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Development of Worksheets for High School Biology Student-Based On Critical Thinking Skills on the Circulation System Concept

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ABSTRACT

Learning in the 2013 curriculum requires a learning process that refers to the scientific approach. The teacher becomes the centre of learning in the current educational problems, students accepting learning as an abstract does not have the opportunity to develop their thinking skills. The purpose of this study is to develop a valid, practical, and effective Educator Worksheet (LKPD). This study uses the Tessmer design method, which consists of (1) expert review; (2) one-to-one; and (3) small group. Subjects of expert opinion research included two biology education lecturers and one high school biology teacher. Individual test subjects were three students educated. The small group test subjects were six students who were educated. The type of data obtained includes data effectiveness expectations. The results obtained from the effectiveness of expectations based on students' critical thinking skills in working on LKPD have very good categories (including analysis, reference, and exploration) and have good categories (including interpretation and self-regulation). Interpersonal skills (collaborating) and intrapersonal skills (conscientious) students have very good categories with scores of interpersonal skills and intrapersonal skills 86.33%.

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A. Introduction

Critical thinking skills are indispensable for 21st-century education that can create a generation that is skilled in using technology, can survive by using life skills, in the form of hard skills and soft skills that include high-level thinking skills (Triling & Fadel, 2009). The 21st century, according to the UN, is to build a knowledge-based society by having (1) skills with ICTs and media (ICT and media literacy skills); (2) critical thinking skills; (3) problem-solving skills; (4) effective communication skills; and (5) collaborative skills (Kusnandar, 2008). In the 21st century, these skills are fundamental, critical thinking skills include the ability to access, recognize, synthesize information that can be taught, trained, and mastered (P21, 2007a; Redecker et al 2011). Other critical thinking skills such as skills; communication and information, and the ability to examine, analyse, interpret, and evaluate evidence. In the era of digital literacy where the flow of information is very abundant, students need to have the ability to choose sources and information that are relevant, have quality sources and carry out an assessment of sources from the aspects of

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objectivity, reliability, and expertise. The 2013 curriculum learning covers three domains of process namely affective (attitude), cognitive (knowledge), and psychomotor (skills). The process adopts NRC decision results (NRC, 2011) with learning models that demand and possess critical thinking skills (CBC) students, such as inquiry models of problem-based learning models and problem-solving models. The implementation of the 2013 curriculum has used the above models, but teaching materials have a role in the form of LKPD used in the learning process that is still lacking in facilitating students' CBCs. The problem that occurs is the use of LKPD has not been able to maximize learning in achieving learning objectives. The purpose of making LKPD is to help students find a concept through both practicum and theory and help students apply and integrate the various concepts that have been discovered.

Permatasari (2018), reports that the existing LKPD only contains a summary or review of learning material, containing practice questions. Student Worksheets (LKPD) that is used in schools have not trained students to carry out the investigation process, the material is only in the form of answering the questions that exist (Mayasari, et al., 2015).

According to Suryawati et al. (2017) based on the results of curriculum analysis and activity analysis on LKPD, several activities were less relevant. Student Worksheets are still not a list of questions that tend to be textual, lack of training KBK, and scientific attitude. Questions raised in LKPD are questions that have not yet triggered students to think at a high level (analyze, evaluate, or create). So, in essence, LKPD needs to be improved by exploring critical thinking skills. One of them is by adopting a Facione model. Not only that the structure must also be following the applicable structure (Daryanto, 2014).

Student Worksheets (LKPD) developed using the Facione model is expected to be of high quality. Quality indicators are valid, practical, and effective. Learning is said to be valid if it is following its theoretical as well as internal consistency in each of its components. Practical can be interpreted that the product developed makes it easy for students and teachers. Learning tools are said to be practical if they provide convenience and can be applied in the field. The effectively can be interpreted that the product developed must bring influence or results following the objectives. Learning tools are said to be effective if they provide results that are following the objectives indicated by the results of students' learning tests (Dwiyogo, 2018).

The Facione model is based on constructivism learning theory. The theory of constructivism explains the formation of knowledge as a result of human construction (knowledge) of the reality it faces. Based on this statement, constructivism is that existing knowledge is the forerunner to get new knowledge (Dwiyogo, 2018).

Based on these descriptions, the study aims to describe the effectiveness of the worksheet expectations of high school biology students based on the development of critical thinking skills based on the concept of the circulation system.

B. Materials and Methods

This type of research is development research, using formative evaluation with Tessmer's design. The study focused on the effectiveness of LKPD expectations in the small group test stage by using 6 students of class XI MIA 1 SMAN Banjarmasin in the second semester of 2019/2020.

The effectiveness of expectations data is from the research sheet instrument students' critical thinking skills, interpersonal skills (collaborating), and intrapersonal skills (thorough). Data collection techniques on the effectiveness of LKPD is done by distributing LKPD results of improvements obtained from the validation test and practicality test, then let the test subjects understand every step of the work of LKPD.

Data analysis techniques on the effectiveness of expectations based on critical thinking skills to do tasks in LKPD calculated by the formula:

$$P = \frac{\mathrm{f}}{\mathrm{N}} \mathrm{X}\ 100\%$$

Then the results obtained are adjusted to the modified categories from Akbar (2010), namely 75.01-100% (very good), 50.01-75.00% (good), 25.01-50.00% (good enough), and 00.00-25.00% (not good).

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C. Results and Discussion

Worksheets of students as a result of developing the concept of the circulatory system produce 5 topics namely (1) circulatory organs, (2) cardiac anatomy, (3) cardiac work, (4) blood clotting, (5) interference with the circulatory system. The following are the results of research from the development of LKPD along with further discussion which is presented in a row according to the steps of the development model, the results of the assessment of critical thinking skills by students obtained with LKPD tasks in the small group test are the effectiveness of expectations presented in Table 1.

Table 1 Expectations Effectiveness of LKPD

No	Skills	Score Max	LKPD section-					Average	Score (%)	Category
			I	II	III	IV	V			
1	Interpretation	14	-	14	-	6,92	-	10,46	74,71	Good
2	Analysis	10	9,17	8,33	8,33	7,83	5,58	7,85	78,50	Very good
3	Evaluation	20	-	-	-	-	-	-	-	-
4	Inference	24	-	-	16,75	-	11,33	19,08	79,50	Very good
5	Eksplanation	20	15,33	-	-	16,75	-	16,04	80,20	Very good
6	Self-regulation	12	-	0	7,83	7,67	-	8,50	70,83	Good

Information:
1. Categories 75.01-100.00% (very good), 50.01-75.00% (good), 25.01-50.00% (good enough), and 00.00-25.00% (not good) (adapted from Akbar (2010).
2. LKPD I = Circulatory Organs; LKPD II = Heart Anatomy; LKPD III = Heart Work; LKPD IV = Blood Clots; and LKPD V = Disorders of the Circulatory System.

Table 1 explains the effectiveness of LKPD expectations which are determined based on critical thinking skills in both categories (including interpretation, analysis, evaluation, inference, explanation, and self-regulation).

Furthermore, research can be continued on Intrapersonal and Interpersonal skills. The results of research on LKPD's Intrapersonal and Interpersonal skills were developed in the small group test while the summary is presented in Table 2.

Table 2 Data Recapitulation of Interpersonal Skills and Intrapersonal Skills of Students

No	Name	Interpersonal Skills (%)	Category	Intrapersonal Skills (%)	Category
1.	Anissa Aprilia	88	Very Good	88	Very Good
2.	Azizah	77	Very Good	77	Very Good
3.	Listiyona Aprilia	77	Very Good	77	Very Good
4.	Gina Rahmah	88	Very Good	88	Very Good
5.	Ria Madina	100	Very Good	100	Very Good
6.	Nisrina Nabilah	88	Very Good	88	Very Good
Average		**86,33**	**Very good**	**86,33**	**Very good**

Information:
1. Categories 75.01-100.00% (very good), 50.01-75.00% (good), 25.01-50.00% (good enough), and 00.00-25.00% (not good) (adapted from Akbar, 2010)
2. LKPD I = Circulatory Organs; LKPD II = Heart Anatomy; LKPD III = Heart Work; LKPD IV = Blood Clots; and LKPD V = Disorders of the Circulatory System.

The effectiveness of LKPD expectations in this study was only measured based on the KBK of students in carrying out LKPD tasks at the small group test stage, different from other studies (Rachman, et al., 2017; Hairiani, et al., 2016; Zaini & Jumirah, 2016; Zulyusri, et al., 2017) which explained the effectiveness measured from learning outcomes, student activeness, students' analytical skills, process skills, performance skills, spiritual assessments, critical thinking assessments, social skills assessments, assessment of student activities and activity assessments teacher. CBC aspects include interpretation, analysis, evaluation, inference, explanation, and self-regulation that has been

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represented with at least one sub-skill. The results showed that LKPD was stated to have the effectiveness of expectations in both categories based on critical thinking skills (interpretation, analysis, evaluation, inference, explanation, and self-regulation).

Based on the results of the study, students' critical thinking skills in the interpretation of 74.71% (good), analysis of 78.50% (very good), inference of 79.50 (very good), expansion of 80.20% (very good)), and self-regulation of 70.83% (good). This is in line with previous studies (Nuraini, 2017; Susilowati, et al., 2017) which explain that each critical thinking skill has a different score and criteria for each skill.

The effectiveness of this study is only measured based on critical thinking skills as a focus on so that it is one of the weaknesses in research. According to Plomp (2007) the research question concerns two things: 1) critical thinking skills are the focus, 2) shows the word development that represents quality. The effectiveness of expectations from small group tests is analyzed based on the results of students' critical thinking skills. Zaini & Asnida (2016) reported that the effectiveness of learning instruments was met based on a) the completion of cognitive learning outcomes, b) the achievement of categories both on the results of assessing the characteristics of behavior, social skills, and critical thinking skills, c) the students' activeness was seen in the learning process.

Based on the results of the study, it is known that interpersonal skills (collaborating) and intrapersonal skills (conscientious) students have very good categories. This shows that the LKPD developed not only enhances students' skills but also can improve interpersonal and intrapersonal skills. This study is in line with previous studies (Lestari, et al., 2015) which reported that meticulous attitude is one of the scientific attitudes of students that can support students' critical thinking skills.

All LKPD developed in this study already included five Facione critical thinking skills, but some did not fulfill all the critical thinking sub-skills. Nevertheless, critical thinking skills have been represented at least by one sub-skill in each task in LKPD. Also, researchers realize the lack of one critical thinking skill according to Facione (1990), namely evaluation. This is due to the limited ability possessed by researchers to develop questions in the form of bills containing evaluation skills.

The results of the effectiveness of expectations in this study were 5 critical thinking skills, namely the analysis found in 5 LKPD. In the interpretation, inference, and explanation there are 2 critical thinking skills in 2 LKPD, and self-regulation there are 3 critical thinking skills in 3 LKPD, and in the evaluation, there are no critical thinking skills in 5 LKPD.

In addition to assessing students' critical thinking skills, and an assessment of interpersonal skills (collaborating) also includes five aspects, namely division of labor, unselfishness, ways of solving problems, tolerance and motivation while intrapersonal skills (meticulous) includes three aspects, namely doing each stage correctly, do all the stages correctly and do it on time.

In this 21st century, critical thinking skills, interpersonal skills, and intrapersonal skills need to be developed. This is following the results of the NRC workshop (2011) there are three focus skills of the 21st century namely 1) cognitive skills (non-routine problem solving, critical thinking, systems thinking); 2) interpersonal skills (complex communication, social skills, teamwork, cultural sensitivity, diversity); and 3) intrapersonal skills (self-management, time management, self-development, self-regulation, adaptability, and executive functions).

These three skills are interconnected and are needed by students. One way that can be done to improve these three skills is to use LKPD in the learning system because with the use of LKPD students can play an active role and take control to solve the problems faced. This statement agrees with Astuti et al. (2017) which explain that for students to be actively involved in critical thinking, one alternative that can facilitate is the use of LKPD for students to express their ideas and opinions on a problem.

D. Conclusion

Based on the results of research conducted on 5 LKPDs through the Development of High School Biology Students Worksheet Based on Thinking Skills on the Concept of Circulation Systems, namely the effectiveness of LKPD

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was stated to be very good (including analysis, inference, and explanation) and declared good (including interpretation and self-regulation), as well as interpersonal and intrapersonal skills expressed very well with an average score of 86.33.

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