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Development of Res-CBD Innovative Teaching Supplements to Improve Students' Science Literacy Abilities

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Abstract

Respiratory system disorders such as Covid-19, SARS, MERS, TB and COPD are in the spotlight in the world of health but have not been widely integrated into teaching materials in schools. The availability of teaching materials that do not meet students' needs and do not include enough coverage of scientific literacy is one of the factors in low scientific literacy abilities. This research aims to develop innovative teaching supplements regarding the respiratory system to improve students' scientific literacy skills. This research is a Research and Development (R&D) study with steps (1) potential and problems; (2) data collection; (3) product design; (4) design validation; (5) design revision; (6) product testing; (7) product revision; (8) final product. The research data were analyzed using qualitative and quantitative descriptive analysis methods. The research results show that the innovative teaching supplement "Res-CBD" is suitable for use in teaching biology regarding the respiratory system. This feasibility is based on the results of material validity which shows a percentage of 90% (very valid), media validity of 97% (very valid), teacher response of 85.75% (very good), and student response of 83.33% (very good) . The use of the innovative teaching supplement "Res-CBD" in learning respiratory system biology is effective in improving students' scientific literacy skills with an N-Gain value of 0.599 (medium category). Based on these results, it can be concluded that the development of the innovative teaching supplement "Res-CBD" to improve students' scientific literacy skills is declared suitable for use in learning the respiratory system and is effective for use as an additional learning resource to improve students' scientific literacy skills.

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INTRODUCTION

Education must now be able to equip students to have the competencies and skills needed in 21st century life (Patimah, 2017). 21st century skills are skills to be responsive to the rapid development of technology and information. This development occurs in line with the increasing human need to obtain information, communicate and solve problems. So the key to success in responding to the challenges of the 21st century is scientific literacy by utilizing information to solve everyday life problems (Nofiana & Julianto, 2018). For this reason, improving scientific literacy skills is a goal of 21st century education (Sutrisna, 2021).

Scientific literacy is a person's ability to understand and apply scientific knowledge in society (Dewantari & Singgih, 2020). Moreover, the object of study in biology lessons includes all objects and phenomena in the natural surroundings, containing many concepts related to life. So scientific literacy is very important for students to increase knowledge information, understand science as a concept and be able to apply it in everyday life. However, the results of students' scientific literacy achievements in PISA (*Program for International Student Assessment*) in 2022 Indonesia will be in 68th position out of 81 countries with a score from 396 in 2018 to 383 (OECD, 2023).

Students' low scientific literacy abilities can be influenced by several factors, one of which is the selection of learning resources that do not contain scientific literacy (Pujiyanti *et al*., 2022). The biology handbook for class XI students contains disproportionate coverage of scientific literacy, especially regarding the respiratory system. The percentage of scientific literacy competency coverage categories in biology textbooks on the human respiratory system is dominated by the competency to explain phenomena scientifically with a percentage of 68% (medium category), the competency to evaluate and design scientific investigations has a percentage of 14% (very low category) and the competency to draw conclusions based on data has a percentage of 17% (very low category) (Lasminawati *et al*., 2019).

Based on the results of interviews with students at SMA Negeri 7 Semarang, they stated that the teaching materials used were LKS books and power points from teachers so that books played an important role in the learning process. The results of researchers' analysis of high school biology books on the respiratory system material show that it is still dominated by rote theories. And contain the material briefly. The student handbook used has too many activity sheets rather than material and a lack of pictures, which can reduce students' interest in reading it. Apart from that, the student handbook provides general information and examples, but does not relate it to current issues. In line with research (Lasminawati *et al*., 2019) who also emphasized that class XI students' biology books explain more in the form of theories and concepts.

Learning based on current biological diseases is learning that utilizes information, phenomena and new knowledge about disorders or diseases that are currently occurring. The actual discussion of disorders or diseases that attack the respiratory system needs to be studied more deeply considering that there is still limited information in student textbooks. The respiratory system is a part of the body system that is very important for survival (Naradhyana *et al*., 2015). Students should understand how the respiratory system works and how respiratory diseases can affect health. Moreover, many students have misconceptions about the respiratory system material, due to the complex concept (N. Ritonga et al., 2018).

Based on the problems described above, additional teaching materials (teaching supplements) are needed that are innovative, creative, linking current biological diseases to breathing so as to increase students' scientific literacy coverage. However, there has been no development of such teaching supplements to help the learning process, so researchers wish to develop innovative teaching supplements and integrate the coverage of scientific literacy through current biological diseases in the respiratory system contextually. Thus, the development of the innovative teaching supplement Res-CBD (Current Biological Diseases in Respiratory) was carried out with the aim of determining the characteristics, feasibility and effectiveness for improving students' scientific literacy abilities.

RESEARCH METHOD

This research uses a modified Research and Development (R&D) method from Sugiyono which consists of 10 stages, namely (1) potential and problem analysis, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) small scale trials, (7) product revisions, (8) large scale trials, (9) product revisions, and (10) final product. Research and Development is a research method that aims to produce a particular product and test the effectiveness of the product (Sugiyono, 2015). In general, research is divided into 2 stages, namely the supplement development stage and the product testing stage. The supplement development stage was carried out at the FMIPA UNNES Biology Education Campus.

Product feasibility is seen based on media validity tests, material validity, teacher responses and student responses. The teacher's response involved the biology teacher in class XI while the student response involved 15 students in class The supplement is declared feasible if the validity results show a percentage in the valid to very valid category and the results of teacher responses and student responses show a percentage in the good to very good category. Then a large-scale trial was carried out to test the effectiveness of the product being developed involving 2 classes, namely XI 6 and XI 8 with a total of 68 students. The effectiveness of the supplement is seen based on increasing scientific literacy skills through pretest and posttest results. The test instrument consists of 24 multiple choice questions which have been tested for validity, reliability, differentiability of the questions and level of difficulty of the questions.

RESULTS AND DISCUSSION

Characteristics of Res-CBD Innovative Teaching Supplement

The development of innovative teaching supplements is based on potential and existing problems and adapted to student needs while still being guided by the biology learning syllabus and the learning objectives of the independent curriculum phase F to be able to analyze the relationship between organ structures in organ systems and their functions and disorders that arise in the human respiratory system. The innovative teaching supplement developed consists of 67 pages with an A5 book size. The cover display is equipped with an image that represents the content. The front cover appearance is a white title in the middle that says "RES-CBD" with the statement Current Biological Diseases in Respiratory below it. In the top right corner there is the UNNES logo, while the right corner says SMA/MA class XI biology. The bottom section is equipped with a brief description of the contents of the book based on scientific literacy, the bottom corner of the year and the author's name. Meanwhile, the dark blue back cover has an illustration of a lung infection with the title at the top left and a brief explanation of the book's contents in the middle.

This supplement was developed with 3 main parts, namely introduction, contents and conclusion. The introduction consists of information about the book, a foreword from the author as well as a table of contents and a list of images. Meanwhile, the content contains a discussion of material on the respiratory system with the main focus connecting the latest diseases that often attack the respiratory system (current biological diseases in the respiratory system) by linking the relationship between organ structure and function and disorders and abnormalities that occur in the respiratory system. The diseases contained in it are Covid-19 (Coronavirus Diseases), MERS (Middle East Respiratory Syndrome), SARS (Severe Acute Respiratory Syndrome), TB (Tuberculosis) and COPD (Chronic Obstructive Pulmonary Disease). It is also equipped with student activities, relevant images, research results and problems that often occur in the area by integrating scientific literacy coverage in it so that it can facilitate students' scientific literacy abilities. Meanwhile, the closing section consists of a summary, practice questions, glossary and bibliography.

Apart from achieving learning objectives, the content of scientific literacy is an advantage of this book. There are 4 indicators of scientific literacy that are integrated in the book through various text readings and student activities, namely, knowledge about science, the nature of scientific investigations, science as a way of thinking, and the interaction of science, technology and society. The suitability of the supplement characteristics was validated by high school biology teachers through a characteristics

questionnaire. This effort was made to be in line with the planned objectives and characteristics. The results of the suitability of the book with the characteristics are presented in table 4 below.

Table 1. Characteristics of Teaching Supplements

No.	Assessment indicators	Scor	Criteria
1.	Presentation Aspects	90%	Very good
2.	Content	83%	Very good
Final Scor		**85%**	**Very good**

Based on the results of characteristic data analysis by the biology teacher at SMA Negeri 7 Semarang, the average characteristic score was 85% with very good criteria. In this way, the book developed is in accordance with the characteristics expected by the author. The percentage of presentation aspects is greater than the content aspect of the discussion. This is because the presentation aspect is seen from the physical appearance of the cover and contents of the book as well as its completeness in presentation. The appearance of the book is representative in describing the contents of the book and good color selection can attract readers' interest so that they get the maximum score. Book covers influence students' reading interest (Amalia *et al*., 2021). Meanwhile, the completeness of the presentation is seen from the sequence of sections and the completeness of the student activity column as supporting material. The supplement presented consists of 3 main parts, namely introduction, content and conclusion which can facilitate student learning.

Aspects of the content of the discussion are obtained from assessing the content of the supplements developed against scientific literacy indicators and learning objectives. There are several indicators used as references, such as explanations of the respiratory system, discussion of knowledge about science, activities that encourage the investigative nature of science, use of science as a way of thinking and interaction between science, technology and society. The lowest percentage was obtained for activity indicators that encourage the investigative nature of science and the interaction of science, technology and society. This indicates that in the supplements developed the material on the respiratory system has been well explained starting from the respiratory organs, mechanisms to the many and widespread disorders that occur in the respiratory system. The discussion presented not only presents theory but also concepts and facts that occur around you. Representing knowledge and information can also increase knowledge about science (Amalia *et al*., 2021).

Activities that encourage the investigative nature of science in the supplement are presented through limited simple experiments and literature studies only. That's why it gets a lower score. Activities to encourage the investigative nature of science are less effective through literature studies and more effective through experimental activities. This is because experimental activities emphasize scientific process skill activities to gain conceptual understanding and reduce theoretical memorization activities (Pujiyanti *et al.*, 2022). Meanwhile, to facilitate the use of science as a way of thinking, several discussion activities on a problem are presented. Because science as a way of thinking shows how students' creativity in thinking activities is constructed by curiosity, knowledge, imagination and belief (Amalia *et al*., 2021). The final indicator is the interaction between science, technology and society. The supplement has presented the role of technology and discussed social problems related to science, technology on the respiratory system. This discussion encourages students to be able to formulate solutions to problems and face these problems in life (Alfiana *et al.*, 2022).

Feasibility of Res-CBD Innovative Teach Supplement

Feasibility is a level that indicates the extent to which a product meets certain requirements, standards or criteria to be considered appropriate or feasible. The feasibility of the Res-CBD innovative teaching supplement is measured through three aspects, namely validation results, teacher responses and student responses to the supplements developed. Validation results are divided into two, namely material validation by material experts and media validation through media validators. There are three aspects in the validated material component, namely (1) content validation, (2) presentation validation, (3) data validation. Data from material validation results are presented in the following table.

Table 2. Material Validation Results

No.	Assessment indicators	Scor	Criteria
1.	Content validity	92%	Very valid
2.	Validity of presentation	97%	Very valid
3.	Linguistic validity	80%	Valid
Final Scor		**90%**	**Very valid**

Based on the results of validation data analysis by material experts, the average material validity score was 90% with very valid criteria. A supplement is said to be valid if the validity score is > 71%. However, minor revisions are still needed based on expert advice. There are several suggestions and improvements that must be made, including (1) improving the location of the glossary to be before the bibliography, (2) adding empty parts of the book with activities that can encourage scientific literacy skills. There are 3 activities added to facilitate students' scientific literacy activities in accordance with scientific literacy indicators. including choking activities, activities to calculate lung capacity based on data to determine the presence or absence of lung function disorders and discussions regarding the relationship between air pollution and the health of the respiratory system, especially COPD. Good scientific literacy-based teaching materials must meet the four scientific literacy indicators (Atmaji & Maryani, 2019).

The content suitability aspect consists of four indicator points, including suitability of the material to learning objectives, accuracy of the material, up-to-dateness of the material, and discussion that encourages scientific literacy. The first indicator is the suitability of the material to the learning objectives, only 1 item received a score of 3 with good criteria. Completeness, breadth and depth of material are needed to achieve learning objectives. It is important to pay attention to the breadth and depth of the material because understanding the material is related to students' cognitive development (Astiti *et al.*, 2021). The second indicator is the accuracy of the material, getting a very good score, this shows that the material explained is accurate in terms of facts, concepts, cases, data, illustrations and terms used. The accuracy of the information and discussion of the material presented can prevent and avoid misconceptions among students (Wahyuningasri & Ambarwati, 2022)

The up-to-date content is also considered in content validation, it must be adapted to the latest scientific developments. Therefore, the latest diseases or diseases that still attack the respiratory system are presented to be discussed in more depth in the supplement. Meanwhile, another aspect of content validation is discussing content that encourages social literacy. The material presented must integrate the scope of scientific literacy by paying attention to scientific literacy indicators. Good scientific literacy-based teaching materials must meet the four scientific literacy indicators (Atmaji & Maryani, 2019). In the feasibility aspect of presentation, there are indicator points such as presentation technique, presentation support and presentation completeness. Almost all items from the presentation aspect sub-indicators get the maximum score, meaning that in general the presentation aspect is said to be adequate. There was only 1 item that received a score of 3 or good description. This score is obtained from the sub-indicator of presentation consistency. This happens because the layout of the glossary and bibliography are not presented coherently.

Linguistic validity consists of straightforwardness, conformity with Indonesian language rules, use of terms and symbols, dialogical and interactive as well as communicative and readable. Straightforward means that the language used is effective, paying attention to language rules so that it does not give rise to double meanings. The terms and symbols used must be consistent and adapted to the principles of biological science. Writing of foreign terms and scientific names has been marked in italics (Azizah & Budijastuti, 2021). The language and information presented must be easy to understand so that it can motivate students and facilitate students to discuss with others and be adapted to students' intellectual development. This way it can clarify students' understanding easily (Ritonga *et al.*, 2022). Overall, all indicators in validating linguistic aspects received good scores according to the material validator.

The validity of the innovative teaching supplement media "Res-CBD" that was developed was obtained from the results of validation by competent and relevant media experts in the media field. Media validity is used to determine whether the teaching supplement being developed is valid or not in terms of graphics. The validity of the media can be seen from the graphic aspects of the teaching supplement being developed including, (1) supplement size, (2) cover design, and (3) content design. The data from validation by media experts is as presented in table 3.

Table 3. Media Validity Results

No.	Assessment Indicators	Scor	Criteria
Graphic validity			
1.	Book size	100%	Very valid
2.	Cover design	96%	Very valid
3.	Content design	98%	Very alid
Final Scor		**97%**	**Very valid**

Based on the results of validation data analysis by media experts, the average media validity score was 97% with very valid criteria. A supplement is said to be valid if the validation score is <71%. The highest percentage is the size of the book because the book developed is in accordance with the ISO standard size. Meanwhile, the cover design and content design aspects of the book did not get the maximum score. This is because there is a suggestion from the validator to change clearly visible human images with animation or AI technology alone. Don't forget to pay attention to image quality. The use of high quality images will increase students' excitement and enthusiasm in the learning process (Suranti, *et al.*, 2020)

Apart from expert validation results, teacher responses are also needed to assess the feasibility of the supplement being developed. Data from teacher responses are presented in the following table.

Table 4 Results of Teacher Responses

Assessment Indicators	Scor	Criteria
Graphics	100%	Very good
Material	83%	Very good
Language	85%	Very good
Convenience	75%	Good
Final scor	**85,75%**	**Very good**

The results of teacher responses show that the average percentage is 85.75 with very good criteria. The teacher gave a response percentage of 100% with very good criteria in the graphic aspect. This supplement is considered quite interesting because it uses colorful designs, harmonious layout placement,

and illustrations in accordance with current developments. The use of illustrations allows readers to understand the content better and creates an impression in memory (Aswan, 2019). In the material aspect, it received a score of 83%, the material presented can complement the respiratory system material in phase F of the independent curriculum. The linguistic aspect is also very good with a percentage of 85%. The use of language with clear sentence structures and consistent terms makes the language used easy to understand and communicative. The use of communicative language can make students happy to read it (Maulidiati *et al.*, 2021). Meanwhile, the ease aspect gets the lowest score. This is because the supplement functions as a complement to textbooks (Soleha, *et al.*, 2017).

A good product is a product that not only contains information but is also accepted by students. Student responses to the product are needed to determine the suitability of the product from the perspective of students as users. The results of student responses are presented in table 5.

Table 5. Student Response Results

Assessment Indicators	Scor	Criteria
Graphics	85,42%	Very good
Material	74%	Good
Language	87,22%	Very good
Interest	80,83%	Very good
Final Scor	**83,33%**	**Very good**

Carrying out student response tests aims to measure interest in the structure and physical appearance of the product, the consistency of material presentation, ease of use and usefulness of the product in helping students' understanding (Prasetiyo, & Perwiraningtyas, 2017). The results of student responses to the supplement obtained an average percentage of 83.33% or very good criteria. In the graphic aspect, students showed a good response when they first received the book being developed even though they had not read it to the end. The arrangement of graphic elements such as typography, font selection, images and layout placement that are applied consistently can prevent boredom and reduce boredom in reading (Khoiriah, *et al.*, 2018).

Meanwhile, the material aspect received a good assessment. The supplement was developed to suit students' needs by integrating scientific literacy so that it is different from other teaching materials. The linguistic aspect also received a very good assessment. Most students consider the language used to be clear and easy to understand. There are supplements. The existence of this teaching supplement makes learning biology less boring because there is new information related to current biological diseases in the respiratory system and problems with the respiratory system in real life. This makes the interest aspect get a very good score from student responses. So it can increase students' motivation to seek further information.

Effectiveness of Res-CBD Innovative Teaching Supplement

Scientific literacy is not just reading, writing and accessing books but the ability to utilize knowledge and thinking in various situations. Science learning is one way to improve scientific literacy skills. However, the use of teaching materials in the learning process is not enough to facilitate students to convey the essential knowledge that students should know (Komalasari, *et al.*, 2019). The teacher is not the only source of learning, but also someone who can create various learning resources to create a better learning environment (Nurhasnah, & Sari, 2020). The Res-CBD teaching supplement was developed as a learning resource to improve scientific literacy skills.

The use of the Res-CBD teaching supplement as a learning resource was carried out during 4 meetings in classes XI 6 and XI 8 at SMA Negeri 7 Semarang. The effectiveness of supplements is seen from whether there is an influence and improvement on scientific literacy skills. Therefore, to test the effectiveness of the teaching supplement, students' scientific literacy

ability tests were carried out twice using 24 multiple choice questions developed based on scientific literacy indicators. The pre-test is a test carried out before using supplements and the post-test is carried out at the end of the meeting after using supplements to determine whether there is an effect on supplement use. The pre-test and post-test results are presented in table 6 below.

Table 6 Pre-test and Post-test scores

Information	Scor	
	Pre-test	*Post-test*
Lowest scor	33	70
Highest scor	87	100

Based on the results of the scientific literacy ability test carried out in 2 classes, namely classes XI 6 and that can be obtained is 100. The pre-test and post-test results show an increase in the post-test score after using the Res-CBD teaching supplement. Even though the post test results have improved, this does not mean that students' scientific literacy skills have increased. So the gain normality test (N-gain) is calculated. The N-gain measurement results are presented in table 7 below.

Table 7 Recapitulation of N-Gain Test Results

Amount	N-gain	Percentage	Criteria
15	$g > 0,7$	22%	High
51	$0,3 < g \leq 0,7$	75%	Medium
2	$g \leq 0,3$	3%	Low
Average		**0,599**	
Criteria		**Medium**	

After involving this supplement in the learning process, students have the knowledge and scientific skills to be able to identify questions, obtain new knowledge, explain theories and hypotheses, draw conclusions and present and solve problems based on knowledge. The results of the N-gain test showed that 51 people obtained N-gain with medium criteria while 15 people obtained N-gain with high criteria. This shows that as many as 97% of the total students experienced an increase in scientific literacy skills. The average N-gain value obtained was 0.599 or within the medium criteria. The developed Res-CBD teaching supplement is effectively used as a learning resource to improve students' scientific literacy skills..

There are four indicators of scientific literacy that are integrated and measured in the use of Res-CBD teaching supplements, namely as follows, 1) knowledge about science, 2) nature of scientific investigation, 3) science as a way of thinking, 4) interaction of science, technology and society (Pujiyanti, *et al*., 2022). The recapitulation results of measuring students' scientific literacy abilities are presented in table 8 below

Table 8 Recapitulation of Scientific Literacy Ability Indicator Values

No	Indicator Scientific Literacy	Percentage	Percentage
1.	Knowledge about science	89%	
2.	Nature of scientific investigation	66%	
3.	Science as a way of thingking	95%	85%
4.	Interaction os science, technology and society	92%	

Based on the data obtained from the results of the recapitulation of the indicators of students' scientific literacy abilities, it shows that there are differences in the percentage results for each scientific literacy indicator. The highest scientific literacy is in the 3rd indicator, namely science as a way of thinking, at 95%, while the lowest is in the 2nd indicator, namely the investigative nature of science, at 66% in the low category. The overall average percentage of scientific literacy is 85% or in the high category. The first indicator, namely knowledge about science, obtained 89%. This shows that through the Res-CBD supplement students already understand the facts, concepts, theories and information about the respiratory system well. Students' ability to understand facts, concepts, hypotheses and theories in the field of science is very necessary in the science learning process (Pujiyanti *et al*., 2022). The second indicator is the nature of scientific investigation which has the lowest percentage. This is because scientific investigation activities are only limited, but other activities are provided through literature studies. Low scores are also influenced by students' lack of accuracy when taking tests. Not being careful in understanding the question instructions shows a low level of reading interest (Suraji, *et al*., 2018).

The third indicator, namely science as a way of thinking, received the highest percentage score of 95%. The supplement developed contains simple experimental activities that can support students' scientific abilities as a way of thinking. Activities that require students to answer, calculate, analyze or engage in hands-on experiments enable students to understand and relate the science material learned to personal experiences (Pujiyanti *et al*., 2022). Meanwhile, the fourth indicator is the interaction of science, technology and society. The research results mean the average percentage of science, technology and society interaction indicators is 92%. Through the Res-CBD supplement developed, students already understand the benefits and uses of science and technology in society. This is because the book contains readings and problems faced by society regarding the respiratory system, including the use of technology, the latest respiratory system diseases that attack the respiratory system and their impact and relationship to respiratory health in society.

CONCLUSION

Based on the results and discussion of research on the development of the innovative teaching supplement "Res-CBD" that has been carried out, it can be concluded that the innovative teaching supplement Res-CBD is an innovative teaching supplement that contains material on the respiratory system and the latest diseases that attack the respiratory system by integrating scientific literacy indicators in it. . Res-CBD's innovative teaching supplement is suitable for use as a learning resource in respiratory system material in high school. Res-CBD's innovative teaching supplement is effective in improving 97% of students' scientific literacy skills with an average N-gain value of 0.599 or in the medium category.

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