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# E-Storybook Media with Problem-Based Learning Model Enhances Learning Outcomes on Human Respiratory Topic

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**Abstract:** This research aims to develop E-Storybook with Problem-Based Learning model that are feasible, effective and practical to improve students' learning outcomes on human respiratory topic. The study come under the Borg and Gall model of research and development (R&D). All of 24 students at SDN 3 Krasak participated in this study. Data were collected using test and non test technique. Data on the feasibility, effectiveness and practicality of learning tools were obtained from feasibility tests, N-gain tests and practicality tests. Feasibility data was obtained from the assessment of 2 validators consisting of media expert and material expert from Universitas Negeri Semarang. The results of feasibility validation conducted by media and material experts showed the average expert validation result of 92.5%, which falls into the feasible category. According to the t-test results, there is a significant difference between learning outcomes before and after media consumption. Furthermore, the N-gain test results indicated a high category, with a small-scale score of 73% and a large-scale score of 84%. These results support the conclusion that creating E-Storybook materials using the Problem Based Learning model is both practical and efficient for use in order to enhance grade V students' learning outcomes regarding human respiratory content.

**Keywords:** E-storybook; Human respiratory; Learning outcomes; Problem based learning

## Introduction

Natural and social science subjects teach students to observe, identify, and understand various natural and social phenomena around them (Zakarina et al., 2024). The good learning outcomes obtained in IPAS learning indicate that students are able to understand the concepts taught and can use them to face future challenges, both in further education and in their professional lives (Zuschaiya et al., 2024).

However, there are still many obstacles in learning science (Winangun, 2022). Factors causing low understanding of science can be the low level of science literacy that occurs because the learning process has not been focused on developing science literacy skills or the ability to innovate learning media (Nisa et al., 2021; Palamar et al., 2023; Sastrawan et al., 2021). Other factors such as learning behaviour, learning motivation, lecturers' competence, supporting facilities and infrastructure can also suspected to be cause of low grade point average (Tokan & Imakulata, 2019).

The issue identified by observations and interviews with grade V students at SDN 3 Krasak Jepara. Based on the results of interviews and observations, students show low interest and learning outcomes in natural science learning. Natural and social sciences study living and non-living things in the universe and their interactions. In studying the environment, students see natural and social phenomena as interrelated (Wijayanti & Ekantini, 2023). The material about human organs, including respiratory, is included in science learning in elementary schools. The low learning outcomes of

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students at SDN 3 Krasak are influenced by difficulties in understanding the concept of material, especially in terms of human respiratory organs. Students have difficulty in distinguishing respiratory organs such as the larynx and pharynx or bronchus and alveolus. Students also do not understand the concept of human respiratory disorders. Students lack motivation in learning science. Learning media development needs to pay attention to practicality and effectiveness in its use (Wallner & Barajas, 2020). The effectiveness of various multimedia tools used for various target groups and subjects depends on the technology and components integrated in the development process (Abdulrahaman et al., 2020). The way interactive technology was used in the classroom was essential to improving the learning outcomes for the students (David & Weinstein, 2024; Diab et al., 2024). Students' success in solving science problems reflects their level of cognitive ability, which in turn can affect their learning outcomes (Tae et al., 2019). According to the teacher at SDN 3 Krasak, the lack of varied learning resources is one of the reasons for students' lack of interest and motivation.

Learning is developed through conversation, and through engagement with texts, including storybooks. Books can be used to engage children in stories as fun prompts to engage in thinking (Williamson et al., 2023). Illustrated storybooks are units of narrative that are accompanied by pictures. The use of picture storybooks as a learning media has its own attraction in increasing elementary school students' interest in reading (Rusydiana et al., 2023). However, the limitations of printed books, such as unmaintained conditions, physical damage, and faded text, are obstacles to their use. Therefore, a digital-based alternative is needed by converting printed storybooks into digital storybooks, which can be a solution in presenting more effective learning media (Sesnawati et al., 2024). E-Storybook is a digital book that is presented in a modern and interactive way with visual design, storyline, and integrative features that are attractive to students (Gogahu & Prasetyo, 2020). This is in line with Tullah et al. (2025) media such as e-books are effectively used in learning. In addition, picture storybooks can improve students' skills in critical and creative thinking (Rindengan, 2023).

Teachers should be selective in choosing learning models that fit the demands of 21st-century skills in the learning process (Sari et al., 2021) . According to the PBL model, education should be viewed as a laboratory for resolving real-world issues (Aufa et al., 2021). Since students must solve the problem, the learning process can foster the development of critical thinking abilities in them (Saputra et al., 2022). Students are guided by the PBL model to solve problems by gathering data based on field reality and then figuring it out (Sari et al., 2021). Students taught using PBL implementation showed a significant improvement in applying knowledge compared to students taught by teachers using traditional teaching methods (Alreshidi & Lally, 2024; Safitri et al., 2023). This is line with Permatasari et al. (2019) that showed PBL model contribute significant impact towards science learning outcomes of elementary school students.

The five main learning syntaxes make up the PBL model. Students are first exposed to real-world scenarios in order to improve their comprehension. Learning is then arranged methodically to give it structure. Investigative techniques are then used to successfully resolve issues. Students then share the conclusions drawn from their research. Lastly, comments are given to consider the results of the problem-solving procedure (Evendi et al., 2022). The percentage of final results achieved from the student teaching and learning process is called learning outcomes (Sidiki et al., 2024). Learning outcomes are indicators of success in mastering school subjects which are reflected in the scores obtained from tests given by the teacher (Deak & Santoso, 2021; Winarto et al., 2020).

Researchers are trying to provide alternatives to solve problems according to the needs of teachers and students in order to improve science learning outcomes, especially in human respiratory material by conducting research by developing audio-visual media, namely E-Storybook, which is integrated with the Problem Based Learning learning model. Audio visual media can affect students' cognitive learning outcomes (Manulang et al., 2024; Monhartini et al., 2023; Repelita et al., 2023; Rosyid & Setyasto, 2024; Subagja et al., 2023). This development aims to make students have high learning motivation and teaching and learning activities more interesting and fun so that in the end it can improve learning outcomes.

The study conducted by Mulyoto et al. (2023) claimed that the creation of picture storybook media can boost student learning motivation as demonstrated by the experimental class's average score of 87 and the control class's average score of 81. Another study conducted by Putri Aryanti et al. (2024) stated that as evidenced by a significance of 0.013, STEAM storybooks were a successful tool for enhancing children' critical thinking abilities.

Several studies have highlighted the benefits of using storybook media to enhance students' knowledge, skills, and motivation in an educational context. Although some studies have demonstrated the effectiveness of storybook media in learning, there has not yet been a study that specifically explores the use of E-Storybooks with the Problem-Based Learning model

in the natural and sosial science subject, particularly on the human respiratory system material in fifth-grade elementary school classes. The development of E-Storybook media using a Problem Based Learning model for science education, particularly for human respiratory content, is the innovative aspect of this study. Testing the feasibility as well as the effectiveness of integrating E-Storybook media with the Problem Based Learning model was the aim of this study.

## Method

*Type of Research*

This research uses a type of R&D (Research and Development). Research and development is research used to test the effectiveness and develop a product (Sugiyono, 2021). The stages of the research development model can be changed to fit the requirements and limitations of the project (Dewi et al., 2024).

The implementation of the Borg and Gall model in this study follows eight key stages, each carefully structured to support researchers in developing and refining the work. It begins with identifying potential and difficulties, where challenges and opportunities in the research process are assessed. This is followed by data collection, ensuring that relevant information is gathered to inform the development process. Next, the product design stage focuses on creating an initial version based on the collected data. Once designed, the product undergoes validation to ensure its effectiveness and feasibility. Feedback from this validation leads to a design revision, refining the product to address any identified issues. Following the revision, a product trial is conducted, allowing for practical testing in a real-world setting. Insights from the trial phase inform further product revisions to enhance its quality and usability. Finally, the trial use stage ensures that the refined product is ready for broader implementation, marking the completion of the development process.

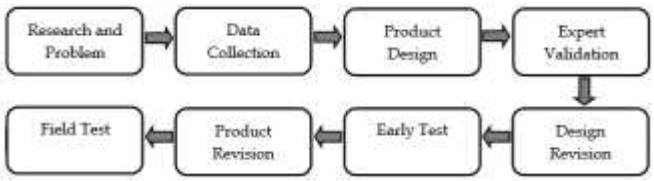


**Figure 1.** Modified from Borg & Gall model

*Test Subjects*

This study was carried out at SDN 3 Krasak, Jepara Regency. In the implementation of small-scale trials, researchers used a purposive sampling technique which is a sampling technique with certain considerations (Sugiyono, 2021). Researchers selected 2 top-ranked students and 2 lower-ranked students based on cognitive aspects. It is intended that product trials can be balanced and evenly used by all students, both upper and lower ranks. The subjects in this study were all grade V students with a total of 24 students.

*Data Collection Technique*

This research data collection was obtained through test and non-test techniques. Pretest and posttest data are used as the test strategy to demonstrate how students' learning outcomes on E-Storybook media have improved while using the PBL model. While non-test data is obtained through interviews, questionnaires, observation, and documentation. This study included questionnaires for teacher and student needs, media and material expert assessment, and feasibility assessment response. Likert scale used in questionnaire data collection.

*Data Analysis Technique*

Data analysis was carried out on the results of the media feasibility assessment, media usage responses, as well as pretest and posttest results. Data obtained from expert validation of the media is used as an analysis for media feasibility. After all the data is obtained, the data is analyzed and converted into a score into a percentage.

$$p = \frac{f}{N}\ x\ 100\ \% \quad (1)$$

Information
P = Percentage Number
F = Score Obtained
N = Maximum Number of Scores

The percentage data obtained is then converted into feasibility criteria for learning media listed in table 1.

**Table 1.** Media Feasibility Assessment Criteria

| Percentage (%) | Criteria |
|---|---|
| 82% ≤ x ≤ 100% | Very feasible |
| 63% ≤ x ≤ 81% | Feasible |
| 44% ≤ x ≤ 62% | Feasible enough |
| 25% ≤ x ≤ 43% | Less feasible |

After the media was applied, the results of the student pretest and posttest were analyzed. normality test was conducted to determine whether the data was normally distributed or not on the results of the student pretest and posttest. The paired t test was conducted to determine the average difference in student learning outcomes. The average increase test (N-Gain) were used to determine the degree of product effectiveness based on the pretest and posttest data.

$$N - Gain = \frac{\bar{X}_{Post} - \bar{X}_{pre}}{\bar{X}_{Max} - \bar{X}_{pre}} \quad (2)$$

Information:
$\bar{X}_{Post}$ = post-test score
$\bar{X}_{pre}$ = pre-test score
$\bar{X}_{Max}$ = maximum score

The data results obtained were converted based on the following criteria.

**Table 2**. Category of N-Gain Score

| N-Gain Score (g) | Category |
|---|---|
| 0.70 < g < 1.00 | High |
| 0.30 < g < 0.70 | Medium |
| 0 < g < 0.30 | Low |

**Table 3**. Effectiveness Interpretation Category N-Gain Score

| N-Gain Score (g) | Category |
|---|---|
| >76% | Effective |
| 56% - 75% | Effective enough |
| 40% - 55% | Less effective |
| <40% | Ineffective |

To find the results of the practicality of the media, data analysis was carried out on the teacher and student response questionnaires in the form of a Likert scale which was then calculated and interpreted in the following criteria.

**Table 4**. Media Practicality Assessment Criteria

| Percentage (%) | Criteria |
|---|---|
| 82% ≤ x ≤ 100% | Very Practical |
| 63% ≤ x ≤ 81% | Practical |
| 44% ≤ x ≤ 62% | Practical enough |
| 25% ≤ x ≤ 43% | Less practical |

## Result and Discussion

The product results of this research are in the form of E-Storybook learning media with PBL models that function to support the learning process. The R&D research model used is the Borg and Gall model with eight stages of implementation that are condensed according to the needs of researchers.

*Potential and Problems*

The problems found by researchers are in the form of low student learning outcomes in IPAS subjects on human respiratory system material. As many as 66.7% of grade V students at SDN 3 Krasak scored below the criteria for learning achievement in the Midterm Summative Assessment. The lack of variety in learning media encourages researchers to develop a product as a solution.

*Data Collection*

The data collection stage is carried out by researchers through the stages of interviews, observations, collecting data and questionnaires of teacher needs regarding the product and as a reference for researchers in determining the product to be developed. Considering the results of the teacher needs analysis recapitulation, it is acknowledged that the usage of learning media is still limited. Teachers only rely on teacher books and student books as the main source of learning. Students need learning media that is interesting and fun to increase learning motivation so that it can enhance learning outcomes.

*Product Design*

Based on the problems found, researchers made a product design in the form of digital-based audio-visual storybook media called E-Storybook and integrated with the Problem Based Learning model. This learning media contains 2 stories that are taught using PBL syntax. The first story is related to the organs and mechanisms of human breathing which is then continued in the second story related to disorders that exist in human respiratory.


**Figure 2.** Learning Instructions based on PBL Syntax and Character Recognition

**Figure 3.** Story narration and illustrations


**Figure 4.** video explanation of learning topic

The media design is designed with attractive colors and images to attract students' reading interest. This is because high interest and motivation can positively affect learning achievement (Tokan & Imakulata, 2019). E-Storybook media with Problem Based learning model is designed using Canva application with a size of 14.8 x 21 cm and developed utilizing digital book technology with the help of Heyzine application to access it.

The stages of applying PBL syntax in E-Storybook are in the first syntax students will be asked to observe pictures and explanations related to problems found in everyday life related to human respiratory. In the second syntax, students will be organized to learn by reading story narratives related to human respiratory. The story narrative is equipped with videos and 3D animations to increase the understanding of the material by students. In the third syntax, students will discuss solving the problems on the worksheet. The use of the PBL model in student worksheet is expected to improve concept understanding by students. This is in line with Ahmadiah et al. (2023) which states that the use of PBL-oriented student worksheets can improve students' concept understanding abilities. In the fourth syntax, students will be asked to present the results of problem solving obtained through group discussions. Finally, students will be asked to evaluate the problem solving process by summarizing the understanding gained through learning. Evaluation questions on the media can be accessed through the Quiziz Application.

The product validation stage is carried out with an assessment by media experts and material experts who are in accordance with the field of science. The media feasibility assessment questionnaire uses a Likert scale. The assessment from media experts is based on three aspects, namely media aspects, display aspects, and language aspects. Three criteria are used to evaluate material experts namely contextual aspects, presentation feasibility aspects, and content feasibility aspects. The following displays the findings of the evaluations conducted by media and material experts.

**Table 5**. Results of Expert Validators Assessment of E-Storybook with Problem Based Learning

| Validators | Validation Index | Description |
|---|---|---|
| Media expert | 95.31% | Very worthy |
| Material expert | 90% | Very worthy |

According to the validation results provided by media experts and material validators, the E-Storybook media with the Problem Based Learning model are classified as highly practicable (Table 1). This is consistent with studies carried out by Gunawan et al. (2023) which states that picture storybook media get a value from material expert assessment of 96 with qualified criteria and media expert assessment of 100 with qualified criteria. Several other studies have also stated that learning using picture storybooks developed is feasible to implement (Darmawan & Wuryandani, 2022; Norholis et al., 2023; Rahmawati et al., 2024; Sadewa et al., 2024). This means that, with a note of correction, the E-Storybook medium with the video-assisted Problem Based Learning model can be classified as good and feasible for testing.

*Design Revisions*

Media product revisions were made according to suggestions from media and material experts. suggestions from media experts in the form of writing consistency, adding activity instructions, and adjusting concrete images. While, the material expert's revision was related to the adjustment of learning tools.


**Figure 5.** Front Cover before revision


**Figure 6.** Front cover after revision


**Figure 7.** Learning Instructions based on PBL before revision


**Figure 10.** Syntax 1 of PBL model after revision

**Figure 8**. Learning Instructions based on PBL after revision and added activity instruction


**Figure 9.** Syntax 1 of PBL model before revision

*The Practical of Media*

A small-scale experiment of media usage was carried out in grade V with four pupils in total two top-ranked and two bottom-ranked. A Likert scale with eleven questions was used to collect the findings of the student response assessment, while the teacher response assessment amounted to 12. The Likert scale is adjusted to the situation of students and teachers after using E-Storybook with Problem-Based Learning model.

**Table 6.** Results of Data Processing of Student and Teacher on a Small Scale

| Respondent | Percentage | Information |
|---|---|---|
| Teacher | 95.83% | Very practical |
| Student | 100% | Very practical |

**Table 7.** Results of Data Processing of Student and Teacher on a Large Scale

| Respondent | Percentage | Information |
|---|---|---|
| Teacher | 97.91% | Very practical |
| Student | 98.97% | Very practical |

Table shows the results of responses to the E-Storybook media with the Problem Based Learning model with the acquisition of 100% response from teachers and 95.83% from students from small scale. While on a large scale obtained a percentage response from teachers of 97.91% and from students of 98.97%. This is in line with a study by Panjaitan et al. (2021) that obtained 87.05% on a big scale and 87.80% on a small scale for the production of illustrated storybooks. According to research by Saputra et al. (2022) found that students responded favorably; a small group trial of six students yielded an 88% percentage in the "very good"

category, while a large group trial of 26 students yielded a 90% percentage in the "very good" category. Another study conducted by Ningsih et al. (2023) stated that the results of the practicality test of picture storybook media development products with a TheoAnthropoEco-centric approach involving teachers and students were in the "Very Practical" category.

*Effectiveness of Media in Usage Trials*

Student learning results using a one-group pretest-posttest model are used to evaluate the efficacy of product. This model involves stages such as administering a pretest prior to treatment and administering a posttest following treatment.

The small and large-scale media trials showed an average increase of 5.25, as shown in Tables 3 and 4. According to the findings, Students in grade V elementary school showed differences in their learning outcomes regarding their understanding of human respiratory content before and after using an e-storybook that employed a problem-based learning strategy. The t-test and N-gain test were then used to perform the efficacy test. A normality test was used as a prerequisite for the analysis.

**Table 8.** Result of Students Pretest and Posttest Trials on a Small Scale

| Test type | Average | Average Difference |
|---|---|---|
| Pretest | 25 | 52.5 |
| Posttest | 77.5 | |

**Table 9.** Results of Students Pretest and Posttest Trials on a Large Scale

| Test type | Average | Average Difference |
|---|---|---|
| Pretest | 30.75 | 57.75 |
| Posttest | 88.5 | |

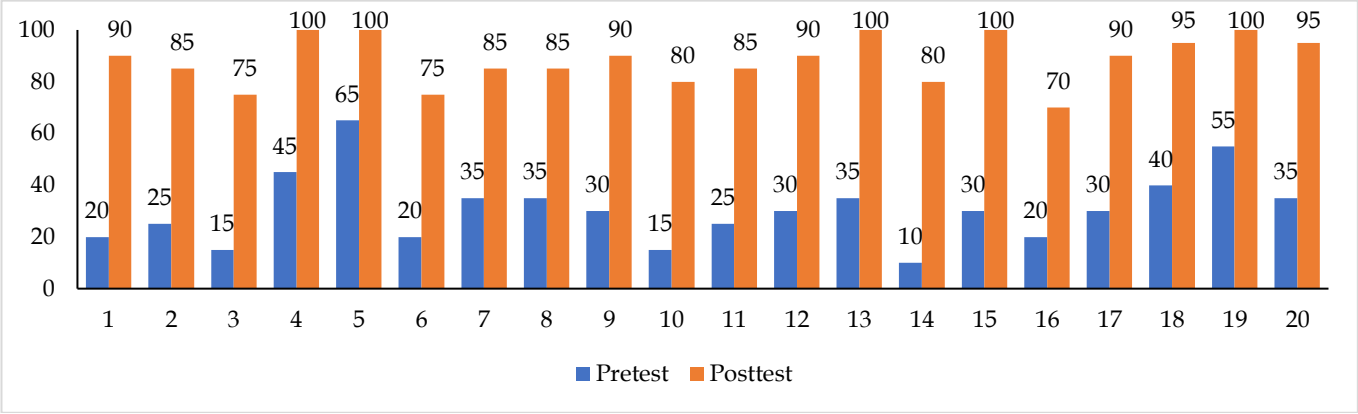


**Figure 11.** Diagram of pre-test and post-test results of large-scale students

**Table 10.** Results of Normality Test on a Small Scale

| Situation | Sig. | Criteria |
|---|---|---|
| Before being given treatment | 0.65 | Normally distributed |
| After being given treatment | 0.58 | Normally distributed |

**Table 11.** Results of Normality Test on a Large Scale

| Situation | Sig. | Criteria |
|---|---|---|
| Before being given treatment | 0.22 | Normally distributed |
| After being given treatment | 0.11 | Normally distributed |

Examine the normality test findings using the Shapiro-Wilk type. Data is said to have a normal distribution if the Sig value. > 0.05. Based on the small scale normality test table, the pretest and posttest normality test results are 0.65 and 0.58. So, it can be seen that the learning outcomes data are normally distributed. The pretest and posttest normality test results on a large scale obtained 0.22 and 0.11. The learning outcomes data are normally distributed. The next phases uses the paired sample t-test, a parametric statistical test, to determine whether there is a significant difference between the pre-test and post-test.

**Table 12.** t-Test Results on a Small Scale

| Average Difference | Sig. (2 tailed) | Criteria |
|---|---|---|
| -52.500 | 0.001 | Significant differences |

**Table 13.** t-Test Results on a Large Scale

| Average Difference | Sig. (2 tailed) | Criteria |
|---|---|---|
| -57.750 | 0.000 | Significant differences |

The results of the small and large scale tests differ significantly when the Sig value is less than 0.05 or the t count is less than the t table. Both the large-scale and small-scale results are 0.000, or less than 0.05. Results showed that before and after the course of treatment, there is a noticeable difference. N-gain analysis is the next step to ascertain the criterion for the acquired average difference.

**Table 14.** N-Gain Results on a Small Scale

| Average Difference | N-gain | Criteria |
|---|---|---|
| 52.5 | 0.73 | High |

**Tabel 15.** N-Gain Results on a Large Scale

| Average Difference | N-gain | Criteria |
|---|---|---|
| 57.5 | 0.84 | High |

The average increase (N-Gain) on a small scale shows a score of 0.73. Thus it can be categorized with high criteria and the percentage of improvement test (N-Gain) of 73.56% with the category of interpretation of effectiveness which is quite effective. The large-scale average improvement score (N-Gain) was 0.84 so that it could be categorized with high criteria and the percentage of the improvement test (N-Gain) was 84.93% with the category of interpretation of effectiveness which is quite effective. Some other studies have shown an increase in learning outcomes through the implementation of picture storybooks (Ainun & Putra, 2024; Qomariyanti et al., 2023).

## Conclusion

The results showed that using the Problem Based Learning model to create E-Storybook learning materials can improve students' learning outcomes of human respiratory topic. The average expert validation result of 92.5%, which falls into the feasible category, serves as proof of this. E-Storybook media with Problem Based Learning model is effectively used in science learning on the topic of Human Respiratory as evidenced by the average increase in the improvement of students' IPAS learning outcomes in Human respiratory material of 84.93% with the category of interpretation of effectiveness which is very effective. This suggests that creating E-Storybook learning materials using the Problem Based Learning model is both practical and successful in raising grade V students' learning outcomes for human respiratory content. Further research is needed using more and diverse subjects to ensure the sustainability of the effect of using E-Storybook with PBL model on student learning outcomes.

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Preparation and development of media, F. F. Z.; Validation, B. I.; Data Collection and analysis, F. F. Z.; Writing original draft article, F. F. Z.; Review and Editing, B. I. All authors have read and agreed to the published version of the manuscript.

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**Conflicts of Interest**
The authors declare no conflict of interest.

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