**Lensa: Jurnal Kependidikan Fisika**
Penerbit: Universitas Pendidikan Mandalika
https://e-journal.undikma.ac.id/index.php/Lensa/index

June 2025. Vol. 13, No, 1
e-ISSN: 2686-0937
pp. 192-202

# Development of Respiratory Card Learning Media Using the Project-Based Learning Model on Human Respiratory System Material

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**Abstract**

Active learning should involve students directly in the learning process through interaction with peers and teachers. However, classroom instruction often fails to engage students effectively, with limited use of varied instructional media and models. This study aims to develop a Respiratory Card learning medium using the Project-Based Learning (PjBL) model to improve learning outcomes of fifth-grade elementary school students on the topic of the human respiratory system. This research employed a Research and Development (R&D) approach using the 4D development model, which includes the stages of Define, Design, Develop, and Disseminate. Data collection techniques included interviews, observations, questionnaires, and tests, while data were analyzed qualitatively and quantitatively. The results showed that: (1) the Respiratory Card learning media was declared valid with average scores of 88% from content experts and 90.6% from media experts, categorized as "highly feasible" using a Likert scale; (2) the media was considered practical based on a 92% average score from teacher responses, categorized as "very practical"; and (3) the media was effective, as indicated by an improvement in students' test scores to an average of 84.2% at SDS Attaufiq Medan, and significant differences were found in learning outcomes between the experimental and control classes at UPT SDN Percobaan (sig. value = 0.000 < 0.05). The use of the Respiratory Card media enhanced student engagement and improved learning outcomes.

**Keywords**: Respiratory card media; Project-based learning; Human respiratory system; Learning outcomes; Elementary science education

**How to cite**: Silitonga, A. N., & Muchtar, Z. (2025). Development of Respiratory Card Learning Media Using the Project-Based Learning Model on Human Respiratory System Material. *Lensa: Jurnal Kependidikan Fisika, 13*(1), 192-202. doi:https://doi.org/10.33394/j-lkf.v13i1.16298

## INTRODUCTION

One of the fundamental pillars of national development is the education sector, which aims to improve the quality of human resources to compete in the global era. Efforts to achieve this goal begin with enhancing the quality of education at all levels, particularly through improving the quality of the teaching and learning process in classrooms. Therefore, innovation in both instructional methods and the provision of educational facilities is essential to support the creation of high-quality learning processes.

To improve educational quality, active student engagement in the learning process is crucial. Asari et al. (2021) argue that learning is an activity in which students actively construct their own knowledge, rather than passively receiving explanations from the teacher. Student involvement is one of the most important components in practicing student-centered learning (Sholicha & El-Yunusi, 2024). Active learning can improve student outcomes by encouraging direct interaction with the learning material. In this regard, teachers are expected not only to deliver content but also to understand students' characteristics, provide adequate learning tools, and foster an interactive classroom atmosphere (Hidayah et al., 2025).

Science (IPA) is one subject that can encourage student engagement in the learning process. The nature of science involves acquiring concepts through scientific methods and inquiry-based attitudes to produce knowledge (Akmal, 2016). Science education emphasizes experiential learning to enhance students' understanding of various natural phenomena. This understanding is constructed through observation, experimentation, and discussion, all of which require students' active involvement (Restudila, 2025). One science topic that is considered abstract and requires media support is the human respiratory system. It includes concepts and processes that are difficult to observe directly, necessitating the use of concrete and engaging instructional media. Teachers' understanding of the nature of science also affects classroom instruction (Aisah, 2020). Teachers must be able to foster students' curiosity and critical thinking.

Instructional media are tools designed systematically to convey information from teacher to students to help achieve learning objectives (Saleh, 2023). Utilizing instructional media can optimize material delivery, leading to more effective learning outcomes (Simamora, 2024). Particularly in elementary schools, where students are in the concrete operational stage of development, the role of instructional media becomes critical in helping them grasp abstract content. One such media is the learning card. Learning cards are flexible, economical, and applicable across various subjects with diverse content, making them effective in enhancing engagement, comprehension, and motivation (Wijayanti, 2023).

In addition to instructional media, teachers must implement varied and innovative learning models to avoid monotonous and tedious lessons. According to Siregar (2021), a learning model is a conceptual framework for designing instruction. One model suited for science education is Project-Based Learning (PjBL), which emphasizes project-based learning activities that are relevant to real life, thus promoting active student participation. Ratih and Arsih (2024) note that Project-Based Learning provides meaningful and deep learning experiences, while also enhancing students' conceptual understanding and skills. This model integrates problem-solving into its structure, making it easier for students to comprehend and internalize theoretical knowledge (Anggraini & Wulandari, 2021).

Based on classroom observations and interviews conducted on October 22, 2024, with fifth-grade students and teachers at SDS Attaufiq Medan, several problems in science learning were identified. First, many students struggled to understand the human respiratory system, particularly in distinguishing between inhalation and exhalation processes, understanding organ functions, and identifying respiratory-related illnesses. Second, instructional media were limited and not utilized, especially for teaching the human respiratory system. Teachers also faced constraints in time and resources to design alternative learning media. Third, the teaching method was still limited to lectures and textbook explanations, resulting in passive student participation. This condition contributed to poor learning outcomes, as reflected in the midterm exam results: only 7 out of 25 students (28%) achieved the minimum mastery score (≥ 70), while 18 students (72%) scored below the threshold.

To address these issues, the researchers aimed to develop instructional media that could improve both student learning outcomes and engagement. The novelty of this research lies in the development of a card-based medium specifically

designed to not only enhance student achievement but also foster active participation. Therefore, the researchers propose the development of a Respiratory Card learning medium using the Project-Based Learning (PjBL) model.

## METHODS

This study employed a Research and Development (R&D) design using the 4D development model, which consists of four stages: Define, Design, Develop, and Disseminate (Sugiyono, 2017). The *Define* stage aimed to analyze the need for instructional media through interviews with fifth-grade teachers. The *Design* stage involved planning the Respiratory Card media according to student needs and curriculum content. The *Develop* stage included validation of the media by content experts, media experts, and education practitioners, followed by limited trials with fifth-grade students (Fayrus & Slamet, 2022). Finally, the *Disseminate* stage involved distributing the developed media to teachers and schools for broader implementation.

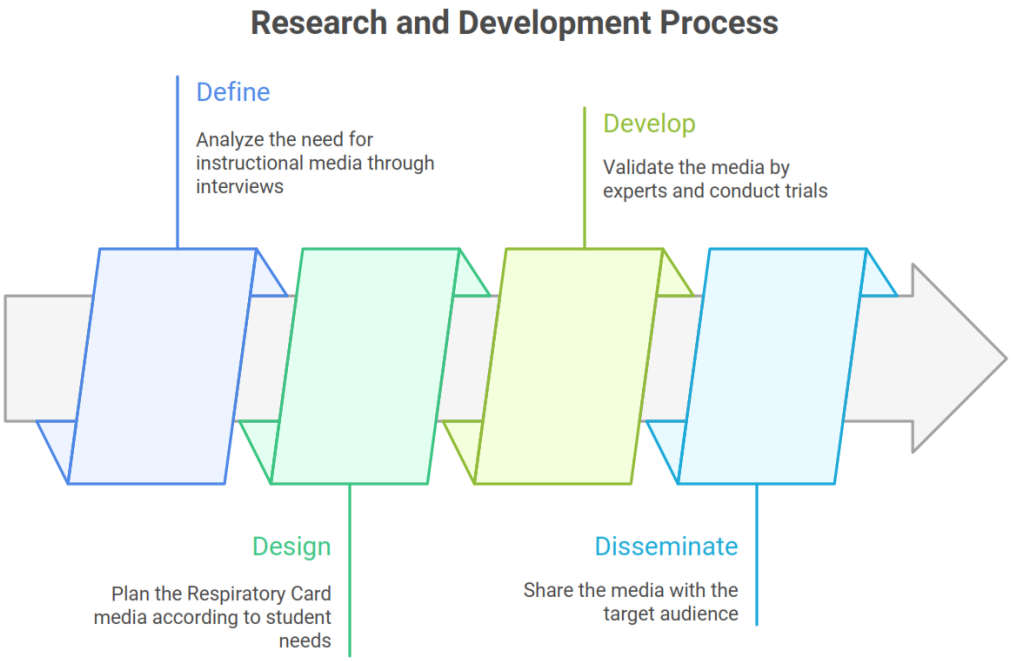


**Figure 1.** The R&D flow

This study was conducted at SDS Attaufiq Medan, located at Jalan Williem Iskandar No. 126, Medan Tembung, during the even semester of the 2024/2025 academic year. The research subjects included content experts, media experts, fifth-grade teachers (as practitioners), and fifth-grade students. Data were collected through interviews, questionnaires, and tests.

Research instruments included interview guides, validation questionnaires for content experts, media experts, and practitioners, student response questionnaires, as well as pre-test and post-test questions. The collected data were analyzed both qualitatively and quantitatively. Qualitative data were derived from interviews and expert suggestions, while quantitative data were analyzed using the Likert scale to assess media feasibility. The effectiveness of the media was measured using the N-Gain formula. Additionally, normality tests, homogeneity tests, and t-tests were

conducted using SPSS software to determine significant differences in learning outcomes before and after using the Respiratory Card media.

The percentage of average expert evaluation scores was calculated using the following formula (Rustandi & Rismayanti, 2021):

$$P = (\sum x / \sum xi) \times 100\%$$

Where:
P = validity percentage
∑x = total score obtained
∑xi = maximum possible score

The classification of validation results based on the Likert scale is as follows:

**Table 1.** The classification of validation results based on the Likert scale

| Percentage | Criteria |
|---|---|
| < 80% - ≤ 100% | Very good/valid without revision |
| < 60% - ≤ 80% | Fairly good/valid with revision |
| < 40% - ≤ 60% | Poor/valid with revision |
| 0% - ≤ 40% | Not valid and must be revised |

(Source: Panggabean & Rozi, 2024)

The students' test scores were analyzed using the following formula to determine learning mastery, with the school's minimum passing grade (KKM) set at 70:

$$P = (\text{obtained score} / \text{ideal score}) \times 100$$

The effectiveness of the product was categorized based on the following learning mastery criteria:

**Table 2.** The criteria of mastery level

| Mastery level | Score (%) |
|---|---|
| Very High | 81% – 100% |
| High | 61% – 80% |
| Moderate | 41% – 60% |
| Low | 21% – 40% |
| Very Low | 0% – 20% |

(Source: Riduwan, 2023)

To assess students' conceptual improvement, the N-Gain analysis was used with the following formula:

$$g = (\text{post-test} - \text{pre-test}) / (\text{ideal score} - \text{pre-test})$$

The results were interpreted based on the following N-Gain categories:

**Table 3.** The N-Gain criteria

| Description | Mean gain (g) |
|---|---|
| High | g > 0.7 |
| Medium | 0.3 < g ≤ 0.7 |
| Low | 0 < g ≤ 0.3 |

(Source: Nurvitasari & Mintohari, 2024)

The product was considered effective if students' post-test learning mastery reached ≥ 61% and the N-Gain score exceeded 0.3, indicating a medium or high level of learning improvement.

## RESULTS AND DISCUSSION

The development of the instructional media in this study refers to three quality criteria: validity, practicality, and effectiveness (Rajagukguk, 2021). The results obtained at each stage of the development process are described as follows:

### Define Phase

The define phase serves to gather information regarding the conditions of prospective users, ensuring that the media to be developed aligns with their needs. In this stage, the researchers identified learning requirements through observation, interviews, and literature review. The activities conducted included needs analysis, learner analysis, instructional tools analysis, concept analysis, and learning objectives analysis.

### Design Phase

After defining the problem and user needs, the researchers proceeded to the design phase. In this stage, the chosen media was the Respiratory Card, selected based on the learning objectives and student characteristics. The researchers then designed the media format and feasibility assessment instruments, such as expert validation sheets and teacher response questionnaires. The initial version of the media was created using Canva, with cards measuring 6 x 9 cm, segmented by topic with distinct colors. The front side of each card featured images and content explanations, while the back displayed illustrations and topic titles. A simple card box was also designed to store the cards neatly.

### Develop Phase

The development phase was carried out after the media design was completed. It involved product validation by experts and practitioners to assess the feasibility and effectiveness of the Respiratory Card media. Validation was conducted by three parties: content experts, media experts, and practitioners (fifth-grade teachers). Prior to validation, the questionnaire instruments were reviewed by instrument experts to ensure their suitability. The validation results showed an average score of 90%, indicating a "highly feasible" category, making the instruments appropriate for use by validators.

#### *Product validation*

Content experts evaluated the media in terms of content relevance, completeness, language, and communication clarity. The initial validation yielded a score of 72%, which fell under the "adequate" category with recommended revisions. After incorporating the expert suggestions, the score increased to 88%, indicating the media was "highly feasible" with no further revisions required.

Media experts assessed the content, layout, presentation, and usability aspects of the media. The Respiratory Card obtained a score of 90.6%, placing it in the "highly feasible" category without the need for revision.

Practitioners provided evaluations on aspects such as instructional media, content presentation, teaching approach, and language clarity. The media received a score of 92%, indicating it was "very practical" and suitable for classroom use.

**Table 4.** Validation Results of the Respiratory Card Learning Media

| Validator | Assessment Aspects | Score Before Revision | Score After Revision | Remarks |
|---|---|---|---|---|
| Content Expert | Content feasibility, completeness, language & communication | 72% | 88% | Initial revision required; highly feasible after revision |
| Media Expert | Content & substance, design & appearance, media usability | – | 90.6% | Highly feasible without revision |
| Practitioner (Teacher) | Instructional media, content delivery, pedagogy, language | – | 92% | Very practical and suitable for classroom use |

### *Product revision*

Revisions were made to the content based on input from content experts. Initially, the material consisted of three sections: respiratory organs, respiratory processes, and respiratory disorders. Two additional sections were added—types of respiration and how to maintain respiratory organ health—bringing the total to five. In addition, complete illustrations of the respiratory organs and their sequences were included to enhance content clarity.

### *Product testing*

The learning media was tested with fifth-grade students at SDS Attaufiq Medan. The trial was conducted using a pre-test and post-test method with multiple-choice questions that had been validated for content and reliability. A test is considered to have high validity if it accurately measures what it is intended to measure, and it is deemed reliable if it consistently yields the same results when administered to the same group under similar conditions (Ramadhan, 2024). Out of 40 questions, 23 were found valid, and the reliability coefficient was very high ($\alpha$ = 0.900).

The results of the trial indicated a significant improvement in student learning outcomes. The average pre-test score was 34.8%, with many students failing to meet the Minimum Mastery Criterion (KKM) of 70. After using the Respiratory Card media, the average post-test score rose to 84.2%, exceeding the KKM threshold.

An N-Gain analysis was conducted to measure the degree of improvement in students' understanding (Sukarelawan, 2024). The N-Gain score was 0.78, which falls into the "high" category, indicating that the media was highly effective in enhancing students' comprehension of the human respiratory system.

### Disseminate Phase

In the dissemination phase, the Respiratory Card media that had been developed and validated was implemented in a broader educational setting to evaluate its effectiveness in a different school environment. Since SDS Attaufiq Medan had only one fifth-grade class, the dissemination was carried out in another school, namely the fifth-grade class at UPT SDN Percobaan Medan.

The study involved two fifth-grade classes: Class VA as the experimental group, which used the Respiratory Card media with the Project-Based Learning

(PjBL) model, and Class VB as the control group, which employed a conventional teaching model. Both groups were administered a pre-test before instruction and a post-test afterward.

A series of statistical analyses were conducted on the pre-test and post-test results, including normality tests, homogeneity tests, and an independent t-test using IBM SPSS software to ensure the validity of the findings.

The normality test is a crucial statistical procedure used to determine whether the observed data are normally distributed (Wulandari & Junaidi, 2024). This test was performed using the Kolmogorov-Smirnov method.

**Table 5.** Normality test results

| Class | Sig. | Conclusion |
|---|---|---|
| Experimental | 0,017 | Normal |
| Control | 0,190 | Normal |

Since the significance values for both groups are greater than 0.05, the post-test data were determined to be normally distributed.

The homogeneity test aims to determine whether the variances between the two groups are equal. This analysis was conducted using Levene's Test.

**Table 6.** Homogeneity test results

| Test | Levene Stat. | df1 | df2 | Sig. | Conclusion |
|---|---|---|---|---|---|
| Based on Mean | 0,178 | 1 | 38 | 0,676 | Homogen |
| Based on Median | 0,222 | 1 | 38 | 0,640 | Homogen |
| Based on Median adj. df | 0,222 | 1 | 37,255 | 0,640 | Homogen |
| Based on Trimmed Mean | 0,215 | 1 | 38 | 0,646 | Homogen |

Since the significance values are all above 0.05, the pre-test and post-test data from both classes were considered to have homogeneous variances.

The independent t-test was conducted to determine whether there was a statistically significant difference in learning outcomes between the experimental and control classes after the treatment.

**Table 7.** Independent t-test post-test results

| Variabel | F | Sig. | t | df | Sig. (2-tailed) | Mean Diff. | Std. Error | 95% Conf. Interval |
|---|---|---|---|---|---|---|---|---|
| Equal variances assumed | 0,178 | 0,676 | 21,230 | 38 | 0,000 | 48,750 | 2,296 | 44,101 – 53,399 |

The significance value (2-tailed) of 0.000 < 0.05 indicates a significant difference in learning outcomes between the experimental and control groups. This finding confirms that the use of the Respiratory Card media was effective in improving students' learning outcomes.

Based on the validation results, the Respiratory Card media was declared valid. The validation was carried out by two validators, namely a content expert and a media expert. Content validation was conducted in two stages: the first round yielded a score of 72%, categorized as moderately feasible. After revisions based on expert feedback, the second round produced a score of 88%, indicating that the media was highly feasible without further revision. Media validation was conducted once and resulted in a score of 90.6%, which also falls under the highly feasible

category. These results demonstrate that the Respiratory Card media meets the feasibility criteria in terms of both content and technical quality, making it suitable for use in the learning process.

In terms of practicality, the media was evaluated based on classroom teacher responses after its implementation. Teachers responded positively, with an average score of 92%, categorized as highly practical. The teachers reported that the media was easy to use, engaging, and effective in enhancing student participation during the learning process, particularly because it was integrated with the Project-Based Learning (PjBL) model. Practicality, as noted by Kiki Fatmawati (2023), refers to the ease and user-friendliness of a developed product. This supports the conclusion that the developed media is not only feasible in content and design but also practical for real classroom application.

Furthermore, the effectiveness of the media was measured by the improvement in students' learning outcomes before and after using the Respiratory Card. The pre-test results showed an average score of 34.8%, whereas the post-test scores increased significantly to an average of 84.2% following the implementation of the media. To test its applicability in a different context, the media was also disseminated to another school. An independent t-test yielded a significance value of $0.000 < 0.05$, indicating a statistically significant difference in learning outcomes between the experimental group (using the media) and the control group (using conventional methods). This finding confirms that the Respiratory Card media is effective in improving student learning outcomes, both within the initial development setting and in other educational environments.

This study, however, has several methodological limitations that must be considered when interpreting the results. As facilitators, teachers may have unintentionally provided different treatments or delivered material inconsistently, which could influence student performance. Additionally, the study employed a non-randomized design, limiting the external validity of the findings. Variations in student characteristics and school environments could not be fully controlled. The study also did not account for external factors that may have impacted outcomes, such as the learning environment, student motivation, parental involvement, or other learning activities outside the use of the media. These factors could contribute to the variability of results and should be considered in future applications of the findings.

Despite these limitations, the overall findings confirm that the Respiratory Card media is valid, practical, and effective for teaching the human respiratory system to fifth-grade students, delivering optimal learning outcomes. These results are consistent with Mahardika (2022), who stated that effective instructional media must demonstrate tested validity, practicality, and a positive impact on student achievement.

The success of the Respiratory Card in enhancing students' understanding can be explained through several theoretical frameworks. From a cognitive theory perspective, the media supports learning by helping students construct new knowledge meaningfully. The structured and visual presentation of information enhances short-term memory function and facilitates integration with existing knowledge in long-term memory. From the perspective of active learning, the

Respiratory Card promotes direct student engagement through project-based group activities, fostering collaboration and active participation among peers.

## CONCLUSION

The validation process conducted by both content and media experts confirmed that the Respiratory Card learning media is highly feasible for use in instructional settings. The content validation yielded a score of 88%, while the media validation resulted in 90.6%, indicating that the media meets the required standards in terms of content accuracy, presentation quality, and instructional completeness.

From the perspective of practicality, the media was positively received by classroom teachers, with an evaluation score of 92%. Teachers found the media to be easy to use, visually appealing, and capable of increasing student engagement during learning activities. These attributes are particularly enhanced by the integration of the Project-Based Learning (PjBL) model, which supports interactive and student-centered learning environments.

In terms of effectiveness, the Respiratory Card demonstrated a significant impact on students' academic achievement. The average pre-test score of 34.8% increased substantially to 84.2% in the post-test after the implementation of the media. Similar results were observed during dissemination trials in another school, where the experimental group achieved an average post-test score of 86.00% compared to 37.25% in the control group. The independent t-test analysis confirmed a statistically significant difference in learning outcomes between students who used the Respiratory Card and those who received conventional instruction ($p = 0.000 < 0.05$).

Overall, the findings indicate that the Respiratory Card, developed using the Project-Based Learning model, is a valid, practical, and effective instructional medium. It successfully fosters active student participation through collaborative and exploratory learning, while enhancing visual comprehension of human respiratory system concepts in fifth-grade science education.

## RECOMMENDATION

Based on the results of this research and development, the Respiratory Card media is recommended as an alternative instructional tool for science teachers, particularly for teaching the human respiratory system at the elementary school level. Teachers are encouraged to use this media optimally by adapting it to the specific characteristics and learning needs of their students. Furthermore, students are encouraged to use the media both in individual and group study settings to facilitate a more enjoyable and effective learning experience.

Given the limitations in testing scope and content coverage, future researchers are advised to expand the development of this media to include a broader range of schools and to explore the application of similar media to different topics and educational levels. It is recommended that subsequent studies replicate the development of Respiratory Card media based on the Project-Based Learning (PjBL) model for other science topics—such as the circulatory system or ecosystems—and implement it at higher education levels, such as junior or senior high school, in order to evaluate its effectiveness and usability in different contexts and cognitive domains.

## ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to SDS Attaufiq Medan and UPT SDN Percobaan Medan for their cooperation and support during the implementation of this research. Special thanks are extended to the teachers, students, and school administrators who participated and contributed valuable insights throughout the development and testing of the Respiratory Card learning media. The authors also acknowledge the contributions of the content and media experts whose feedback and validation were essential to improving the quality of the instructional material. This research was carried out with the encouragement and support of the Faculty of Teacher Training and Education, Universitas Negeri Medan.

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