The Implementation of Portfolio Assessment to Increase Critical Thinking Ability for High School Students on Human Coordination System Material

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Article Info	Abstract
	Critical thinking has an essential role in the development of 21st-century skills to form students who have a deep understanding of the subject being studied. The use of portfolio assessment is believed to be a means of mastering a subject. This study was aimed to analyze whether the implementation of portfolio assessment in Biology learning in human coordination systems material can improve students' critical thinking skills. This study used a *pretest* and *posttest control group design*. Based on the results of the analysis, it was found that the *means posttest* score of students' critical thinking skills in the experimental class was 78.28, and the control class was 63.36. The Independent Sample T-Test showed a significant mean difference between the experimental class and the control class. The improvement of critical thinking skills by implementing portfolio assessment was better than the control class. The regression test showed that the contribution of the portfolio assessment to the improvement of critical thinking skills was 19.1%. The results of the analysis showed that the portfolio assessment distributed students in three categories of critical thinking skills were 59.4% in the enough category, 31.3% in the good category, and 9.4% in the very good category. The conclusion is that the implementation of portfolio assessment has a positive effect on increasing students' critical thinking skills in the human coordination system material.

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INTRODUCTION

The Critical thinking ability is one of the thinking skills needed by students in dealing with the rapid current flow of information. Critical thinking is needed to form a person who can ask questions, express opinions, look for factual evidence, and be able to evaluate any information obtained without merely accepting it as truth (Adnyana, 2012). Kim et al. (2012) stated that critical thinking has a vital role in helping students construct their knowledge in selecting information and arguments. Students with critical thinking skills will be able to analyze information based on clear facts and reasons. This condition makes it easier for students to understand something that is being studied in the learning process.

Critical thinking is a competency to think rationally and reflectively that students need in learning activities (Redhana, 2010). It is in line with the opinion of Ildayanti (2017), which states that critical thinking is the right direction for students to understand learning material. The purpose of critical thinking is to ensure as far as possible the valid and correct thinking of students is formed in analyzing a problem faced in the learning process (Faiz, 2012). In summary, critical thinking plays a role in increasing in-depth understanding of learning materials, including in the context of learning Biology.

Human coordination system material is one of the Biology learning materials for class XI in the even semester. The human coordination system includes sub-topics, namely the nervous system, hormone system, and sensory system. According to Cimer (2012), students need special learning techniques to make it easier to understand the human coordination system material. It is because the material of the human coordination system involves a lot of complex discussions related to several detailed physiological processes of the human body. (Aminy *et al.,* 2017).

Based on the results of interview with a Biology teacher in class XI at SMA Negeri 1 Tanah Abang, Pali, South Sumatra, it is known that teachers had not trained or developed students' critical thinking skills maximally. The learning process carried out by the teacher was still dominated by the ability of students to remember a biological concept. The teacher argues that smart and critical students only owned the ability to think critically. All students can own the ability to think critically without specific characteristics. Teachers only need to practice or get used to thinking actively and gradually in each learning development of students. Therefore, a learning activity that can facilitate students in developing and controlling their thinking skills is needed. Idris *et al.* (2014) explained that the active and independent thinking control of students would affect sharpening their thinking. One alternative learning activity that can be implemented based on this objective is portfolio assessment.

Portfolio assessment is a form of class-based assessment (*assessment for* learning) of a set of students' assignment within a particular time which aims to determine the learning development of students (Surapranata & Hatta, 2006). Giving assignment in a systematic and organized way is believed to improve critical thinking skills because students are trained to think more actively in doing the tasks related to learning material (Ningtyas & Tenzer, 2018). It is in line with Sadikin (2016), which states that the implementation of portfolio assessment encourages an in-depth learning process. In-depth learning is meant in the form of action to evaluate situations, problems, or arguments, and to choose patterns of investigation that produce the best answers that can be obtained. These actions are part of the scope of critical thinking skills (Dwijananti & Yulianti, 2010). Lukitasari *et al.* (2013) stated that portfolio assessment provides opportunities for students to identify, focus, analyze, synthesize, and create based on a subject being studied, where all aspects are within the scope of critical thinking skills.

The most dominant assessment component in the implementation of portfolio assessment is the presence of *feedback* and *self-assessment* (Idris *et al.*, 2014). In other words, students not only have self-control but also get input or feedback from the teacher in developing their critical thinking skills.

The purpose of this research was to analyze the implementation of portfolio assessment in increasing the critical thinking skills of high school students in the human coordination system material. The significance of this research was to obtain alternative learning methods by prioritizing the use of assessment in monitoring learning

development, especially the students' critical thinking skills.

METHODS

The study was conducted in May until June 2020. The study used a *Pretest-Posttest Control Group Design* (Sugiyono, 2016) with the following scheme.

E	O1	X	O2
K	O3	-	O4

Figure 1. Research Design Schematic

Information:
E = Experiment
K = Control
O1 = Pretest
O2 = Posttest
X = treatment (portfolio assessment implementation in a scientific approach)
O3 = Pretest
O4 = Posttest
- = There is no treatment (scientific learning approach)

The population in this study was students of class XI SMA Negeri 1 Tanah Abang, Pali, South Sumatra in the 2019/2020 school year. Sampling was done by random sampling technique by taking two classes. Class XI MIPA 2 was the experimental class and class XI MIPA 1 was the control class. Each class consisted of 32 students.

The independent variable in this study was the learning design. The dependent variable was the critical thinking ability of students. Meanwhile, the control variables were the curriculum used, the teacher, the learning approach, the learning materials, the teaching materials used, and the number of lesson hours.

The data collection methods were the test and documentation method. The test method was an essay test that consists of 10 items which were used to obtain students' critical thinking skills data. Moreover, the documentation method was used to list names, the number of students, and all data required in the study.

The critical thinking skills of students can be identified by analyzing the answers written by students in the form of subjective tests (essay test). The data from the students' answers were analyzed

based on the assessment guidelines that had been made. Assessment guidelines were made by giving interval scores 0-4 with specific criteria. Scoring was followed by calculations using the following formula.

$$\text{Average} = \frac{R}{SM} \times 100\%$$

Information:
Average : Percentage
R : The score obtained by students
SM : Maximum test score
100 : Fixed number

The mean of critical thinking skills value in each student who has been obtained then qualified into the Pritasari (2011) category.

Table 1. Percentage of Critical Thinking Ability Category

Value Range	Category
$90 \leq A \leq 100$	Very Good
$75 \leq B < 90$	Good
$55 \leq C < 75$	Enough
$40 \leq D < 55$	Poor
$0 \leq E < 40$	Very Poor

Critical thinking skills data were analyzed using the N-*gain* test and the t-test to determine whether there was a critical thinking skill increase between the experimental class and the control class. The increase of the *pretest* and *posttest* mean score was calculated using the following Meltzer (2002) formula.

$$\text{N } gain = \frac{posttest\ score - pretest\ score}{maksimum\ score - pretest\ score}$$

The *N gain* values that have been obtained were categorized in Table 2 below.

Table 2. Category of *Gain* Index

Gain Index Value	Category
> 0.7	High
0.3 – 0.7	Moderate
< 0.3	Low

After finding an increase, the calculation was continued with a regression test to determine the contribution of portfolio assessment implementation to the critical thinking skills value. The t-test and regression test was performed using *SPSS 21 for windows*.

RESULT AND DISCUSSION

The data analysis began with the homogeneity test analysis and the data normality test of *pretest* on students' critical thinking ability. In succession, the homogeneity and normality tests were carried out with the help of the SPSS application through the *one way ANOVA* test and the *Shapiro-Wilk test.* It was obtained; the mean score of students pretest in the sample class was not significantly different with a significance value of 0.297> 0.05. It shows that the sample came from a homogeneous population. Also, the data normality test analysis showed that the significance value for the experimental group was 0.096 and the control group was 0.105> 0.05, which indicated that the experimental and control group data were normally distributed.

Furthermore, the data analysis of the *gain* value (the difference between the *posttest* and *pretest* scores) of students' critical thinking skills in each class showed a significant difference. The mean score of critical thinking ability in the experimental class was higher than the control class. The mean score of *pretest, posttest, gain, N-gain*, along with the *N-gain* category of the sample class can be seen in Table 3.

Table 3. Summary of Mean Score of *Pretest, Posttest, Gain, N-Gain*, N-*Gain* Category

| Class | N | Average | | *Gain* | N-*Gain* | N-Gain Category |
		Pretest	*Posttest*			
Experiment	32	44.06	78.28	34.22	0.61	Moderate
Control	32	37.03	63.36	26.33	0.42	Moderate

Based on Table 3, it was found that the *means posttest* score of students' critical thinking skills in the experimental class was 78.28 and the control class was 63.36. Table 3 also showed that the increase in the mean score from *pretest* to *posttest* in the experimental class is higher than the control class. The experimental class has a *gain* value of 34.22, which was higher than the control class of 26.33. In general, the increase of the pretest and *posttest* mean score in the two sample classes was in the moderate N-*gain* category. The experimental class has an N-*gain* value of 0.61, and the control class is 0.42. The results are supported by the distribution of students in the critical thinking skills category is shown in Figure 1 below.
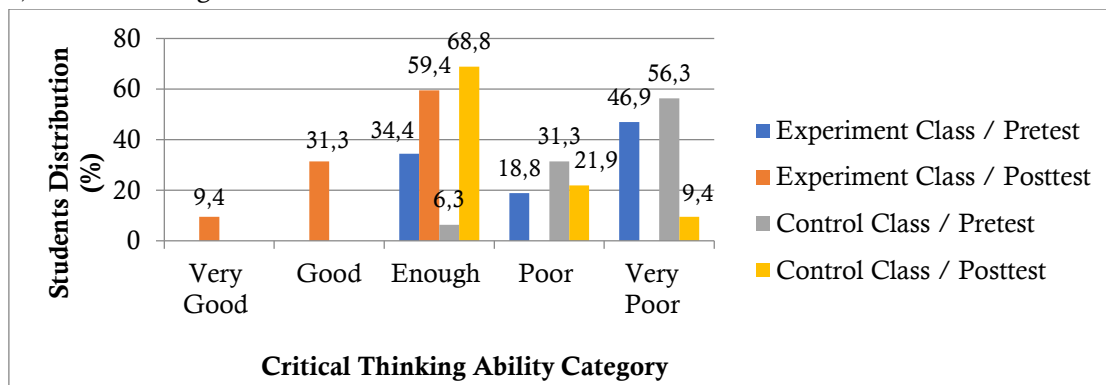

Figure 1. Students Distribution in the Critical Thinking Ability Category

Based on Figure 1, the *pretest* scores of critical thinking skills between the experimental class and the control class are in the same three categories, namely very poor, poor, and enough. The difference in critical thinking skills category occurred in the *posttest* scores. The *posttest* score of the experimental class classifies students into the category of enough, good, and very good with a percentage of 59.4%; 31.3%; and 9.4%. Meanwhile, the control class does not experience a change in the category as well as the *pretest* score. Thus, there is a positive effect between portfolio assessment and increased critical thinking skills.

Data analysis continued with hypothesis testing to prove that there was a significant difference or not between the critical thinking skills value between the experimental class and the control class statistically. The hypothesis test began with a data normality test using the *Shapiro-Wilk* test by comparing the *gain* values in the two sample

classes. The results obtained were the significance value of the experimental class and the control class, respectively, 0.292 and 0.299> 0.05, which indicates that the data for the two samples were normally distributed.

Hypothesis testing through the *independent-sample T-test* shows that there were significant differences in the critical thinking skills value between the experimental class and the control class. The results of the analysis of the hypothesis test showed that the t-count with a probability was 0.012 <0.05, it can be concluded that there was a significant difference in critical thinking skills value between the experimental class and the control class.

The critical thinking ability of students in the human coordination system material has increased significantly through the implementation of portfolio assessment. Students' critical thinking skills are getting better after the implementation of portfolio assessment. It is in line with research by Ningtyas and Tenzer (2018) and research by Parwoto et al. (2019) which states that the implementation of portfolio assessment causes the critical thinking power of students to be higher. The contribution of portfolio assessment to increasing critical thinking skills is shown by the results of the regression test in Table 4 below.

Table 4. Summary of Mean Score of *Pretest, Posttest, Gain, N-Gain*, N-*Gain* Category

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.437[a]	0.191	0.164	6.49455

a. Predictors: (Constant). Portfolio

Based on Table 4, it is known that the value of the correlation/relationship (R) is 0.437 with a determination coefficient of 0.191. It shows that the effect of the independent variable (portfolio assessment) on the dependent variable (critical thinking ability value) is 19.1%. It can be interpreted that the critical thinking skills of students are honed by implementing portfolio assessments. It is in line with the results of research by Pantiwati (2013) which states that portfolio assessment as a form of authentic assessment that is implemented consistently in learning can support the development of critical thinking of students. Through the application of portfolio assessment in the learning process, it allows students to evaluate situations, problems, or arguments, and choose patterns of investigation in finding the best answers that can be obtained (Dwijananti & Yulianti, 2010).

One form of the task in the implementation of portfolio assessment in this study was summarizing task. According to Ningtyas *et al.* (2018), the summarizing task can train students' critical thinking skills in making arguments, making deductions, induction, and evaluating. Through summarizing assignments, students are allowed to read, collect information, analyze and evaluate information obtained related to learning materials. Summarizing activities that come from the book and the internet sources requires students to remember, retrieve, and link their previous

knowledge and analyze this information to build new concepts. The summarizing task becomes an alternative for students in developing their critical thinking skills (An & Ying, 2009).

Self-reflection is an essential part of developing critical thinking skills. It is supported by the statement of Ennis (2011), who argues that critical thinking emphasizes thinking patterns that are reasoned and reflective. A similar opinion by Hasanah (2016) who states that self-reflection activities can empower critical thinking skills in deciding and implementing actions that students will take to correct their deficiencies in subsequent learning.

The manifestations of self-reflection activities in this study were quizzes and formative tests at each meeting. Quiz giving was done at the beginning of the learning activity. It was aimed to determine the prior knowledge of students. The initial knowledge becomes the basis for the teacher in acting, whether it provides reinforcement of the correct initial knowledge or correcting wrong knowledge. The formative test given was aimed to find out the final knowledge obtained by students after participating in the learning process. In summary, giving quizzes and formative tests is a form of portfolio assessment that emphasizes the elements of *feedback* and *self-assessment* (Idris *et al.*, 2014).

The basis for determining the regression equation between portfolio assessment and critical thinking skills refers to Table 5 below.

Table 5. Value of the Regression Equation between Portfolios and Critical Thinking Ability

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	61.794	5.239		11.796	0.000
	Portofolio	0.237	0.089	0.437	2.660	0.012

a. Dependent Variable: Posttest

Based on Table 5, *Constant* (a) is 61.794, and the Portfolio value (b / regression coefficient) is 0.237. Thus the regression equation can be written as follows.

$$Y' = 61{,}794 + 0{,}237X$$

The regression equation means that the Constant of 61.794 is the consistent value of the critical thinking ability variable, which is 61.794. The X regression coefficient of 0.237 states that for every 1% increase in portfolio value, the value of critical thinking skills increases by 0.237. The regression coefficient was positive. Thus there was a positive effect of variable X (portfolio assessment) on Y (critical thinking ability). The results of this study are relevant to the research results of Utami *et al.* (2018). They argue that the application of portfolio assessment is effective in improving the critical thinking skills of students in learning biology in the immune system chapter. Further, research Rahmi et al. (2017) and Parwoto et al. (2019) emphasized that there was an increase in critical thinking as part of students' higher-order thinking skills after the implementation of portfolio assessment.

The effect of portfolio assessment on students' critical thinking skills is shown by students who complete a set of tasks. They can analyze, evaluate, and convey their ideas obtained during learning. It is reinforced by Dewi's (2016) research which confirms that portfolio assessment trains a student to analyze, organize, evaluate, and describe their learning experience so that critical thinking skills can be developed. It is in line with Maesuri (2002). One of the advantages of portfolios as a means for students to evaluate themselves independently (*self-assessment*). By implementing a portfolio assessment, students' critical thinking skills can be trained and developed in a better way.

CONCLUSION

This study concluded that there is a significant difference in critical thinking skills value between the experimental class and the control class. Students' critical thinking skills in the experimental class is better than the control class. Thus, the implementation of portfolio assessment has a positive effect on increasing students' critical thinking skills in the human coordination system material.

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