Application of the Stim-Hots Model Combined with Brainstorming Methods and SAC Media on Critical Thinking Skills and Student Motivation on Metabolism Materials

Meutia Bijeh Mata[1], Hafnati Rahmatan[1*], Andi Ulfa Tenri Pada[1], Samingan[1], Abdullah[1]

[1] Master of Biology Education Study Program, Syiah Kuala University, Banda Aceh, Indonesia.

Abstract: Students' low critical thinking skills are a problem that must be solved. Critical thinking is also related to motivation, because student motivation is seen as a necessary prerequisite for critical thinking skills. This study aims to determine the differences in the improvement of critical thinking skills and the differences in students' learning motivation using the Stim-HOTs learning model combined with the brainstorming method and SAC media on metabolic material. This study uses a quasi-experimental method withNonrandomized Control Group design, Pre-test Post-test Design.The sampling technique used purposive sampling technique with a total sample of 230 students consisting of the control group and the experimental group. The instrument used to measure critical thinking skills used 40 multiple-choice reasoned questions, while motivation was measured using 30 ARCS motivation questionnaires. Data analysis used independent sample t-test at a significance level of 0.05. The results showed that there were differences in the improvement of critical thinking skills and there were differences in students' learning motivation on metabolic material in class XII after the application of the Stim-HOTs learning model combined with the brainstorming method and SAC media. The conclusion of this study is that the Stim-HOTs learning model combined with the brainstorming method and SAC media can be applied to improve critical thinking skills and students' motivation to learn on the subject of metabolism.

Keywords: Stim-HOTs; Brainstorming; Media SAC; Critical Thinking Skills; Motivation ARCS

Introduction

Learning today requires students to be able to master a number of competencies such as critical thinking and problem-solving skills, communication skills, creativity, and collaboration. The 2013 curriculum which is currently being implemented by the government also requires students to have higher-order thinking skills, such as critical thinking skills. This is indicated by the presence of several operational verbs that indicate the demands for the achievement of students' critical thinking skills in the core competencies of the 2013 curriculum, for example in the core competencies in class XII. But in fact, students in Aceh are generally still not used or trained to use critical thinking skills. This fact is supported by Puspendik data

which shows the average value of the National Examination (known with UN) for the province of Aceh for the 2019 school year for metabolic materials is 30.18 while the national average is 38.60, and the average in the 2018 school year is 37.02 for the province of Aceh while 47.77 for national. In addition, the achievement of the provincial Biology UN is 42.34 which ranks second to last of the national average in 2019. Meanwhile, in 2018, the average value of the provincial Biology UN was 37.98 so Aceh was in the last place of the national average at that time. The data shows that the average Biology National Examination in Aceh province is in the category of low mastery. and the average in the 2018 school year was 37.02 for the province of Aceh while 47.77 for the national. In addition, the achievement of the provincial Biology UN is 42.34 which ranks second to

last of the national average in 2019. Meanwhile, in 2018, the average value of the provincial Biology UN was 37.98 so Aceh was in the last place of the national average at that time. The data shows that the average Biology National Examination in Aceh province is in the category of low mastery. and the average in the 2018 school year was 37.02 for the province of Aceh while 47.77 for the national. In addition, the achievement of the provincial Biology UN is 42.34 which ranks second to last of the national average in 2019. Meanwhile, in 2018, the average value of the provincial Biology UN was 37.98 so that Aceh was in the last place of the national average at that time. The data shows that the average Biology National Examination in Aceh province is in the category of low mastery.

Currently, critical thinking skills are considered as very important basic skills that must be possessed by students in learning.Critical thinking is understanding or reflecting on problems in depth, keeping the mind open to different arguments and perspectives, and not simply believing information that comes from various sources (Sofiah, et al., 2016). Critical thinking skills will improve the ability of high order thinking skills learners in providing reasonable reasoning to understand and make complex choices, understand the interconnections between systems, have the ability to structure, express, analyze, and solve problems (Sajidan & Afandi, 2017; Fascione, 2011). Critical thinking skills can be developed either directly or indirectly in learning at school (Saputra, 2016). Through continuous training,learnerswill be accustomed to developing critical thinking skills, both in solving HOTs standardized exam questions at school and in the implementation of daily life in the community. Basically, the ability of HOTs can be improved with various HOTs-based teaching materials and various learning media (Ichsan, et al., 2019). The purpose of Stim-HOTs is how to increase the level of thinking at a higher level, especially those related to critical thinking skills. Critical thinking is the most important aspect resulting from Stim-HOTs (Afandi et al., 2019).

The success of learning in the classroom is also influenced by the motivation of students. Damis' research (2018) shows that students who have strong motivation in participating in the learning process in class look full of enthusiasm, enthusiasm, have high curiosity, are active in learning, diligent in doing the tasks given by the teacher, so that they have long enough endurance in completing tasks in learning. Students who are motivated to learn will use higher cognitive processes in studying a particular material, so thatlearners can absorb the material more good again.Students with high learning motivation have better critical thinking skills than students with low motivation. Research by Zanthy (2016), Sucipta, et al. (2018), Senjayawati, & Nurfauziah (2018) state that

students who have high learning motivation will have a higher level of critical thinking than students who have low motivation.

Training and improving students' critical thinking skills and motivation requires an appropriate method, model, and learning media. Several studies related to the application of learning models to improving students' cognitive abilities on metabolic materials, such as Problem Based Learning, experimental methods, CIRC models, and STAD models have been carried out. Various studies both on modules and models of Stimulating High Order Thinking skills of students have been carried out (Sajidan and Afandi, 2017; Rahmawati, et al., 2019; Saputri, et al., 2019; Pramesti et al., 2018).

Based on this, it is necessary to conduct research related to the application of the Stimulating High Order Thinking skill (Stim-HOTs) learning model combined with the brainstorming method and the Smart Apps Creator (SAC) media to improve critical thinking skills and students' motivation on metabolic material. Research using the Stim-HOTs model combined with the brainstorming method and SAC media on metabolic material is expected to carry out an optimal learning process and critical thinking skills and students' learning motivation on metabolic material.

Method

This research was conducted at SMA Negeri Lhokseumawe which consists of 2 schools, namely SMAN Modal Bangsa Arun Lhokseumawe and SMAN 1 Lhokseumawe. The approach used is quantitative with a quasi-experimental type of research with Non randomized Control Group design, Pre-test Post-test Design (Ary, et al., 2010).

The population in this study were all participants in class XII science at SMA Negeri Modal Bangsa, Arun Lhokseumawe and all students in class XII science at SMA Negeri 1 Lhokseumawe, totaling 350 students with a sample of 230 students, which is presented in Table 1.

Sampling in this study was done by purposive sampling technique, namely the technique of determining the sample with consideration. Purposive sampling is used if the target sample being studied already has certain characteristics so that it is impossible to take other samples that do not meet the predetermined characteristics (Sugiyono, 2010). The basis for class considerations areby giving pre test questions to all students of class XII IPA SMA Negeri Modal Bangsa Lhokseumawe and SMA Negeri 1 Lhokseumawe, then the class that will be used as the control class and the experimental class is determined based on the average value of the pre test which is not significantly different or almost the same (homogeneous).

Table 1. Research Sample Sample Group and Experimental Group

School	Class Status		Number of Students
	Control	Experiment	
Capital Nation SMA Arun Lhokseumawe	XII-IPA 2	XII-IPA 1	115 Students
	XII-IPA 4	XII-IPA 3	
SMA Negeri 1 Lhokseumawe	XII-IPA 2	XII-IPA 3	115 Students
	XII-IPA 6	XII-IPA 4	

Research data collection instruments in the form of test and non-test instruments.The test instrument is peset of objective tests of critical thinking skillsthrough reasoned multiple choice tests given before and after learning by applying the Stimulating High Order Thinking skills (Stim-HOTs) learning model combined with brainstorming and media methods Smart Apps Creator (SAC). While the non-test technique used to measure students' learning motivation is carried out through a questionnaire statement totaling 36 statements according to the ARCS indicator (Attention, Relevance, Confidence, and Satisfaction) (Keller, 2010). This questionnaire is given to students after participating in the learning process by applying the Stimulating High Order Thinking skills (Stim-HOTs) learning model combined with brainstorming and media methods Smart Apps Creator (SAC).

Data analysis for critical thinking skills was analyzed by quantitative descriptive analysis presented in the form of tables,then calculate the percentage of each score.Normalized Gain calculation is used to determine the improvement of critical thinking skills through the difference in pre-test and post-test scores using the formula according to Meltzer (2002).Analysis of the average difference test was carried out on the average pre-test score post-test score through the independent sample t-test test with the criteria if ($p < 0.05$) then Ha was accepted, whereas if ($p > 0.05$) then Ha rejected. While the motivation questionnaire was analyzed by quantitative descriptive analysis by converting ordinal data into interval data using the Method of Successive Interval (MSI) (Sugiyono, 2013) to then calculate the average score of the motivation questionnaire data using the Arikunto (2010) formula.

Results and Discussion

Students' Critical Thinking Skills

The analysis of the increase in the average score of N-Gain critical thinking skills of students in the control group and the experimental group is presented in Figure 1. It shows that there is an increase in the mean score of N-Gain critical thinking skills between the control group and the experimental group. The average N-Gain score of critical thinking skills in the experimental group was 0.9 with a high interpretation, while the control group was 0.3 with a low interpretation.
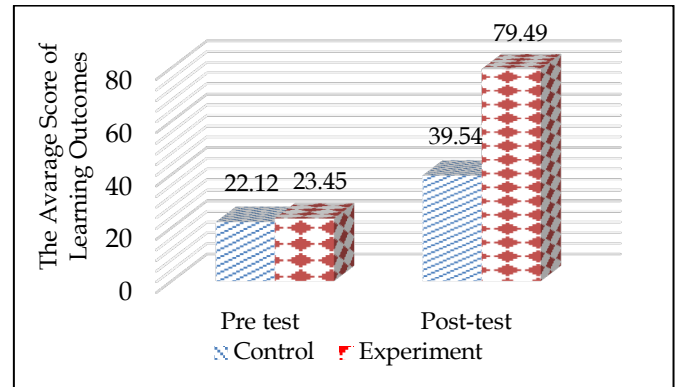

Figure 1. Average N-Gain of Critical Thinking Skills

The achievement of critical thinking skills in the experimental group taught using the Stim-HOTs model makes students more active and responsive, because the steps in these learning activities direct and train students in developing problems that stimulate their thinking processes in responding to cases or problems, collecting information. from various relevant sources, discussing with their group friends, formulating conclusions, communicating the results of information exploration, and reflecting with their group friends. The series of learning activities can encourage and train reasoning skills to solve problems so as to improve students' critical thinking skills in the material being taught.By doing it in stages like the model, students are able to absorb information well as well as trainlearnerscritical thinking (Afandi & Sajidan, 2017). This is also in line with hstudy results (Primary & Pramesti, 2018)which suggests thatuto improve critical thinking skillslearners, one of which is the Stim-HOTs learning model.

The application of the Stim-HOTs model in the experimental group combined with the brainstorming method will train students' critical thinking skills during the learning process, namelytrain students to seek, find, and express as many ideas, views, or ideas as possible while discussing with their group friends so as to help stimulate their thinking processes in responding to questions or problems related to learning. This is in line with studies (Dhull & Beniwal, 2018) which suggest that one of the main advantages of brainstorming is that it requires a person to think critically, to solve a particular problem, or to create something innovative. Brainstorming directs students to problem development while giving each student the opportunity to express his ideas and share ideas with others and encourage new ideas (Al-Blwi, 2006).

Learning activities in the experimental class that begin with syntax orientation make students accustomed to observing and investigating images, problems, or metabolic materials that are studied every time learning begins. Through questioning syntax, students are directedto actively identify problems and make various questions independently related to metabolic material, as well as answer questions from teachers so that they are trained to analyze the relationship between questions and concepts, opinions, and other information so as to train their critical thinking skills. Technique*questioning*, plays an important role in encouraging students' higher order thinking skills, such as self-reflection, revision, and social debate which are all important to improve critical thinking skills (Alsaleh, 2020).

The application of Stim-HOTs combined withbrainstorming method. This method encourages students to learn to brainstorm or express various opinions as well as discuss problems related to metabolic material obtained through the syntax of exploration activities onamount of information either independently or in groups to findpossible problem solving solutionsto existing questions and problems. Through discussion and explanation syntax, students are trained to exchange information, discuss information, andverifying the results of his observations with data from various sources, as well as verbally communicating the findings of the information aimed at answering the problem formulation or questions related to the metabolic material presented in class. Brainstorming encourages participants, both in pairs and groups to make a large number of suggestions without limitation (creative and imaginative) which are then collected, combined, expanded, and refined (Litcanu et al., 2015).

During the learning activities on metabolic materials by applying the Stim-HOTs model combined with the brainstorming method, learning activities are also assisted by the use of SAC media as a means as well as a learning resource to support the presentation of material that is packaged in a practical, innovative, and attractive way that can be fully accessed by students via smartphones. This SAC media accommodates students' needs for easy, interesting, and fun access to information on metabolic materials. Media SAC also provides structured material, examples of HOTs questions and their solutions, pictures, and videos that support metabolism material. This media is one of the means as well as learning resources that strongly support the needs of student learning activities in the classroom. The use of technology as the main supporting learning resource in the application of this model is one strategy that can train students in analyzing and synthesizing so that they can practice their critical thinking skills. This is in line with the opinion which states that there are other strategies that can be used to improve critical thinking skills through the use of technology such as web-quests, which are a type of resource-based learning that requires students to analyze, synthesize, and apply information retrieval strategies that represent higher levels of thinking skills (Dodge, 1995; MacGregor & Lou, 2006). In this research, the technology used is media or SAC (Smart Application Creator) application.

Meanwhile, in the control class, the learning activities tend to be monotonous because students only get expository information from the teacher. The learning resources used are only in the form of ordinary Biology textbooks with a very limited number. Evenlearnersrarely use their textbooks because the material is not complete enough and the display is unattractive. This causes learning activities to be less than optimal, in contrast to the experimental group.

The Stimulating High Order Thinking skill (Stim-HOTs) learning model combined with the brainstorming method and SAC media can train students to develop several aspects or indicators of critical thinking skills such as providing simple explanations (basic clarification), building basic skills (basic support), concluding (inference), make further explanations (advanced clarification), andsupposition and integration.The percentage of data acquisition on the average number of students who answered correctly for each indicator of critical thinking skills in the control group and the experimental group is presented in Figure2.
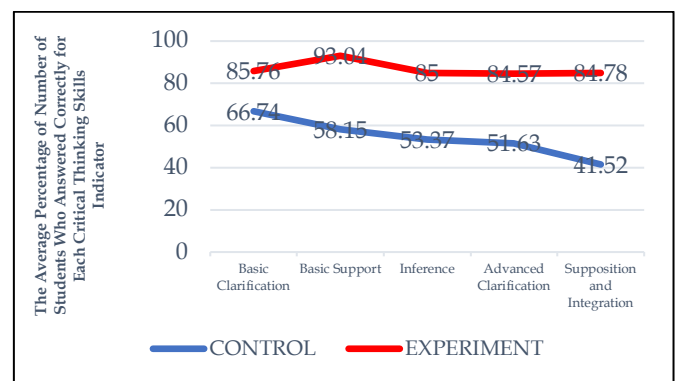

Figure 2. Percentage of Students Who Answered Correctly on Each Indicator of Critical Thinking Skills

Figure-2 shows that students experienced an increase in critical thinking skills in each indicator after learning using the Stimulating High Order Thinking skill (Stim-HOTs) learning model combined with the brainstorming method and SAC media. This can be seen from the significant increase in the average percentage of the number of experimental group students who correctly answered the post-test questions on each indicator of critical thinking skills. The basic support indicator is the indicator with the highest number of students who answered correctly, namely 93.04%,

followed by the basic clarification indicator at 85.76%, the inference indicator at 85%, supposition and integration indicators at 84.78%. , and the advanced clarification indicator is 84.57%.

Furthermore, the results of the independent sample t-test on the N-Gain data on students' critical thinking skills in the control group and the experimental group are presented in Table 2.

Table 2. Independent Sample Test t-Test Data N-Gain Critical Thinking Skills Learners Control and Experiment Group

Score	N	Average	Normality*)	Homogeneity**)	t*** test)
Control	115	0.3	Sig. (0.070)	Sig. (0.733)	Sig. (0.000)
Experiment	115	0.9	Sig. (0.071)		

Information:
*)   =Kolmogorov-Smirnov test (Normal, Sig >0.05)
**)   =Levene-Smirnov (homogeneous, Sig >Sig >0.05)
***)   =Independent Sample t-test (homogeneous, Sig > 0.05)

Table 2 shows that there are significant differences between the control group and the experimental group. The statistical analysis test between the control group and the experimental group was significant or significantly different, meaning that the application of the Stimulating High Order Thinking skill (Stim-HOTs) learning model combined with the brainstorming method and SAC media was effective to improve students' critical thinking skills in the experimental class.

Student Motivation

The results of the independent sample t-test on the learning motivation of students in the control group and the experimental group are presented in Table 3.

Table 3. Independent Sample t-Test Test of Student Motivation Data for Control and Experimental Groups

Score	N	Average	Normality*)	Homogeneity**)	t*** test)
Control	115	66.37	Sig. (0.174)	Sig. (0.475)	Sig. (0.000)
Experiment	115	82.42	Sig. (0.098)		

Information:
*)   =Kolmogorov-Smirnov test (Normal, Sig >0.05)
**)   =Levene-Smirnov (homogeneous, Sig >Sig >0.05)
***)   =Independent Sample t-test (homogeneous, Sig > 0.05)

Table 3 shows that there are significant differences in learning motivation between the control group and the experimental group. The results of the statistical analysis test between the control group and the experimental group were significant or significantly different, meaning that there were differences in the motivation of the experimental group students who applied the Stimulating High Order Thinking Skills (Stim-HOTs) learning model combined with the brainstorming method and SAC media. This result is also in line with research by Rahmawati, et al., (2019) which states that the student center concept in the Stim-HOTs model can make students active in learning and feel happy, so that students can master complex material, and is in line with research. Dhull & Beniwal (2018) that brainstorming is very helpful in generating attention among students. This shows that the Stimulating High Order Thinking skill (Stim-HOTs) learning model combined with the brainstorming method and SAC media is effective in increasing the Stimulating High Order Thinking skill (Stim-HOTs) combined with the brainstorming method and SAC media can foster student motivation in learning which includes several component aspects or indicators, namely attention, relevance, confidence, and

satisfaction. The percentage of the average score for each indicator of students' learning motivation in the control group and the experimental group is presented in Figure 3.
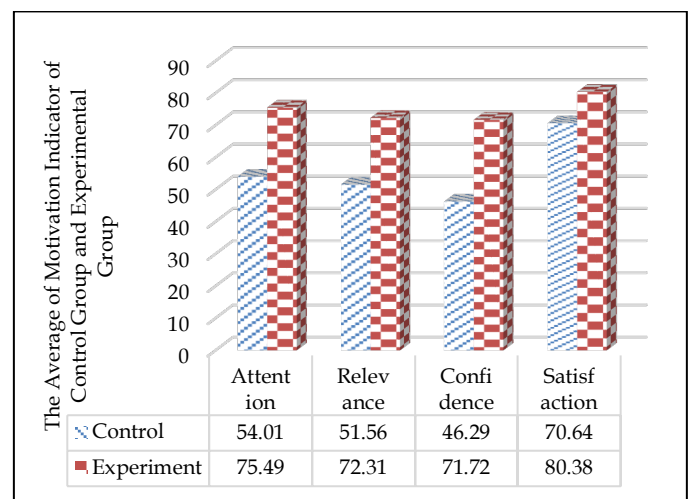

Figure 3. Average ARCS Motivation Indicator Control Group and Experiment Group

Based on the results shown in Figure 3, it can be seen that there are differences in the average score of

learning motivation for each motivation indicator in the control group and the experimental group. The increase in the average score of motivation in the experimental group appears in each indicator and the highest average score is found in the satisfaction indicator, which is 80.38%. Students feel the learning atmosphere becomes more fun because they are actively involved from determining problems, brainstorming, exploring, discussing, to finding solutions and linking them to the concept of metabolism. Students also feel satisfaction with the use of SAC media as a learning tool and resource that supports learning. Abidin (2006) states that successful work, successful experience and problem solving can makelearnersfeel satisfied in a learning process. Indeed, learning does not occur without attention (Jamil, 2019). In line with this,Herndon (1987) states that there is interest or concern learners towards the given task can encouragelearnerscontinue his work. Fun learning will be marked by the amount of attention of students on the task, so that learning outcomes can increase. In addition, in the long term students are expected to be happy to learn to create an attitude of lifelong independent learning.

Conclusion

The conclusion of this research isthere are differences in the improvement of students' critical thinking skills between the control class and the experimental class and there are differences in students' learning motivation between the control class and the experimental class on the subject of metabolism.

Acknowledgments

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