The Validity and Practicality Test of Textbooks Based on Metacognitive Skills in Blood Circulation System Materials for Grade XI High School

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Abstract

This research aims to develop a textbook based on metacognitive skills in blood circulation system materials for grade XI high school students that are valid and practical. The development of textbooks based on metacognitive skills refers to the ADDIE development model, The stages of analysis, design, development, implementation, and evaluation. The data collection was carried out using several research instruments consisting of: (1) textbook validation instrument to find out textbook validity data assessed by 2 (two) expert validators, (2) teacher and student response instruments to find out the practicality of textbooks. This research was conducted in July-September 2020 at SMA Negeri 9 Makassar. The results of the research data analysis obtained: (1) the textbook based on metacognitive skills is valid with a validity value of 4.57, and (2) the textbook based on metacognitive skills is practical, with the results of the teacher's response being 94.58 with very positive criteria and the results of student responses being 88.85 with very positive criteria. Based on the research that has been found, it can be concluded that the textbook based on metacognitive skills in blood circulation system materials for grade XI high school students is valid and practical.

Keywords: *Metacognitive, Research and Development, Textbook*

1. Introduction

One of the essential standards to consider in the implementation of education is the standard process which contains how the learning process is carried out. Teachers are one of the resources that have a vital role in improving the quality of education. Teachers are required to be able to carry out learning well, be able to make teaching materials good learning resources, and understand student learning difficulties. This is because the teacher directly guides and directs students to learn.

Efforts to improve the quality of education continue to be carried out, starting from improving the curriculum, improving learning infrastructure, upgrading teachers in the field of study, and procuring textbooks adapted to student learning conditions. However, the value of learning biology in high school is still relatively low. Based on data from the Education Assessment Center of the Ministry of Education and Culture (2020), the 2019 Biology National Examination score is still relatively low, with an average of 50.61. This is very different from the 2016 UN Biology score of 59. However, the two Biology UN scores are still in the low category. Likewise, the value of the Biology National Examination in South Sulawesi is still relatively low. Therefore, more student-oriented learning is needed where students themselves can measure what they have understood and will understand, as well as innovative efforts created to increase student knowledge.

Based on the 2013 curriculum, metacognition is a component of knowledge expected to exist in students. Metacognition plays an important role in education because it helps students to be able to develop plans, monitor and evaluate (Abdellah, 2015). Miranda in Budi & Ghofar (2017) states that student learning outcomes can be said to be of high quality if students are consciously able to control their cognitive processes and have an impact on increasing their metacognitive abilities. With metacognition, it is hoped that students will be able to learn meaningfully and construct their own knowledge so that they can improve student learning outcomes. Therefore, metacognitive abilities and skills are essential in a learning process and are expected to be a solution to improve learning outcomes.

One solution that is expected to be able to improve learning outcomes is the existence of teaching materials in the form of textbooks that are able to guide students

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in instilling awareness about the knowledge they have independently. Therefore, it is necessary to develop a textbook that can improve students' metacognitive knowledge and skills. Metacognition skills provide space for students to explore their abilities by providing the ability to control what they learn, as well as being able to improve higher-order thinking processes independently so that learning can be more meaningful for students.

Based on the results of observations at several schools in Makassar City, it was found that: (1) based on interviews with biology teachers, the value of biology subjects is still in the low category, (2) based on interviews with students, one of the subjects considered complicated for students is the material of the circulatory system, and sometimes misconceptions occur in students.

Research and development services to validate and develop products. Validating the product means that the product already exists, and the researcher only tests the effectiveness or validity of the product. Developing products in a broad sense can be in the form of updating existing products so that they become more practical, effective, and efficient or creating products (Sugiyono, 2016)

The textbook that will be developed will provide space for students to find ideas from a sentence, underline important words, make margin notes, make concept maps based on their respective understandings, make conclusions from learning materials and other aspects that are considered necessary to improve students' metacognitive skills.

Taking a metacognitive attitude involves thinking about one's teaching, at the same time, having an awareness of oneself as an actor in one's environment (Dori et al., 2018). Metacognitive regulation can be divided into three component activities. This includes planning, monitoring and evaluation. Planning involves only the cognitive task of selecting appropriate strategies and cognitive resources. Monitoring involves our awareness of our progress through cognitive tasks and our ability to determine our performance. Evaluation involves looking at the results and determining whether the learning outcomes match the learning objectives and regulatory processes that are used effectively (Rivai, 2019). There are two aspects of metacognition: reflective thinking about what we know and self-regulation—managing the way we learn. Taken together, these processes form an important aspect of learning and development. Developing these metacognitive abilities is not just about being a reflective learner but also about acquiring specific learning strategies. The fundamental aspect of critical thinking is the metacognitive activity that reflects the extent of our own thinking so that we can evaluate the results of our thinking and learn from learning experiences. Metacognitive skills are related to the development of critical thinking and are an important aspect of improving students' cognitive abilities (Amin et al., 2020).

Therefore, this textbook is expected to be able to improve student learning outcomes by increasing students' ability to plan, monitor, evaluate and know how to learn on their own. Thus, the textbooks that will be developed are expected to be able to provide space for students to improve their metacognitive abilities.

2. Method

The type of research is research and development using the ADDIE model (analysis, design, development, implementation, and evaluation). Research and development of textbooks based on metacognition skills were conducted at SMA Negeri 9 Makassar in July-October 2020 for the 2020/2021 academic year. The research and development procedures of the ADDIE model are as follows: 1) In the analysis phase, the researcher conducts initial data collection activities to find problems in learning that occur in schools. The analysis carried out is an analysis of the student needs, analysis of students, analysis of content/content, and analysis of objectives, 2) The design stage is carried out by designing products according to what is needed, 3) The development stage is carried out on the development of the initial material so that it contains a discussion that refers to the basic competencies and assessments given after carrying out the learning, 4)The implementation phase is carried out with limited trials to get the practicality of teaching materials. 5) The evaluation stage is a process to revise the entire product development textbook.

The research instrument consists of 1) expert validation questionnaire sheets to provide information on the validity of textbooks and 2) teacher and student responses to provide information on the practicality of textbooks. Data was collected through non-test techniques using expert validation sheets and teacher and student response sheets regarding textbooks based on metacognition skills.

Data analysis techniques are validity and reliability. Validity analysis uses the criteria of validity Hobri (2009), which can be seen in table 1.

Table 1. Product Validity Category

Score	Description
Va=5	Very valid
4≤Va<5	Valid
3≤Va<4	Fairly valid

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2≤Va<3	Less valid	
1≤Va<2	Invalid	

*Description: Va is the average total score

Practicality analysis use practicality criteria on teacher and student responses by Riduwan & Akdon (2010), which can be seen in table 2.

Table 2. The Category of Teacher and Student Responses

Value	Description
85% ≤ R	Very positive
70% ≤ R < 85%	Positive
50% ≤ R < 70%	Less positive
R < 50%	Not positive

3. Result and Discussion

After analyzing the needs of students, students, content, structure, and objectives, it was found that the metacognitive skills textbooks were needed in learning in schools. The next stage is to design a textbook that is adjusted to the results of the analysis that has been done. The textbooks developed were adapted to the needs of the learning process. The design stage consists of (1) making specifications for metacognitive skills-based textbooks, which include specifications of material, appearance, language, objectives, and functions of textbooks, and (2) designing the initial format of textbooks according to these specifications in the form of hypothetical models and storyboards, (3) the design of research instruments in the form of textbook validation instruments based on metacognition skills, teacher response questionnaires, and student response questionnaires.

Furthermore, the development stage was carried out with various revisions both in the appearance, material, and practice questions in the metacognition skill-based textbooks that were developed. The development stage aims to realize all the stages that have been carried out previously and to produce the final product of metacognition-based textbooks. In this stage, the validity of the textbook was tested by 2 (two) expert validators. The results of the test of the validity of the textbooks can be seen in table 3.

Table 3. The Results of The Validity Analysis of The Textbooks Based On Metacognition Skills

Aspect	Score	Category
Didactic	4.75	Valid
Construction	4.63	Valid
Technical	4.33	Valid
Characteristics	4.33	Valid
Average	4.33	Valid

Table 3 shows that based on aspects of didactic requirements, construction requirements, technical requirements, and characteristics have an average aspect of 4.33 with a valid category which means that the metacognitive skill-based textbook meets the validity criteria.

The next stage is the implementation of a practicality test by providing a teacher response questionnaire and student responses to the developed textbooks. The results of the practicality test of teacher and student responses can be seen in tables 4 and 5.

Table 4. The Results of The Practicality Analysis of The Teacher's Response to Textbooks Based on Metacognition Skills

Aspect	Score	Category
Feasibility content	93.33	Very positive
Display	93.33	Very positive
Language	93.33	Very positive
Benefits	98.33	Very positive
Aspect average	94, 58	Very positive

Table 5. The Results of The Practicality Analysis of Students' Responses to Textbooks Based on Metacognition Skills

Aspect	Score	Category
Feasibility content	88.40	Very positive
Display	90.94	Very positive
Language	88.75	Very positive
Benefits	87.29	Very positive
Aspect average	88.85	Very positive

Table 4 shows that the teacher's response has an average aspect of 94.58 with a very positive category and has met the practicality criteria. Likewise, table 5 shows that the student responses have an average aspect of 88.85 with a very positive category and have met the practicality criteria. Therefore, based on the test of the validity and practicality of textbooks based on metacognition skills on the material of the circulatory system grade XI high school, it is considered suitable to be used in learning.

Textbooks based on metacognition skills that have been developed are teaching materials that contain material on the human circulatory system which refers to the basic competencies of the 2013 curriculum. The material in the textbooks is summarized from several national

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and international books, journals, and several sources on the internet. In addition, the material in the textbook is presented in simple and easy-to-understand language according to the developmental stage of students and follows the concept of General Indonesian Spelling Guidelines (PUEBI).

Metacognition is defined as awareness and control of thinking. The main characteristic that distinguishes metacognition-based textbooks from other textbooks is the presentation of material that emphasizes the ability of students to construct their own understanding by being able to learn independently. Students are required to know what they have, are, and will learn so as to create a deeper learning understanding of the circulatory system material for all students. According to (Dye & Stanton 2017), to improve student learning through metacognition, we need to understand the important changes that occur when students acquire these skills. One way to address this need is to examine students with well-developed metacognition to learn when, why, and how they use this ability. Then we can use the insights gained from highly metacognitive students to help other students improve their metacognition.

The metacognitive skill-based textbooks that have been developed are teaching materials that contain material on the human circulatory system, which refers to the basic competencies of the 2013 curriculum. Compiled from several national and international books and journals, as well as several sources on the internet. In addition, the material in the textbook is presented in simple and easy-to-understand language according to the developmental stage of students and follows the concept of General Indonesian Spelling Guidelines (PUEBI).

Based aspects of didactic requirements, aspects of construction requirements, aspects of technical requirements, and aspects of characteristics indicate that the textbooks developed have a valid category. Therefore, textbooks based on metacognition skills are considered suitable for use in the material on the circulatory system in grade XI high school.

Based on the results of the teacher's response questionnaire analysis in terms of benefits, the percentage value was 98.33, with a very positive category. These results are based on the teacher's assessment who considers that metacognitive skill-based textbooks are easy to use in teaching, are able to provide students with learning motivation, are able to encourage students to study actively and independently, and students are able to understand the material of the circulatory system well, and textbooks are able to support the teacher's role as a facilitator. All aspects of the teacher's response questionnaire have an average value of 94.58%, with a very positive category which

means that metacognition-based textbooks have practical value to the teacher. Nieveen in Wardani (2020) states that the practicality of the development of products is determined by the opinion of the teacher, who states that the resulting product can be used and the product is easy to use by teachers and students in accordance with the developer's intent.

Learning tools are said to be practical if teachers and students consider the learning tools easy to use and in accordance with the developer's plan. If there is consistency between the curriculum and the learning process, the learning tools can be said to be practical (Purboningsih, 2015).

The results of the teacher response questionnaire analysis and student response questionnaires showed that all responses were in the very positive category. Therefore, textbooks based on metacognitive skills meet the criteria of practicality and are suitable for use in the learning process.

Students with strong metacognitive skills can identify concepts they do not understand and choose an appropriate approach to learning those ideas. Metacognitive students know how to apply the chosen strategy, and they modify their approach based on experience. These metacognitive skills can have a major impact on learning (Dye & Stanton, 2017). Students who develop metacognitive strategies can plan, monitor and regulate their cognition process. Thus, more efficient study plans, responsibilities and deep learning should be developed (Siqueira et al., 2020). Providing learning using several metacognitive strategies such as providing opportunities for students to understand themselves and reflect is considered to be able to improve students' metacognitive skills (Langdon et al., 2019). Research on metacognition was also conducted by (Zepeda et al., 2015), which showed that metacognitive instruction could lead to better independent learning outcomes during adolescence, where adolescent students tend to have academic achievement and motivation that often declines.

Metacognitive knowledge is an important component in achieving Indonesian graduation standards in the 2013 curriculum. Based on the Regulation of the Minister of Education and Culture Number 20 of 2016 concerning Graduation Standards, it is stated that high school graduates must be equipped with factual, conceptual, procedural, and metacognitive knowledge both in terms of technical, specific, detail, as well as complex levels related to science, technology, art, culture, and humanities (Herlanti et al., 2017). Therefore, to increase metacognitive knowledge, a textbook is needed that is able to provide metacognitive skills so that curriculum objectives can be achieved. From the research data that

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has been carried out, the findings of the research indicate that the development of textbooks based on metacognition skills on the material of the blood circulatory system in grade XI high school is feasible to use.

4. Conclusiom

Based on the research and development that has been carried out, the textbooks based on metacognition skills on the material of the human circulatory system grade XI SMA developed are valid and practical and suitable for use in the learning process. The advice given is that further research is able to carry out the implementation of textbooks in learning so that they can find out student learning outcomes on the use of textbooks based on metacognition skills.

References

Abdellah, R. (2015). Metacognitive Awareness and its Relation to Academic Achievement and Teaching Performance of Pre-service Female Teachers in Ajman University in UAE. Procedia - Social and Behavioral Sciences, 174, 560–567. https://doi.org/10.1016/j.sbspro.2015.01.707

Amin, A. M., Corebima, A. D., Zubaidah, S., & Mahanal, S. (2020). The Correlation between Metacognitive Skills and Critical Thinking Skills at the Implementation of Four Different Learning Strategies in Animal Physiology Lectures. European Journal of Educational Research, 9(1), 143–163. https://doi.org/10.12973/eu-jer.9.1.143

Budi, I., & Ghofar CW, A. (2017). Analisis Keterampilan Berpikir Kritis Dan Metakognitif Mahasiswa Program Studi Pendidikan Biologi. Bioma, 6(1).

Dori, Y. J., Mevarech, Z. R., & Baker, D. R. (Eds.). (2018). Cognition, Metacognition, and Culture in STEM Education: Learning, Teaching and Assessment (Vol. 24). Springer International Publishing. https://doi.org/10.1007/978-3-319-66659-4

Dye, K. M., & Stanton, J. D. (2017). Metacognition in Upper-Division Biology Students: Awareness Does Not Always Lead to Control. CBE—Life Sciences Education, 16(2), ar31. https://doi.org/10.1187/cbe.16-09-0286

Herlanti, Y., Mardiati, Y., Wahyuningtias, R., Mahardini, E., Iqbal, M., & Sofyan, A. (2017). Discovering Learning Strategy to Increase Metacognitive Knowledge in Biology Learning in Secondary School. Jurnal Pendidikan IPA Indonesia, 6(1). https://doi.org/10.15294/jpii.v6i1.9605

Hobri. (2009). Metodologi Penelitian Pengembangan (Development Research). Jember: FKIP Universitas Jember.

Langdon, J., Botnaru, D. T., Wittenberg, M., Riggs, A. J., Mutchler, J., Syno, M., & Caciula, M. C. (2019). Examining the effects of different teaching strategies on metacognition and academic performance. Advances in Physiology Education, 43, 514–422. https://doi.org/10.1152/advan.00013.2018

Purboningsih, D. (2015). Pengembangan Perangkat Pembelajaran dengan Pendekatan Guided Discovery pada Materi Barisan dan Deret untuk Siswa SMK Kelas X. 8.

Riduwan & Akdon. (2010). Rumus dan Data dalam Analisis Data Statistika. Bandung: Alfabeta.

Rivai, A. T. O. (2019). Hubungan Keterampilan Metakognisi dengan Peningkatan Hasil Belajar. Prosiding Seminar Nasioal Biologi VI, 160–166.

Siqueira, M. A. M., Gonçalves, J. P., Mendonça, V. S., Kobayasi, R., Arantes-Costa, F. M., Tempski, P. Z., & Martins, M. de A. (2020). Relationship between metacognitive awareness and motivation to learn in medical students. BMC Medical Education, 20(1), 393. https://doi.org/10.1186/s12909-020-02318-8

Sugiyono. (2016). Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D). Bandung: Alfabeta.

Wardani, S. (2020). Pengembangan Buku Ajar Berbasis Literasi Sains Pada Materi Biologi Semester Genap Kelas X Sma 5 Kabupaten Pinrang. Tesis. Universitas Negeri Makassar.

Zepeda, C. D., Richey, J. E., Ronevich, P., & Nokes-Malach, T. J. (2015). Direct instruction of metacognition benefits adolescent science learning, transfer, and motivation: An in vivo study. Journal of Educational Psychology, 107(4), 954–970. https://doi.org/10.1037/edu0000022