence
4.	Develop and present results	
5.	Analyze and evaluate the problem solving process	Reasoning

The E-Booklet was developed as a digital instructional medium comprising three main sections: the opening, content, and closing sections. To provide a clearer representation of the product structure, the Interactive E-Booklet is visualized in three main sections, as shown in Figures 3-5.



Figure 3. Opening section of the Interactive E-Booklet

The Opening Section serves as the orientation phase of the E-Booklet. This section includes the front cover, foreword, table of contents, list of figures, user guidelines for teachers and students, learning outcomes, learning objectives and their learning flow, schedule and material mapping, concept map, apperception, and an introduction to scientific explanation. These components are designed to provide students with a clear structure of the learning process, clarify expectations, and activate prior knowledge before engaging with the main content. By offering a transparent overview and navigation guidance, this section ensures that learners enter the material with sufficient context, direction, and readiness.



Figure 4. Content section of the Interactive E-Booklet

The Content Section represents the core learning phase, where students interact with the main instructional material. This section presents respiratory system concepts, guided scientific explanation exercises, and the *"Let's Think"* feature, which prompts students to analyze problems, connect phenomena with biological concepts, and justify their reasoning. The design emphasizes active engagement and inquiry-based exploration rather than passive reading. Through structured prompts and visual support, this section encourages deeper conceptual understanding and strengthens students' scientific explanation skills.



Figure 5. Closing section of the Interactive E-Booklet

The Closing Section functions as the consolidation phase. It contains a summary, glossary, bibliography, author biography, and back cover. This section is intended to reinforce key concepts, clarify terminology, and provide sources that support further exploration. The presence of a glossary and summary ensures that students can review essential information independently, enabling knowledge retention even after instruction. By offering closure and reflection opportunities, the Closing Section completes the learning cycle and supports the development of long-term conceptual understanding.

The development stage involved refining the initial design of the E-Booklet produced in the previous phase. This stage consisted of two main processes: the E-Booklet production and its subsequent validation. The E-Booklet production process began by compiling the learning materials and enhancing the content with supporting elements such as images and videos. Additionally, QR codes were embedded to provide access to real-world phenomena related to the respiratory system, which in turn guided students toward scientific explanation exercises. The inclusion of QR codes was intended to help students easily obtain supplementary information and deepen their understanding of the subject matter (Handayani & Haryati, 2024).

The feasibility of the Interactive E-Booklet was assessed by experts in material, media, and language. The evaluation results demonstrated that the E-Booklet met the criteria for very high feasibility, supporting its suitability for classroom implementation. For clarity and ease of interpretation, the detailed assessment scores for each expert category are presented in Table 5.

Table 5. Expert Assessment of the Feasibility of the Interactive E-Booklet

Validator Category	Validator I (%)	Validator II (%)	Average (%)	Criteria
Material Expert	98. 89	94. 44	96.67	Very feasible
Media Expert	92.3 1	90.77	91.54	Very feasible
Language Expert	92	88	90	Very feasible

The Interactive E-Booklet was validated by material, media, and language experts to determine its feasibility for classroom use. The material validation produced feasibility scores 96.67%, indicating a *"very feasible"* category based on the 81–100% range established by Larista et al. (2023). These results demonstrate strong content validity, confirming that the E-Booklet is appropriate for

instructional use, as emphasized by (Akker et al., 2013). The media validation resulted in feasibility scores 91.54% classified as *"very feasible"* The high score reflects effective visual and layout design, which is essential because well-designed instructional materials increase student attention and motivation (Smaldino et al., 2012). Language validation scores 90% confirmed that the E-Booklet uses developmentally appropriate language aligned with students' cognitive levels (Tomlinson, 2011). The content also integrates relevant biological concepts suitable for student learning needs (Marlina et al., 2018). These results align with the standards proposed by Hakim et al., (2020), in which a feasibility score ranging from 81% to 100% is classified as "very feasible.

To assess the practicality of the Interactive E-Booklet, a panel of five senior biology teachers conducted an evaluation using the Content Validity Ratio (CVR) method. Although some individual items did not meet the minimum CVR threshold, the overall Content Validity Index (CVI) indicated a high level of practicality. The detailed results are presented in Table 6 for clarity and ease of interpretation.

Table 6. CVR Judgments and Overall CVI for Practicality Assessment

Item No	CVR	Decision
1	1.00	Acceptable
2	0.60	Less acceptable
3	1.00	Acceptable
4	1.00	Acceptable
5	1.00	Acceptable
6	0.60	Less acceptable
7	1.00	Acceptable
8	1.00	Acceptable
9	1.00	Acceptable
10	1.00	Acceptable
11	1.00	Acceptable
12	1.00	Acceptable
13	0.60	Less acceptable
14	1.00	Acceptable
15	1.00	Acceptable
16	1.00	Acceptable
17	1.00	Acceptable
18	1.00	Acceptable
19	1.00	Acceptable
ΣCVR / CVI	**17.8 / 0.94**	**Feasible**

The practicality assessment indicates that the Interactive E-Booklet on the respiratory system is highly suitable for classroom implementation. According to (Lawshe, 1975), an item is deemed valid if its CVR meets the minimum threshold established by the number of expert judges. Although the strict CVR requirement for five judges is approximately 0.99, minor deviations can be considered acceptable in the context of media development and practical

evaluation. Most items were rated as "very feasible," and the overall CVI of 0.94 confirms that the E-Booklet demonstrates a high level of practicality, supporting its use as an effective learning medium in biology instruction. These findings suggest that the Interactive E-Booklet is highly practical for biology instruction, fulfilling key criteria related to content accuracy, linguistic clarity, and pedagogical effectiveness.

These findings indicate that the Interactive E-Booklet is highly practical for biology instruction, meeting established criteria for content accuracy, linguistic clarity, and effective presentation. The high practicality can be attributed to several factors. The integration of clear explanations with supportive visual elements enhanced students' comprehension and engagement. Moreover, the material was carefully aligned with the national biology curriculum and utilized language that was accessible and appropriate for the target learners, contributing to its ease of use and acceptance by teachers. The systematic development process based on the ADDIE model allowed iterative evaluation and refinement, incorporating feedback from both subject-matter experts and classroom teachers (Hidayat & Nizar, 2021). Collectively, these factors provide a coherent explanation for the observed high practicality of the Interactive E-Booklet and support its implementation in the experimental class.

The implementation phase followed the development stage, in which the Interactive E-Booklet on the respiratory system was employed in both the experimental and control classes at MAN 3 Cirebon. The control class received conventional instruction without the E-Booklet, whereas the experimental class utilized the E-Booklet as the primary instructional medium to enhance students' scientific explanation skills. The instructional sequence consisted of a pretest, three teaching sessions using the E-Booklet, and a posttest. Students' scientific explanation skills were subsequently assessed by comparing pretest and posttest scores.

To quantify the learning gains, N-Gain scores were calculated for both classes. Table 7 presents a recapitulation of the N-Gain scores, categorized into high, medium, and low improvement levels.

Table 7. Recapitulation of N-Gain Scores

Interval	**Category**	**Eksperiment**		**Control**	
		Number of Students	**Percentage (%)**	**Number of Student**	**Percentage (%)**
$g > 0.70$	High	0	0%	0	0%
$0.70 \leq g \leq 0{,}30$	Medium	32	88.89%	8	22.86%
$g \leq 0.30$	Low	4	11.11%	27	77.14%
Total		36	100%	36	100%
Mean			39,02		022,53

As illustrated in Table 7, the majority of students in the experimental class demonstrated medium N-Gain values, indicating moderate improvement in scientific explanation skills. Conversely, most students in the control class remained in the low N-Gain category, reflecting limited progress. These findings suggest that the use of the Interactive E-Booklet contributed positively to the development of scientific explanation skills. To further clarify the magnitude of learning gains, Figure 6 visualizes the average N-Gain scores for both classes.

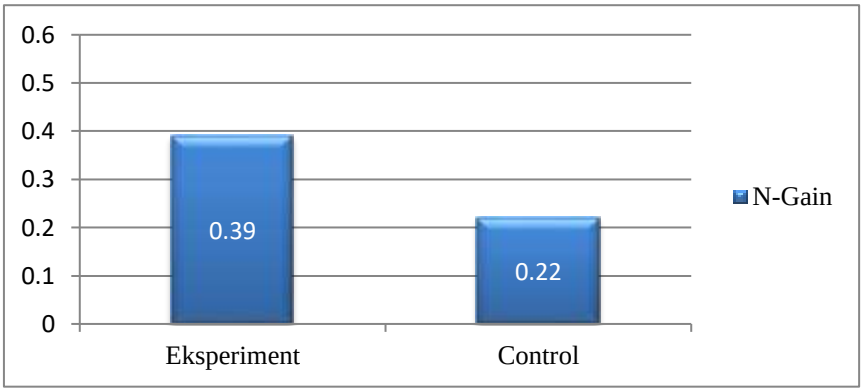


Figure 6. Graph of Average N-Gain Scores

The figure demonstrates that the experimental class achieved a higher mean N-Gain (0.39) compared to the control class (0.22), underscoring the effectiveness of the Interactive E-Booklet in supporting students' scientific explanation skills. This visual representation reinforces the quantitative data, providing a clear depiction of the differential impact of instructional methods on learning outcomes.

Based on the descriptive analysis of pretest and posttest scores, both the control and experimental classes showed an increase in average scores. This improvement reflects students' enhanced knowledge of the respiratory system material delivered during the intervention. Furthermore, the experimental class demonstrated higher average pretest and posttest scores than the control class. These findings suggest that the use of the Interactive Respiratory System E-Booklet during instruction can effectively improve students' scientific explanation skills.

The pretest and posttest results were subsequently subjected to statistical analysis through prerequisite tests, hypothesis testing, and N-Gain analysis. The prerequisite tests included normality and homogeneity tests, which indicated that the pretest and posttest data in both the experimental and control classes were normally and homogeneously distributed. In accordance with Sari & Fikrati, (2023) these results justified the use of the independent samples t-test for hypothesis testing. The independent samples t-test revealed a significant difference in the improvement of students' scientific explanation skills between the experimental and control classes.

Additionally, the experimental class utilizing the Interactive E-Booklet of the respiratory system integrated with the PBL model fostered more active student engagement and a more

dynamic learning atmosphere compared to the control class. Students in the experimental class demonstrated greater confidence in articulating their analyses of the phenomena presented. Beyond formulating claims supported by evidence and linking these components logically, they were also able to propose solutions to the phenomena and problems under study. This enhanced performance can be attributed to the clearly structured and accessible material provided in the E-Booklet, which facilitated deeper conceptual understanding. Consequently, students' scientific explanation skills in the experimental class were higher than those of students in the control class. Furthermore, PBL engages students with authentic, thought-provoking problems that encourage active participation in the learning process. By examining respiratory system–related problems collaboratively, students gained diverse and meaningful learning experiences Maryuningsih, (2012). Taken together, the findings from both descriptive and statistical analyses suggest that the implementation of the Interactive E-Booklet on the respiratory system effectively improves students' scientific explanation skills.

Students' responses to the E-Booklet were gathered from the experimental class to evaluate its effectiveness upon completion of the learning process. The responses were collected using a questionnaire distributed via Google Form. The student responses were analyzed across several indicators, namely: presentation of material, scientific explanation skills, Problem-Based Learning (PBL) integration, visual elements, user satisfaction, and overall attractiveness of the E-Booklet. The results revealed high student approval across all indicators, with 88.61% for material presentation, 87.41% for scientific explanation skills, 87.00% for PBL integration, 94.44% for visual elements, 89.44% for user satisfaction, and 90.93% for the overall attractiveness of the E-Booklet. The detailed results of student response analysis for each indicator are presented in Table 8.

Table 8. Summary of Student Response Categories per Indicator

No	Indicator	Total Score	Maximum Score	Average Percentage	Category
1.	Student responses to material presentation techniques	319	360	88,61%	Very Effective
2.	Student responses to Scientific explanation skills	472	540	87,41%	Very Effective
3.	Student responses to Problem Based Learning capabilities	783	900	87%	Very Effective
4.	Student responses to the images presented	340	360	94,44%	Very Effective
5.	Student Responses to Satisfaction with E-Booklets	161	180	89,44%	Very Effective

No	Indicator	Total Score	Maximum Score	Average Percentage	Category
6.	Student Responses to the Attraction of E-Booklets	491	540	90,93%	Very Effective

Based on the table 8, all student response indicators fall into the "very effective" category. This is supported by Soliqah, (2019) who stated that an assessment score of 81%–100% can be classified as very effective. The high effectiveness ratings across all student response indicators can be attributed to several key factors. First, the integration of Problem-Based Learning (PBL) within the E-Booklet likely promoted active engagement and facilitated critical thinking, enabling students to construct scientific explanations based on data rather than rote memorization. Second, the systematic organization and clarity of the content may have enhanced comprehension and eased cognitive load, supporting better understanding of complex respiratory system concepts. Third, the inclusion of visual and interactive elements appears to have increased motivation, engagement, and satisfaction, as reflected by the highest scores in visual quality and overall attractiveness. Furthermore, the E-Booklet's alignment with specific learning objectives and scientific explanation skill indicators likely strengthened its instructional relevance and practicality. Collectively, these factors explain the very effective responses and indicate that the E-Booklet is not only feasible and practical but also a successful tool in enhancing students' scientific explanation skills and fostering a student-centered learning environment in biology education.

Based on the research findings, the Interactive Respiratory System E-Booklet exhibits several advantages and disadvantages compared to other learning media. The primary advantages include its practicality, as it can be accessed anytime and anywhere, as well as its visually engaging design, which features clear and comprehensible materials and images. Furthermore, the E-Booklet integrates the Problem-Based Learning (PBL) model with scientific explanation skills indicators, and incorporates QR codes linked to real-world respiratory system phenomena, allowing students to easily access additional resources. However, the E-Booklet also has limitations, namely its dependency on a stable internet connection and its focus solely on respiratory system content, which restricts its use to this specific topic.

This student response questionnaire was given to the experimental class with 36 students. This student response questionnaire was only given to students in the experimental class because the experimental class had been given treatment in the form of implementing the Interactive E-Booklet while the control class was not given a response questionnaire because it was not given the treatment of implementing the Interactive E-Booklet. The response questionnaire consists of 16 statements divided into 6 indicators. Based on the results of the analysis of student responses to learning using the Interactive E-Booklet of the Respiratory System, an average percentage of 89.10% was obtained, which means that the E-Booklet is very effective for use in learning activities. This is supported by Soliqah, (2019) who stated that responses with a score of 81%-100% have very effective criteria. Based on the results of the student response questionnaire to

the implementation of the Interactive E-Booklet of the Respiratory System, a positive response was received from students, which was indicated by the average student who stated that the response strongly agreed. The students stated that the E-Booklet has an attractive appearance and color and can facilitate making scientific explanations. Based on the student's comments, it indicates that the E-Booklet is very feasible and effective for use in learning. This is supported by (Christie & Lestari, 2019) that the advantages of this booklet are that it is uniquely and attractively designed, the visualization is more dominant with images, and is more flexible, it can make students interested in reading it. In addition, the contents of the material in the E-Booklet are equipped with images and appropriate descriptions so that they can clarify the material, can be accessed by many people and are practical in their use because they can be used anywhere and anytime.

The student response questionnaire was administered to the experimental class, consisting of 36 students, because only this class had received the treatment of using the Interactive Respiratory System E-Booklet. The control class was not given the questionnaire as they did not experience the E-Booklet implementation. The questionnaire consisted of 16 statements distributed across six indicators. Analysis of student responses revealed an average score of 89.10%, indicating that the E-Booklet was highly effective for use in the learning process. This is in line with Soliqah, (2019) , who noted that a score between 81% and 100% falls into the “very effective” category. Furthermore, the students expressed strong agreement that the E-Booklet was visually appealing, facilitated their scientific explanations, and enhanced their interest in learning. These findings suggest that the Interactive E-Booklet is highly feasible and effective as a learning resource. This is supported by Christie & Lestari, (2019), who emphasized that well-designed booklets—with engaging visuals, appropriate descriptions, and flexible, accessible formats—can enhance student interest, improve learning engagement, and make learning more practical anytime and anywhere.

Based on the research findings, the development of the Interactive E-Booklet on the respiratory system presents several advantages and limitations compared to other learning media. Its main advantages include practicality, as it can be accessed anytime and anywhere, and a visually engaging design with clear and comprehensible materials and images. The E-Booklet integrates the Problem-Based Learning (PBL) model with scientific explanation skills indicators and incorporates QR codes linking to relevant respiratory system phenomena, enabling students to quickly access supplementary information. Nevertheless, the E-Booklet has several limitations. It depends on a stable internet connection, focuses exclusively on the respiratory system, and has only been tested in two purposively sampled classes, which may limit generalizability. Future research could expand the E-Booklet to other biology topics, test it across more diverse student populations, and explore integration with additional interactive features or mobile learning applications to further enhance engagement and learning outcomes.

CONCLUSION

Based on the results of this study and discussion concerning the development of the Interactive E-Booklet to enhance scientific explanation skills in respiratory system topic, several conclusions can be drawn as follows: (1) The Interactive E-Booklet was successfully developed using the ADDIE model, consisting of five stages: analysis, design, development, implementation, and evaluation. (2) The feasibility of the Interactive Respiratory System E-Booklet was rated as very feasible, with mean percentages of 96.67% for material feasibility, 90% for media feasibility, and 96.67% for language feasibility. (3) The practicality of the Interactive Respiratory System E-Booklet was assessed using CVR and CVI, resulting in a CVI score of 0.94, which falls into the very practical category. (4) The effectiveness of the Interactive Respiratory System E-Booklet in improving students' scientific explanation skills was demonstrated by an N-Gain score of 0.39 for the experimental class, indicating a moderate level of effectiveness, whereas the control class achieved an N-Gain score of 0.22, which corresponds to a low level of effectiveness.

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