

## Development of CTL-Based Teaching Material Supplements in Biological Literacy Training

Dinda Fuji Islamiyanti<sup>✉</sup>, Lisdiana Lisdiana, Ari Yuniastuti

Pascasarjana, Universitas Negeri Semarang, Indonesia

### Article Info

Article History :  
April 2023  
Accepted  
June 2023  
Published  
August 2023

Keywords:  
biological literacy; CTL;  
respiratory system; sup-  
plements of teaching  
materials

### Abstract

This study aims to develop supplemental CTL-based respiratory system teaching materials to train students' biological literacy skills. The quality of teaching material supplements is measured by the criteria of the characteristics of teaching material supplements, validity, readability and effectiveness of teaching material supplements when used in the learning process. The characteristics of teaching material supplements consist of 7 activities, namely Constructivism, Inquiry, Questioning, Learning community, Reflection, Authentic assessment. The validation of teaching material supplements was assessed by material experts and media experts. The results showed that the percentage of validity of teaching material supplements by material experts was 88.1% with very valid criteria and the mean validity by media experts was 96% with very valid criteria. The legibility of teaching material supplements was analyzed based on the readability questionnaire data for teachers and students after the trial was carried out at SMA Negeri 7 Cirebon City. The results of the teacher readability questionnaire were 87.7% very good criteria and 85.5% very good criteria for student readability. The effectiveness of teaching material supplements in training biological literacy skills was tested using the N-gain test obtained from the results of the pretest and posttest questions based on biological literacy. The mean value of the pretest is 48.15 and the posttest is 77.04. Biological literacy N-test gain with an average of 0.56 in the medium category. Based on the results obtained, it can be concluded that the developed teaching material supplements meet the criteria of characteristics, validity, readability and effectiveness and can train biological literacy skills.

<sup>✉</sup> correspondence :  
Jalan Kelud Utara III No.37, Kota Semarang,  
Jawa Tengah, Indonesia 50237  
E-mail: [dindaislamiyanti@students.unnes.ac.id](mailto:dindaislamiyanti@students.unnes.ac.id)

## INTRODUCTION

Science education has an important role in preparing students to enter the world of life, namely preparing students to be able to think logically, creatively, be critical, be able to master technology and be adaptive to change. Science learning is expected to provide learning experiences through scientific processes, utilizing technology in information retrieval, references whose results will affect both nature and society. The results of the 2018 PISA study assessment show that Indonesian students' scientific literacy skills are ranked 71st out of 79 participating countries. The low PISA score indicates that something needs to be improved in the science learning process.

Suparya et al. (2022) explained the factors causing low scientific literacy skills based on the results of the PISA survey, namely the use of textbooks that were not in accordance with students' needs, student misconceptions, non-contextual learning, low reading ability, learning environment and climate that had not been formed properly. well, school infrastructure that does not yet support learning, human resources and school management. The low ability of students' biology literacy can be caused by learning activities not yet oriented towards contextual learning. Lotulung et al. (2018) explained Contextual Teaching Learning is a learning concept in which teachers present real-world situations to the classroom and encourage students to make connections between knowledge and the application of their knowledge in their lives individually and as members of society.

Contextual learning activities also of course require teaching tools or teaching supplements that support increasing students' biological literacy abilities. Suparya et al. (2022) states that learning resources in science learning are still limited, namely in the form of textbooks or texts that do not include information that supports students to experience the learning process directly. Biological literacy knowledge and skills cannot be achieved by relying solely on textbooks or texts so that learning activities become boring and students do not understand science material in the context of life (Suparya et al., 2022).

CTL is draft learning that helps teachers connect between the material being taught with situation world real and push student to make

connection between knowledge and its application in daily they life, which involves seven component main from learning effective main, that is constructivism, inquiry, inquiry, community learning, modeling and authentic evaluation (Pangemanan, 2020; Rapanta et al., 2020; Mishra et al., 2020). Learning contextual is draft learning where the teacher presents situation world real to in class And push student For make connection between knowledge And application they in life they as family And member society . By Because That is , knowledge that is brought by somebody is results from experience alone . Without experience individual so student No capable understand draft material learning (Teles & Tomimatsu, 2014) .

A student-centered learning approach in which the learning process takes place naturally in the form of student work and experience activities, not transferring knowledge from teacher to student. This makes the learning process more meaningful for students (Mulbasari & Surmilasari, 2018) .

The results of the preliminary study in the form of interviews with Biology subject teachers at SMA Negeri 7 Kota Cirebon explained that the textbooks used were books from the 2016 Ministry of Education and Culture which felt that the material was sufficient but there was a lack of student activities and needed additional, up-to-date information. Student learning resources also only use textbooks lent from the library and simple worksheets that have been provided at the school cooperative so that the supplement to the Respiratory System teaching material which includes contextual learning activities (CTL-based) has never been used in SMA Negeri 7 Cirebon City. The following are the characteristics of supplementary CTL-based teaching materials in an effort to train students' biological literacy skills.

1. Constructivism, contained in apperception activities, namely by providing an overview of the material to be studied, there are 3 chapters where each chapter contains initial information about the material to be studied (providing information from news articles also helps students to have an overview of the concepts to be studied)
2. Inquiry is shown by simple practical activities (performance) measuring the volume of breathed air in various circumstances. Students

carry out measurement activities and also make conclusions.

3. Questioning is contained in the "discussion questions" column, for example discussion questions that the teacher can ask students to build students' ability to give opinions from reading results
4. Learning Community activities in the form of directly identifying things that cause respiratory problems in the environment around students (group projects interviewing sources or literature studies)
5. Modeling the steps of learning activities where in textbooks describe new interdisciplinary information in the form of flowcharts, modeling pictures or posters
6. Reflection has a column that students can fill in about teaching material they have understood, which they have not understood or teaching material which is difficult to understand. Budiamin (2016) describes activities reflection on CTL approach in the form of enrichment or revision from knowledge before, response events, activities or new knowledge received And can help student make connection between the knowledge you have previously with new knowledge.

The use of CTL-based Respiratory System teaching material supplements developed to train biological literacy skills as measured according to Bauerle et al. (2009) that is ability in application of scientific processes knowledge, ability use reasoning quantitative, ability use modeling, capabilities in use interdisciplinary knowledge, ability collaboration knowledge, as well ability understand context connection science And society. Inquiry is one of the activities in CTL Wenning (2007) in journal *Assessing Inquiry Skills As a Component of Scientific Literacy* that is ability literacy science can be measured through ability inquiry student. Through CTL learning, students are trained to carry out inquiry activities and learn from the surrounding environment by direct observation of problems that

exist in the student's environment, this allows students to understand science concepts contextually and be able to implement this information in everyday life. This is in accordance with the understanding of the concept of biological literacy. Biological literacy is a broad biological understanding of principles and applying them in appropriate ways to activities in personal and social settings (Bybee et al., 1994; Auerbach & Andrews, 2018).

Biological literacy skills need to be understood and trained by students, so that students must also have the opportunity to develop core competencies and prepare them to practice biology, as well as to solve more complex biology problems related to problems faced by society. Core concepts and competencies, derived from the common features of the discipline, together build a student's frame of mind through a variety of knowledge or interdisciplinary knowledge (Bauerle et al., 2009).

This study aims to analyze the characteristics of CTL-based respiratory system teaching material supplements, test the validity of teaching material supplements based on expert judgment, analyze student and teacher responses to the teaching material supplements developed, and test the effectiveness of these teaching material supplements in terms of the results of tests of biological literacy abilities.

## METHODS

Method study And development or Research and Development (R&D). Study This focused on development supplement System teaching materials Respiration based Contextual Teaching Learning (CTL) in an effort to train students' biological literacy skills. Trials of teaching material supplement products were carried out in classes XI IPA 3 and XI IPA 4 SMA Negeri 7 Cirebon City with a total of 72 students on May 9 – May 26 2023 in 4 meetings. All data collection techniques and instruments are presented in Table 1.

**Table 1.** All data collection techniques and instruments

No	Data	Instrument	Technique data collection	Technical data analysis
1	Characteristics Supplement Teaching Materials	Based Teaching Materials <i>Contextual Teaching Learning</i>	Documentation	Descriptive Qualitative
2	validity Supplement Teaching Materials	Sheet validation	Questionnaire	Descriptive quantitative
3	Legibility Supplement Teaching Materials	Questionnaire teacher readability and student	Questionnaire	Quantitative
4	Literacy Biology	Sheet test	Test	quantitative

## RESULTS AND DISCUSSION

The research began with a preliminary study at SMA Negeri 7 Kota Cirebon including interviewing teacher needs and questionnaires on student needs. The results show that the use of teaching material supplements developed using CTL steps has never been used in Biology lessons and the reference books used in SMA Negeri 7 Cirebon City are only books from the 2016 Ministry of Education and Culture and LKS.

Results research in this study includes: 1) characteristics supplement system teaching materials respiration based Contextual Teaching Learning developed ; 2) validity supplement system teaching materials respiration based Contextual Teaching Learning by expert material , media experts ; 3) readability supplement system teaching materials respiration based Contextual Teaching Learning by student and teachers; 4) effectiveness supplement system teaching materials respiration based Contextual Teaching Learning in practice ability literature biology student.

### Characteristics of CTL-Based Teaching Material Supplements

Structure supplement this teaching material covers cover (title/ identity supplement teaching materials), preface, steps CTL syntax , list content , map material, competence basic, structured material on chapter 1 (System Respiration), chapter 2 (Causes Disturbance System Respiration) and chapter 3 (Disease System Respiration), reflection And summary, test competency key test competency, glossary and list library. The characteristics of supplementary CTL-based teaching materials are found in the material section,

namely the Constructivism Step in the "think about it!" column, the Inquiry step in activities 2 and 3 "Find out", the Questioning step in the form of discussion questions that aim to provide new knowledge to the reader, the steps The learning community is in the form of student activities directly identifying the causes of respiratory system disorders in the surrounding environment, modeling steps are presented in the form of pictures or posters that help students get to know the latest information, the Reflection step is in the "reflection" column filled in by students about the material they have learned using CTL-based teaching material supplements. The Authentic Assessment step is in the "competence test" activity as well as in assessing student activities in general.

### Validation of CTL-Based Teaching Material Supplements

The results of the assessment of the developed CTL-based teaching material supplements are in Table 2.

**Table 2.** The results of the CTL-based respiratory system teaching material supplements

No	Evaluation	Average Percentage (%)	Criteria
1	Material expert validation	88.1	Very valid
2	Teacher practitioner validation	77.3	Valid
3	Media expert validation	96	Very valid
4	Teacher Readability	87.7	Very good

5	Student Readability	85.5	Very good
---	---------------------	------	-----------

Based on the assessment in Table 2, it shows that the CTL-based respiratory system teaching material supplements developed are suitable for use in teaching biology in class.

**Readability of Students and Teachers of CTL-Based Teaching Material Supplements**

Students' readability of CTL-based Respiratory System teaching material supplements was obtained from student response questionnaires given to students of class XI IPA 3 and XI IPA 4 SMA Negeri 7 Cirebon City as many as 72 respondents. The three indicators for assessing readability that are used as aspects of the assessment include appearance, content and language.

**Table 3** Results Teacher readability of Supplement Teaching Materials

No	Indicator	Score obtained	Score maximum	Percentage (%)
1	Appearance	161	180	89.4
2	Content	87	100	87
3	Language	68	80	85
	Total	316	360	87.7
	Criteria	Very Good		

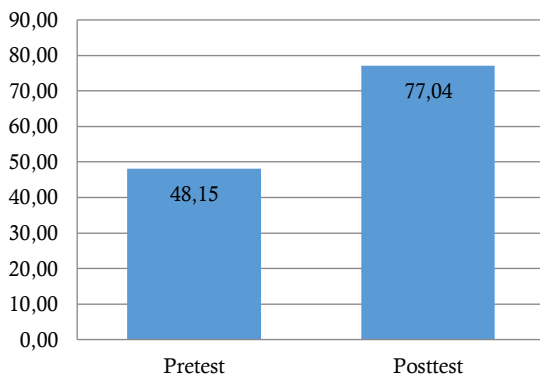
**Table 4.** Results Legibility Student to Supplement Teaching Materials

No	Indicator	Score obtained	Score maximum	Percentage (%)
1	Appearance	2203	2592	84.9
2	Content / content	1232	1440	85.5
3	Language	1000	1152	86.8
	Total	4435	5184	85.5
	Criteria	Very Good		

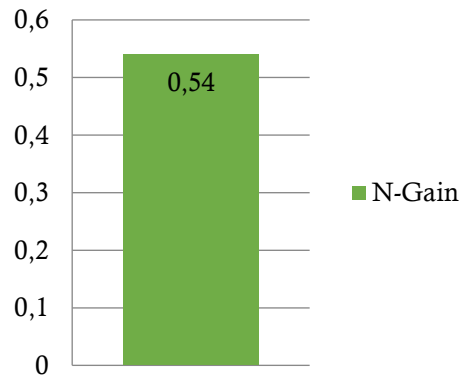
The display indicator shows the highest percentage of 89.4%, in general teaching material supplements are developed using communicative language with the selection of font types and sizes that are not excessive, the display of images used is very good and in accordance with the material discussed in each chapter. The two legibility assessments show very good criteria and show that CTL-based respiratory system teaching material supplements can be used in biology learning.

**The Effectiveness of CTL-Based Teaching Material Supplements**

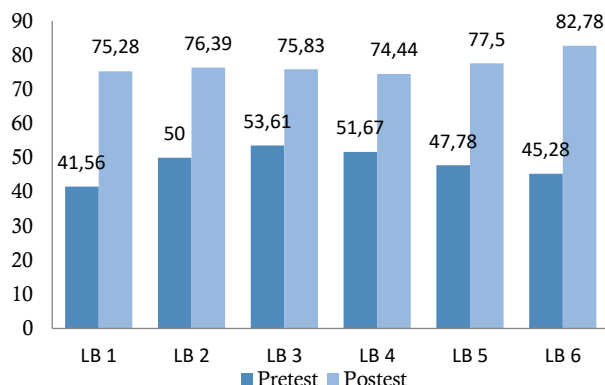
The results of the trial were shown by the students' classical completeness scores while to assess the effectiveness of the CTL-based respiratory system supplement in teaching biological literacy skills was shown by the N-gain test. Figure 1 . The average pretest and posttest results of students were 48 and 77 with a classical completeness score of 72% with 20 students out of 72 students not being declared complete. The questions used are multiple choice questions that have been adapted to indicators of biological literacy so that they require the ability to understand science, interpret science, scientific literacy, especially biological literacy skills. Even though there were students who had not completed the N-gain test results , it showed that 8 students reached the highest level of achievement, 58 students reached the medium level and 6 students reached the lowest level, with an average N-gain value of 0.56, the criteria being shown in Figure 2.



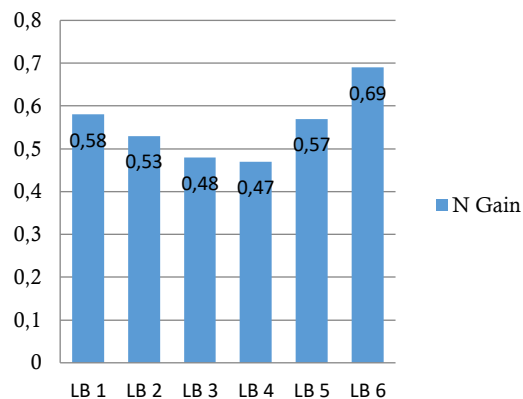
**Figure 1.** Average pretest and posttest scores of students



**Figure 2.** Average N-gain



**Figure 3.** Average pretest and posttest scores each indicator of biological literacy



**Figure 4.** Average N-gain for each indicator biological literacy

The increase in the results of the biological literacy ability test is also shown in 6 indicators of biological literacy. Aspects of biological literacy skills that are measured according to Bauerle et al. (2009) and Maas et al. (2019) are the ability to apply scientific processes, the ability to use quantitative reasoning, the ability to use modeling, the ability to use interdisciplinary knowledge, the ability to communicate and collaborate with other disciplines, and the ability to understand the context of the relationship between science and society. Based on Figure 3, the test results showed an increase in test scores before and after learning Biology using the developed CTL-based teaching material supplement. The highest increase was the biological literacy indicator 6, namely the understanding of the relationship between science and society, shown by the N-gain value of 0.69 in the medium category, which is shown in Figure 4. But in general the 6 indicators of biological literacy show an increase in their posttest scores. The increase in test results shows that students can understand Respiratory System material through learning activities using supplemental CTL-based teaching materials, especially on indicators of biological literacy and the ability to understand the relationship between science and society. Bauerle et al. (2009) and Harris et al. (2020) are explains taht learning correct biology is expected can give chance to student in develop and connect competence core in overcome problem related facing biology society.

These results show that contextual learning (CTL) can train students' biological literacy skills through learning activities that bring the real world into the classroom so that students are able to associate their scientific knowledge with events that

occur in their daily lives. This explanation is in line with the opinion of Lotulung et al. (2018) that explained CTL is a learning concept that helps teachers connect the material being taught with real-world situations and encourages students to make connections between knowledge and its application in students' daily lives. According to Karim's (2017) and Purba & Surya (2020) opinions state that deep CTL approach learning will help student make relationships between material lesson with life real so that student will get meaning from what did he learn.

Based on this explanation, it can be concluded that the CTL-based respiratory system teaching material supplement developed can be said to be valid and has very good legibility. The CTL-based respiratory system teaching material supplement contains material that relates the scientific concept of the respiratory system to events in students' daily lives that are arranged contextually. The Contextual Teaching Learning step involves seven main components of effective learning: Constructivism, Question and Answer, Inquiry, Community Learning, Modeling, and Authentic Assessment which enable students to learn actively, independently, understand science concepts and can apply them in students' daily lives.

## CONCLUSION

Based on the analysis of research results and discussion, it can be concluded that the teaching material supplements developed meet valid criteria, read very well, and are effective in training students' biological literacy skills so that they can be used as products to be reproduced and used in the learning process.

## REFERENCES

- Auerbach, A. J. J., & Andrews, T. C. (2018). Pedagogical knowledge for active-learning instruction in large undergraduate biology courses: a large-scale qualitative investigation of instructor thinking. *International journal of STEM education*, 5(1), 1-25.
- Bauerle, C., Anthony, D., David, L., Clare, O., & Michelle, W. *Vision and Change in Undergraduate Biology Education A Call to Action*. Washington, DC : Directorate for Education and Human Resources Division of Undergraduate Education and the Directorate for Biological Sciences.
- Budiamine, A. (2016). Implementation of the CTL (Contextual Teaching And Learning) Approach in Improving Learning Outcomes. UPI Bandung. Thesis.
- Bybe and Uno. (1994). Understanding the dimensions of biological Literacy. *BioScience*, Volume. 44, p.553-557.
- Harris, B. N., McCarthy, P. C., Wright, A. M., Schutz, H., Boersma, K. S., Shepherd, S. L., ... & Ellington, R. M. (2020). From panic to pedagogy: Using online active learning to promote inclusive instruction in ecology and evolutionary biology courses and beyond. *Ecology and evolution*, 10(22), 12581-12612.
- Lotulung, CF, Ibrahim, N., & Tumurang, H. (2018). Effectiveness of learning methods Contextual Teaching Learning (CTL) for increasing learning outcomes of entrepreneurship education. *The Turkish Online Journal of Educational Technology - TOJET* , 17 (3), 37–46.
- Maass, K., Geiger, V., Ariza, M. R., & Goos, M. (2019). The role of mathematics in interdisciplinary STEM education. *Zdm*, 51, 869-884.
- Mishra, L., Gupta, T., & Shree, A. (2020). Online teaching-learning in higher education during lockdown period of COVID-19 pandemic. *International journal of educational research open*, 1, 100012.
- Mulbasari, AS, & Surmilasari, N. (2018). *The Effect of Contextual Teaching and Learning (CTL) Based Teaching Materials on High School Students' Mathematical Reasoning Ability* . 4(2), 197–203.  
<https://doi.org/10.29408/jel.v4i2.719>
- Pangemanan, A. (2020). *Application of Contextual Teaching and Learning Approach on Statistics Material Against Student Results* . 13 (4), 1–7.  
<https://doi.org/10.5539/ies.v13n4p1>
- Purba, G. I. D., & Surya, E. (2020, February). The improving of mathematical understanding ability and positive attitudes of unimed fmipa students by using the contextual teaching learning (CTL) approach. In *Journal of Physics: Conference Series* (Vol. 1462, No. 1, p. 012019). IOP Publishing.
- Karim, A. (2017). Analysis of the CTL (Contextual Teaching and Learning) Approach at SMPN 2 Teluk Jambe Timur , Indraprasta University PGRI Jakarta *Karawang* . 7 (2), 144–152.
- Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital science and education*, 2, 923-945.
- Suparya, IK, I Wayan Suastra, & Putu Arnyana, IB (2022). Low Scientific Literacy: Causal Factors And Alternative Solutions. *Citra Bakti Scientific Journal of Education* , 9 (1), 153–166.  
<https://doi.org/10.38048/jipcb.v9i1.580>
- Teles, S., & Tomimatsu, K. (2014). Contextual Teaching and Learning Using a Card Game Interface. *International Journal of Asia Digital Art and Design* , 18 (2), 18–23.
- Wenning , CJ (2011). Experimental Inquiry in Introductory Physics Courses. *Journal of Physics Teacher Education Online*. Volume 6. Number.2, Pg.2-8.