



Development of the PjBL Model Science E-Book to Improve Creative Thinking Skills of Middle School Students

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Abstract: The aim of this research is to develop a science e-book with material on the respiratory system using the PjBL model which can be used to improve students' creative thinking skills. This is a R&D using Borg and Gall research design. This research uses a one group pretest-posttest design. Subjects were 31 students in grade 8C of SMP Negeri 5 Depok Yogyakarta. Level of product suitability show that in terms of content suitability, presentation suitability and language suitability, as well as the characteristics of PjBL e-books, the average value is 3.25 in the very good category. Graphic aspects as well as technical quality and usability aspects received an average score of 3.40 in the very good category, meaning this e-book can be used in learning at school. Furthermore, the average product practicality level results for students were 90.10% in the very practical category. The research results show that the PjBL model science e-book can improve students' creative thinking skills with a normalized gain test of 0.7 in the high category. Therefore, the e-book with material on the respiratory system that has been developed can facilitate the application of the PjBL model and improve students' creative thinking skills.

Keywords: Creative thinking skills; E-book; PjBL

Introduction

The fact that the number of smokers in Indonesia has increased significantly is a national issue that needs to be resolved. Based on surveys, the number of smokers has increased by 14.59% in the last 10 years (Widyawati, 2022). The number of active smokers in Indonesia reach 69.1 million people in 2021. The majority of Indonesian smokers first smoked at the age of 15-19 years. According to Basic Health Research data, there are 52.1% of smokers who smoked for the first time at the age of 15-19 years (Megatsari et al., 2023; Pahlavi, 2022). This means that many junior high school students have become active smokers. As is known, smoking has various dangerous impacts on health such as causing cancer, bronchitis, pneumonia, etc (Holipah et al., 2020). Therefore, public health is seriously threatened so efforts must be made to overcome this.

Efforts to prevent the increasing number of teenage smokers must be carried out early through learning in schools and through outreach in the community. In the world of education, this effort can be carried out through

integration in learning materials so that it can increase understanding and concern for the environment (Asi et al., 2021). Other efforts can also be made by implementing certain learning models (Gafour et al., 2020).

Natural Science subjects in junior high school teach logical and scientific thinking so that we can live a better and healthier life. The development of a scientific mindset is carried out through scientific methods, namely observation and tests (Ilafi et al., 2023). Science also functions to equip students with 21st century skills related to natural and social phenomena (Ministry of Education and Culture RI, 2022).

The 21st century skills are the skills needed to face various changes and problems in the future. These skills include 6C, namely critical thinking and problem solving, creativity and innovation, collaboration, communication, character education, and citizenship (Asi et al., 2021; Gafour et al., 2020). These skills are HOTS skills developed in this modern era (Hasibuan et al., 2023). Creative thinking skills are considered one of the main competencies that must be developed because

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they are considered important for creative industries (van Laar et al., 2020) entrepreneurial activity and long-term economic growth (Ritter et al., 2017).

Creative thinking skills are innovative ways of approaching and analyzing ideas, problem solving, or critical thinking, and these skills can be developed and improved using various techniques and practices (Gafour et al., 2020; Ritter et al., 2017). It is important for students to master these skills to develop themselves in the era of globalization and solve problems with new approaches.

Creative thinking skills need to be trained and improved through learning in the classroom through the application of certain models (Asrizal et al., 2023). Research from Kusumaningtyas et al. (2023) shows that creative thinking skills can be trained and improved by implementing the PjBL learning model. PjBL model is a learning model that is student-centered, invites students to think creatively, and gives teachers the opportunity to manage the class by involving project activities (Nursamsu et al., 2023). Kokotsaki et al. (2016) also states that this learning model is student-centered active learning which is characterized by student autonomy, constructive investigation, goal setting, collaboration, communication, and reflection in real-world practice.

Learning requires valid and up-to-date teaching materials. Teachers can use developing technology according to students' interests and talents so that students can learn creatively, innovatively and independently (Sagala et al., 2021). Teaching materials are tools used to facilitate students learning and understanding concepts and learning materials in a practical, fun and contextual manner. Teaching materials are made in accordance with the learning objectives and those set out in the learning plan (Kapur, 2019). Learning materials that can be accessed using gadget can increase flexibility in learning (Ilfiana et al., 2021).

The development of teaching materials is important because it has various functions: as a learning guide, making learning more effective, as a source of assessment of student learning; so that educators can play a more active role as facilitators and be efficient in using time (Kosasih, 2021). Teaching materials should teach students, provide orientation and instructions, and become a learning center (Kumar, 2017). Electronic teaching materials are no longer affected by limited facilities, because students already have laptops and mobile phones (Saputri et al., 2023). In reality, teaching materials using the PjBL model related to solutions for smokers have not been developed. Therefore, this research aims to develop teaching materials in the form of e-books with the PjBL model regarding respiratory system material that can improve the creative thinking skills of junior high school students.

Method

This research is a research and development (R&D) adapting the Borg and Gall model (Borg et al., 1998) which has ten stages of development, namely: Research and information collecting, Planning, Develop Preliminary form of Product, Preliminary Field Testing, Main Product Revision, Main Field Testing, Operational Product Revision, Operational Field Testing, Final Product Revision, and Dissemination (Borg et al., 1998). In this study, researchers limited these steps to steps 1-6.

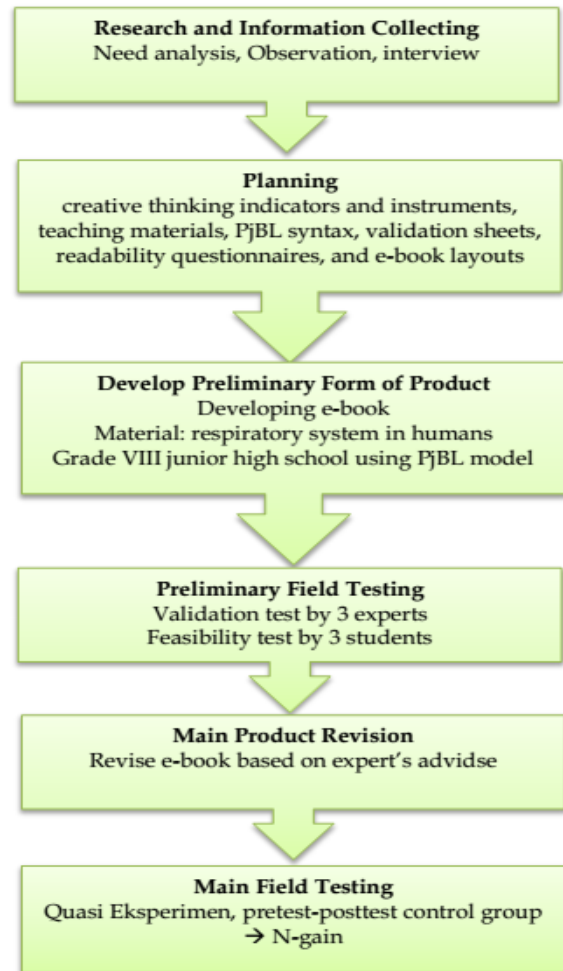


Figure 1. Research and development steps

The research began with compiling an e-book on material on the respiratory system in humans, conducting a readability test, then carrying out a field trial in October 2023. The subjects of the field trial were 31 students in class VIII of SMP Negeri 5 Depok Yogyakarta. Students are divided into groups and carry out projects regarding the human respiratory system, namely providing solutions for smokers with the help of e-books that have been developed. Before and after carrying out the project, students do a pretest and posttest as done by Licorish et al. (2018), Kim (2020) and Pather et al. (2020). The results obtained were then

analyzed quantitatively and qualitatively to see students' creative thinking skills.

The instrument used in this research is a test. Instrument was corrected and analyzed by practitioners so that it could be used to obtain research data. The test instrument is in the form of descriptive questions developed from indicators of creative thinking skills that are integrated in each step of the e-book. The data analysis technique for improving creative thinking skills to determine the increase in cognitive learning outcomes before and after learning using interactive ebooks (Rosida et al., 2017) is *normalized gain score* with the equation:

$$g = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}} \quad (1)$$

The data obtained is categorized according to the table.

Table 1. Criteria for Increasing Creative Thinking Skills

Intervals	Category
$g \geq 0.70$	Tall
$0.30 \leq g < 0.70$	Currently
$g < 0.30$	Low

Results and Discussion

Research and Information Collecting

This stage begins with analyzing the needs of students, analyzing concepts and formulating learning objectives. Needs analysis was carried out by conducting interviews with teachers at SMP Negeri 5 Depok. Based on the interviews, students already have textbooks but they feel reluctant to use them because students are already familiar with hand phones. Students have also never carried out science learning using the PjBL model. The teacher said that time allocation was an inhibiting factor so that she could not implement PjBL. Teachers are also not familiar with this learning model. The science textbook used is not specifically designed to help implement PjBL model learning. This in line with Syahlan et al. (2023). Therefore, it is necessary to develop teaching materials that can bridge this problem, by developing PjBL model e-books.

Based on the results of the interview, teachers already know about the PjBL learning model but have never implemented it. Teachers' reluctance is because PjBL is considered to require a lot of time while there is a lot of material that must be conveyed. Teachers also have not found an effective and efficient formula for implementing PjBL, both in terms of time use and application of PjBL syntax.

Next, curriculum analysis was carried out as well as material analysis, namely the respiratory system. One of the learning objectives to be achieved in the respiratory system material is that students are able to provide

solutions to smokers. This material is related to student's problems and local context which as suggested by Nashon et al. (2013). Project-based learning encourages students to explore material further and produce different projects so that they can simultaneously improve students' creative thinking skills.

Planning

The planning stage includes overall research planning, including the preparation of creative thinking indicators and instruments, teaching materials, PjBL syntax, validation sheets, readability questionnaires, and e-book layouts. Creative thinking indicators are synthesized from various sources consisting of fluency, flexibility, originality, elaboration and evaluation (Lian et al., 2018; Megawan et al., 2019; Zubaidah et al., 2017).

Develop Preliminary Form of Product

At this stage an e-book design is created that can facilitate the implementation of PjBL. PjBL is rooted in constructivist learning theory (Rahardian et al., 2023), where teachers cannot provide material directly (direct learning). Students must use prior knowledge to construct new knowledge. Material on respiratory organs, respiratory mechanisms, types of breathing, and diseases related to respiratory organs are also presented in the e-book as prior knowledge. The sub-material 'providing solutions for smokers' is presented according to the PjBL syntax.

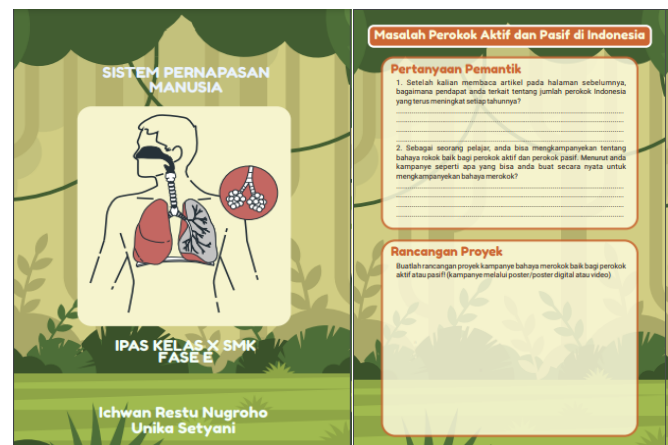


Figure 2. PjBL model respiratory system e-book

There are 6 PjBL syntax (Martati, 2022; Susilawati et al., 2017) including determining basic questions, develop project plans, prepare schedules, monitor students and project progress, assess results, and evaluate experiences.

The e-book was created using the Corel Draw program, complete with student worksheet with Google Form. The e-book is equipped with concept maps, images, videos, video links, and student worksheet links. The output is a file with the pdf extension.

Preliminary Field Testing

The e-book product that has been developed is then tested for feasibility, practicality, then applied in the learning of the Science and Technology Project at SMP Negeri 5 Depok. Sugiyono (2018) states that validation must be carried out by experienced experts. Thus this research was carried out by 3 material experts and 3 media experts.

Table 2. Material Expert Validation Results

Aspect	Score	Mark	Category
Appropriateness of content	3.5	A	Very good
Suitability of presentation	3	A	Very good
Language suitability	3.5	A	Very good
Characteristic of PjBL e-books	3	A	Very good
Average	3.25	A	Very good

Table 2 shows that the e-book produced received an average score of 3.25 with a grade of A in the very good category.

Table 3. Media Expert Validation Results

Aspect	Score	Mark	Category
Graphics	3.3	A	Very good
Technical quality and use	3.5	A	Very good
Average	3.4	A	Very good

The media experts gave scores according to table 3. Table 3 shows that the e-book produced received an average score of 3.4 with a score of A in the very good category.

Next, a practical test was carried out involving 3 junior high school students from 3 different junior high schools in the Gunungkidul area. The practicality questionnaire consists of 16 items with a Likert scale of 1-4. The final score is obtained by dividing the score obtained by the maximum score multiplied by 100%. The practicality category (Ridwan, 2016) is 80% < x ≤ 100% Very practical; 60% < x ≤ 80% Practical; 40% < x ≤ 60% Practical enough; 20% < x ≤ 40% Less practical; 0% < x ≤ 20% Not practical. The practicality test shows that the e-book developed meets the very practical category with a practicality percentage of 90.10%.

Both validation and feasibility test show good result which means the developed e-book can be used for further research. Therefore, revision is needed according to expert's suggestions.

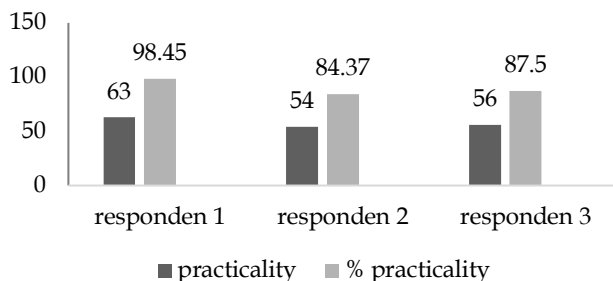


Figure 3. Result of practicality test

Main Product Revision

The e-book was then revised according to suggestions from material experts and media experts. Some changes can be seen in the following image.

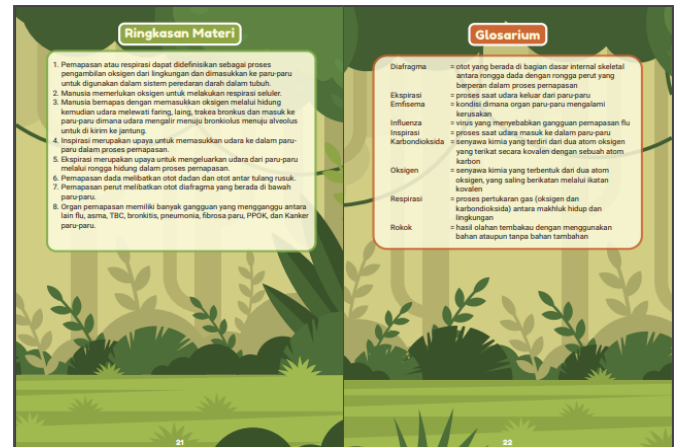


Figure 4. Addition of material summary, glossary and page numbers to the e-book

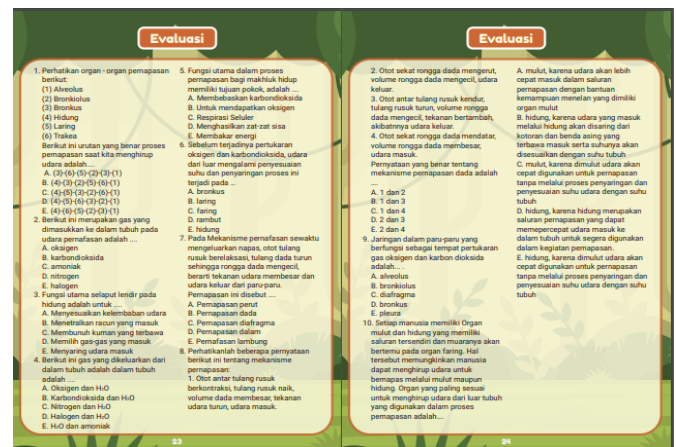


Figure 5. Addition of respiratory system evaluation

Main Field Testing

Furthermore, e-books are used in learning at SMP Negeri 5 Depok class VIII.C. Before learning is carried out, students are given a pretest in the form of 8 essay questions. After learning, students work on posttest questions with the same questions as the pretest. The questions are prepared based on indicators of creative thinking skills and analyzed using SPSS. Obtained normalized gain test results of 0.7 in the high category.

Table 4. Pre-test, Post-test and N-Gain Results

Aspect	Pre-test	Posttest	N-gain	Category
Fluency	56.2	84.2	0.64	Currently
Flexibility	31.6	77.5	0.67	Currently
Originality	29.9	83.7	0.77	Tall
Elaboration	36.4	77.7	0.65	Currently
Evaluation	32.4	82.9	0.75	Tall
Average	37.3	81.2	0.7	Tall

As shown on the table, posttest achieve higher score than pretest significantly. Therefore, it can be concluded that learning using e-book is effective for improving students learning outcomes. Students can learn the materials in the e-book before class and also can reread the materials so that learning becomes more optimal (Rahmi et al., 2021).

The project carried out by the students is to provide a solution for smokers. This real life problem is chosen to ensure that students interested and understand the problem they are facing (Siagian et al., 2019) so they can provide appropriate solution. The PjBL syntax begins by determining the basic question. Teachers should emphasize this step because it will underlie the entire project. Basic questions are discussed classically and must be agreed upon equally for all groups. Next, students work in groups to complete the project. Students are free to choose their educational pursuits and to collaborate on learning tasks until a finished product is produced (Halim et al., 2023). Because students are implementing the PjBL model learning for the first time, the teacher needs additional time to explain this learning model.



Figure 6. Project results flyer

Students divide tasks followed by preparing a project design and creating a timeline or compiling a project schedule. The teacher ensures that students understand what steps must be taken in implementing the project and that each student has an active role in the project. Students open and re-read the available e-books, and also use their hand phones to dig up further information. The use of student worksheets helps students in carrying out projects step by step as well as helping teachers in seeing learning outcomes. It is in with the research by Syukri et al. (2021), Nursamsu et al. (Nursamsu et al., 2023) and Asrizal et al. (2023). Even

though they were given the choice to make a digital flier or video, all students chose to make a digital flier. The application used is Canva. Based on observations, students do not experience problems using Canva. This means that students can use their phone to support mobile science learning, in line with the research by Rahmat et al. (2023). However, what emerged was that students were less agile in dividing group tasks because they were still waiting for each other's initiatives.

The digital flier results look diverse and show students exploring creative thinking skills and realizing them in real work. Apart from that, the contents of the flyer are also correct and providing solutions for smokers. The following is an example of a digital flyer made by students.

Conclusion

The research results show that the e-book developed has feasibility in the very good category with a score of 3.25 from material experts and 3.4 from media experts. The practicality results for the module were 90.10% in the very practical category. The e-Book also has the PjBL model of science which can improve students' creative thinking skills with a normalized gain test of 0.7 in the high category. Therefore, the development of a PjBL model science e-book with material on the respiratory system that has been developed can facilitate the application of the PjBL model and improve students' creative thinking skills.

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Author Contributions

Conceptualization, US, IW; methodology, IRN, SS; software, IRN; validation, US, IW; investigation, US, IRN; writing—original draft preparation, US writing—review and editing, US, JJ.

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Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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