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Development of Student Worksheets on Biology Topics Based on Critical Thinking Skills

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Abstract: This study aims to develop student worksheets based on critical thinking skills for seventh-grade students in junior high school. Development is carried out by means of Education Design Research (EDR). This article describes the results of the validity and practicality of worksheets based on critical thinking skills. The data collection technique used is a test questionnaire. The instruments used in this study were students' validity and practicality questionnaires. Data analysis techniques include analysis of data validity, data, and practicality (practical content, expectations, and actual). The worksheets validation sheet based on critical thinking skills was given to 5 validators consisting of 3 education experts and 2 science teachers in public junior high school 12 Banjarmasin. Three students filled out the questionnaire on the practicality of the contents of the worksheets through the one to one evaluation test, nine students filled out the practicality of the expectations of the worksheets through the small group evaluation test, and thirty-two students of the developed worksheets filled out the actual practicality of the worksheets. The results of the analysis of the validity of the questionnaire concluded that the validity of the worksheets was 3.60 valid categories. The results of the practicality of the contents are 3.84 in the practical category, the practicality of hope is 95.90 in the practical category, and the actual practicality is 96.06 in the practical category. This means that the worksheets based on critical thinking skills are valid and practical in the learning process to practice critical thinking skills.

Keywords: Worksheets; Critical thinking skills; Validity; Practicality

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Introduction

The world of education in this century plays an important role, and it is hoped that today's education can prepare students to master various skills. According to (Ariyana et al., 2018; Redhana, 2019), in the 21st century, there are at least four learning competencies that must be mastered by students, namely creative thinking skills, critical thinking skills, collaboration, and communication. In addition, students must have skills in using media, information, and technology (Pesakovic et al., 2014; Vlasta & Jan, 2011). Critical thinking skills are logical reflective thinking processes and focus on helping students interpret, analyze, evaluate, and infer, explain (Mundilarto & Ismoyo, 2017; Vong & Kaewurai, 2017; Zulfaneti et al., 2018). Critical thinking skills include several skills, such as listening, reading carefully, finding and determining basic assumptions, and believing in what is done with a good knowledge base. These critical thinking skills also have sub-skills and questions that will direct individuals to have critical thinking skills (Nuraini, 2017).

Critical thinking is also defined as a way of solving

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problems, using and applying concepts; freedom of thought, use of knowledge and responsibility to make decisions; overcoming bias and fanaticism; thinking to make decisions, interpreting problems; thinking based on skills and responsibilities leading to criteria-based judgments and being sensitive to problems (Ennis, 2011; Zivkovic, 2016).

The development of critical thinking skills includes the primary goal of learning science and one of the 2013 Junior High School Students science curricula demands to produce a quality Indonesian generation (Suryanti et al., 2018; Zulmaulida et al., 2018). It has been emphasized in the Indonesian National Qualifications Framework level 1 that junior high school graduates must be able to carry out simple, limited, routine tasks; using established tools, rules, and processes; and under the guidance, supervision, and responsibility of superiors (Perpres, 2012). The graduate achievements above are emphasized through a learning process that integrates students' critical thinking skills and collaboration in scientific investigation, decision making, and real-life problem solving (Kemendikbud, 2016).

Results the Organization for Economic Co-operation and Development (OECD) evaluates students' academic abilities in various countries. The OECD uses the 2018 International Student Assessment (PISA) system. Indonesia's Science score ranks 70 countries out of 78 countries (OECD, 2019). Thus, the low PISA scores, especially in science, indicate that students in Indonesia still have difficulties applying concepts in everyday life, analyzing situations, integrating information, and drawing conclusions (Nisa et al., 2019).

The critical thinking skills of junior high school students are still categorized as low. The low critical thinking skills of junior high school students are due to not having the facilities to develop their critical thinking skills due to the lack of textbooks or books that can support students in developing their critical thinking skills (Daniati et al., 2018; Martawijaya, 2015).

Efforts to improve student's critical thinking skills can be through the provision of learning tools that support the learning process, one of which is through Student Worksheets. According to Taufiq and Basir (2017), worksheets are teaching materials that contain material, summaries and assignments related to the material. The worksheets are important to achieve learning success. Learning in the classroom, which currently prioritizes student-centered learning, encourages teachers to develop worksheets in their learning. The use of worksheets can minimize the work of teachers but can further activate the role of students.

The worksheets have several elements that make it suitable for learning media because it can increase student activity in the learning process. The worksheets elements are title, subject, semester, place, study instructions, competencies to be achieved, learning indicators, supporting information, tools, and materials in working on worksheets, work steps, and assessment (Elfina & Sylvia, 2020).

Therefore, if the worksheets that has been made has met the indicators of critical thinking skills, it is also expected to improve students' critical thinking skills. Observations were also made on the teaching materials used by the teacher. The teaching materials used are in the form of science student books for curriculum 13 and worksheets. However, the worksheets used has not guided students to carry out investigations according to the scientific method. worksheets currently only contain questions that assess cognitive aspects at the remembering, understanding and application level. The worksheets should contain student activity sheets that can provide learning experiences with a high level of thinking, especially critical thinking.

This study aimed to develop a student worksheet based on critical thinking skills on Biology Topic grade class VII junior high school students. Therefore, the product criteria developed must meet valid and practical requirements (Van den Akker, 2010)

Method

This type of research is educational development research or Education Design Research (EDR) with the Tessmer Formative evaluation model (Tessmer, 1993). The population in this study were students of class VII junior high school students. At the same time, the research sample was students of State Junior High School 12 Banjarmasin (three students for one-to-one, nine students for small group, and thirty-two students for field test). The validators in this study consisted of 3 education experts and 2 science teachers State Junior High School 12 Banjarmasin.

Data collection techniques were carried out through validity questionnaires and practicality questionnaires. The validity questionnaire was used to collect valid data from the validator. The practicality questionnaire is divided into a content practicality questionnaire, expectation practicality, and actual practicality. Data on the practicality of the contents of the worksheet were obtained from filling in the practicality test instrument contents by three students through a one-to-one evaluation test. Data on the practicality of worksheet expectations were obtained from nine students filling out the practical expectations test instrument through the small group evaluation test. Data on the actual practicality of the worksheet were obtained from the responses given by nine

students to the developed worksheet.

Data analysis techniques consist of data analysis validity and practicality data (practical content, expectations, and actual). The validation questionnaire data were analyzed by processing the values obtained at the expert validation stage. A formula can determine the validity of the worksheet. Namely, the score obtained is divided by the total score (overall) 4 times and converted to Table 1. While the formula can determine the practicality content of the worksheet, the score obtained is divided by the total score. (total) is multiplied by 4 and converted to Table 2 (Zaini, 2018). While the formula can determine the practicality expectations and actual of the worksheet, the score obtained is divided by the total score. (total) is multiplied by 100 and converted to Table 3 (Zaini, 2018).

Table 1. Validity criteria

Interval	Validation result
4	Very valid
3 - < 4	Valid
2 - < 3	Quite valid
1 - < 2	Invalid

Table 2. Practical content criteria

Interval	Practical result
4	Very practical
3 - < 4	Practical
2 - < 3	quite practical
1 - < 2	Impractical

Table 3. Practical expectations and actual criteria

Interval	Practical result
85.01-100	Very good
70.01-85	Good
50.01-70	Quite good
01.00-50	Impractical

Result and Discussion

This research produces worksheet based on critical thinking skills. This study focuses on the validity and practicality of worksheet. The worksheet based on critical thinking skills was developed through the stages of Educational Development Research (EDR) Tessmer's Formative evaluation model, namely self-evaluation, expert reviews, one-to-one, small group, and field tests. The results of the validity of the worksheet will be obtained from the evaluation results of the validator and the practicality of the worksheet will be obtained from analyzing the students' responses to the worksheet.

The results of the validation state that the development of worksheet based on critical thinking skills for class VII junior high school students is feasible in terms of the validity of the aspects of language, content, presentation, and graphics. The results of worksheet validation can be seen in Table 4. Based on Table 4. The average results of worksheet validation have valid criteria. These results indicate that the worksheet developed in general is in the valid category to be used in learning after going through the revision stage following the suggestions and input from the validator.

Table 4. Average results of worksheet validation

Aspect	Total	Average
Learning materials at the appropriate level become a single unit	11.00	3.67
Learning media is easy to find	11.33	3.78
Has a high adaptive capacity to advances in science and technology	9.67	3.22
a. Consistency in using type and size of letters (except tables, if any)	10.67	3.56
b. Consistently use spaces (except tables if any)	11.00	3.67
c. Consistently use the layout	10.00	3.33
a. The students know the photo on the cover	11.00	3.67
b. Photographs known to students	10.00	3.33
a. Display charts, images easy to understand and attractive	10.00	3.33
b. The composition of the contents is made systematic	11.00	3.67
c. Placing interesting manuscripts, pictures, and illustrations	10.33	3.44
a. Combining colors and images (as illustrations)	11.00	3.67
b. Bold, italic, underline, and color printing where necessary	11.00	3.67
Tasks and exercises reflect the demands of students' critical thinking skills	12.00	4.00
Critical thinking skills are realized through each of the sub-skills represented	11.67	3.89
Intrapersonal skills have adopted self-regulation integrated in critical thinking skills	11.00	3.67
Worksheet Overall Average		3.60
Category		Valid

The results of developing worksheet based on critical thinking skills for seventh grade junior high school students can be seen in Figure 1.

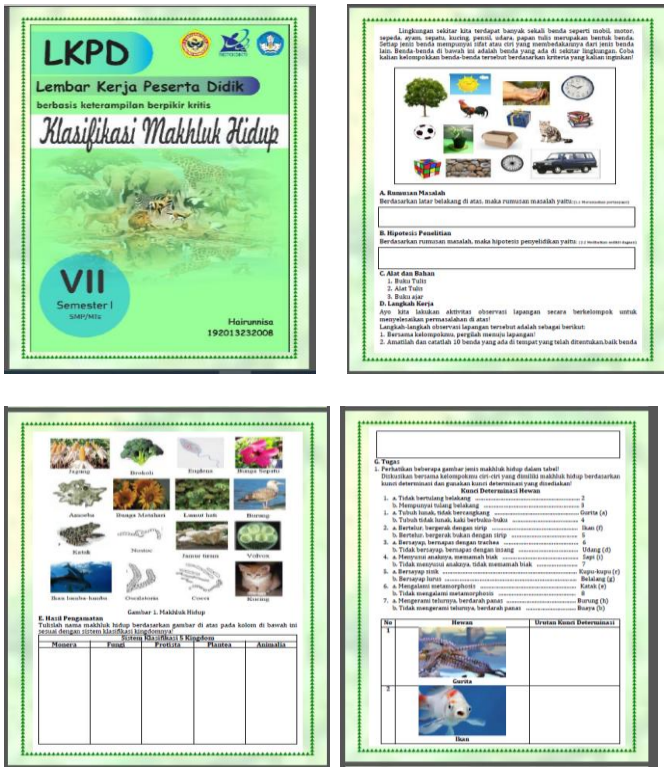

Figure 1: Results of worksheet development based on critical thinking skills

Based on the analysis of the validity results, it is known that the validity value of the worksheet based on critical thinking skills is 3.60 with a valid category. Although in the valid category, several sections of the worksheet need to be improved, such as titles, study instructions, learning indicators, supporting information, work steps, and assessment according to critical skills indicators as mentioned by (Wahyuni et al., 2021).

The results of this study are in line with research (Erina et al., 2021; Mardhatillah et al., 2020; Nadhira et al., 2020; Zahwa & Isnawati, 2020) which states that quality learning worksheets are suitable for use in the learning process, besides that the worksheet can be tested for practicality.

The worksheet is based on the critical thinking skills of seventh-grade junior high school students who are already valid based on the validator's assessment. Then a content practicality test is carried out on the worksheet developed for 3 students. The results can be seen in Table 5, the practicality of expectations on the worksheet developed for 9 students, and the results can be seen in Table 6. The actual practicality of the worksheet developed for thirty-two students, and the results can be seen in Table 7:

Table 5. Average results of the practicality of worksheet content

Aspect	Average
Every part learned is easy to understand	3.89
Include indicators or learning objectives	3.78
Include the subject matter	3.78
Instructions for use and how to carry out tasks are clear	4.00
The entire contents are complete in a logical order	3.78
The words used are easy to understand.	3.67
The images are of good quality and understandable	4.00
No typos or grammar errors were found	3.89
The photo on the cover is clear and understandable	3.78
Average	3.84

Table 6. Average results of the practicality of worksheet expectations

Aspect	Average
The content is easy to learn and understand	95.37
Commands given to acquire skills (such as observing, experimenting, etc.)	96.30
There is sufficient time to study	94.44
a. Content related to (equipment, method, source of material) is known beforehand.	96.30
b. Methods of learning (such as orders/tasks) have been implemented before.	95.37
c. Fun learning atmosphere	95.37
Interesting learning materials to learn.	98.15
Average	95.90

Table 7. Average results of the practicality of worksheet actual

Aspect	Average
The content is easy to learn and understand	95.57
Commands given to acquire skills (such as observing, experimenting, etc.)	96.88
There is sufficient time to study	95.57
a. Content related to (equipment, method, source of material) is known beforehand.	95.57
b. Methods of learning (such as orders/tasks) have been implemented before.	96.09
c. Fun learning atmosphere	95.83
Interesting learning materials to learn.	96.88
Average	96.06

The results of the practicality test of contents, expectations, and actual with practical categories. This means that the science worksheets based on critical thinking skills resulting from the development can be used in the science learning process for class seventh-grade junior high school students. This is in line with the results of previous research, which states that if the worksheet based on critical thinking skills gets an average score in the practical/very practical category, it can be used in the learning process (Harahap et al., 2021; Pramaditya & Ambarwati, 2021; Rahimah et al.,

2020; Sari et al., 2017). Therefore, based on the validation and practicality test results, it is said to be very good and can be used in the science learning process to train critical thinking skills for seventh-grade junior high school students.

Conclusion

Based on the research results that have been done, it can be concluded that the worksheet based on critical thinking skills has validity results in the valid category and the results of the practicality of content, expectations, and actual with practical categories. Therefore, it can be said that worksheet on Biology topics based on critical thinking skills can be used in the learning process to train the critical thinking skills of seventh-grade junior high school students.

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