

Validity and Reliability of Collaborative Based Science Learning Model to Improve Critical Thinking Skill and Responsibility of Junior High School Students

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Abstract—The Collaborative Based Science Learning (CBSL) model is a collaborative science-based learning that is used in science learning to improve the critical thinking skill and responsibility of junior high school students. The syntax of CBSL model includes: 1) Motivation and problem orientation, 2) Collaborative-based critical thinking activity, 3) communicating the results of collaborative critical thinking activity, 4) Advance practice of critical thinking and responsibility, and 5) Reflection. The purpose of this study is to analyze the validity and reliability of CBSL model that has been developed to improve the critical thinking skill and responsibility of junior high school students. The validity and reliability data of CBSL model is obtained through Focus Group Discussion (FGD) activities. The single measures inter rater coefficient correlation (ICC) and Cronbach's coefficient alpha was used to analyze the validity and reliability of the CBSL model. The results showed that CBSL Model has fulfilled the validity requirements ($\alpha = .86$) and reliability ($\alpha = .98$), so the CBSL Model qualified the validity and reliability. The implication of this research is that the valid and reliable CBSL models can be used to improve students' critical thinking skill and student responsibility theoretically. Further research can be conducted to test the practicality and effectiveness of the CBSL Model to improve the critical thinking skill and responsibility of junior high school students.

Keywords—*Validity, reliability, collaborative, critical thinking skills, responsibility.*

I. INTRODUCTION

The demographic Bonus of 2045 should be maximized; one of the ways is by equipping students with 21st century competences, for example the critical thinking and responsibility. Students must have superior competence with a variety of skills in the 21st century. Some of the learning and innovation skills that students need to have is the mastery of information technology, critical thinking skills, collaboration, life skills and career, and one of them is the responsibility. The 21st century competency framework becomes a foothold in the development of the 2013 curriculum that is designed to anticipate the needs of 21st century competencies [1]. It shows how important the critical

thinking skill for students, one of the ways is by training it in classroom learning.

A more in-depth review of the preliminary study provides an overview that the vast majority students still have difficulties in using critical thinking skill. Another indication is that students are still lack of responsibility. The facts of PISA's international study result put Indonesian students at the bottom of the study in 2009, 2012, and 2015 [2-5]. The results [6] found that Responsibility is an important part of life skills and career in the 21st century. The above facts indicate a need for innovative natural science learning models to be able to trace the critical thinking skill and responsibility of junior high school students in Indonesia.

The Collaborative Based Science Learning (CBSL) model is a collaborative based learning that is used in learning to improve the critical thinking skill and responsibility of junior high school students. The previous research has been developed the hypothetical CBSL model based on the innovation of Problem Based Learning (PBL) and Inquiry model that is specifically developed to improve students' critical thinking skill and responsibility. The CBSL model that has been developed is expected to improve critical thinking skill and responsibility refers to the flow of problem-solving process from Dewey.

The prototype criteria that were developed should be eligible to be valid, practical, and effective [7]. This also applies to the CBSL model that have been developed to improve students' critical thinking skill and responsibility that it has to fulfill the aspects of validity, practicality, and effectiveness. In this research, the first step in fulfilling the appropriateness aspect of CBSL model which is developed was the fulfillment of validity aspect. The validity aspect of CBSL model was in terms of content validity, construct validity, and reliability. After the CBSL Model had been declared as valid and reliable, theoretically it can be used for the test of practicality and effectiveness to improve the students' critical thinking skill and responsibility.

Therefore, this study focused to analyze the validity and reliability of CBSL model in improving the critical thinking skill and responsibility of junior high school students.

The rest of this paper is organized as follow: Section II describes proposed research method. Section III presents the

II. METHOD

The Validity of CBSL model is determined based on the content and construct validity. According to Nieveen in [8] the validity is divided into two, namely the content and the validity of the construct validity. Content validity means that there is a need for the intervention and its design is based on state-of-the-art (scientific) knowledge [8-9]. Assessment of content validity is reviewed from several aspects of assessment as follows: 1) CBSL Model Development Needs; 2) State of the art of knowledge; 3) Thinking Framework of CBSL Model Formation; and 4) Description of CBSL Model [8-11]. Construct validity means that the intervention is 'logically' designed [8-9]. The assessment of construct validity is reviewed from several aspects of the assessment as follows: 1) Consistency of CBSL Model Development; 2) Thinking Framework of CBSL Model Formation; and 3) CBSL Model Description [8-11]. The developed CBSL model is validated by 2 experts in Focus Group Discussion (FGD). FGD is small group discussion in which the participants respond to a series of questions focused on the topic being studied [9]. Experts in the FGD consist of 1 doctor of science education expert and 1 biology expert. The FGD was held for 2 hours. Before the FGD, the experts were given CBSL Model Books and CBSL Model Validation Sheets 2 weeks earlier. The CBSL Model Validation Sheet is filled with experts who review and assess the learning model developed by researchers in the FGD. The CBSL Model Validation Sheet is used to obtain the validity and reliability data of the CBSL Model. The CBSL Model Validation Sheet consists of: 1) Validation Sheet of CBSL Model content validity, 2) Validation Sheet of CBSL Model construct validity. FGD results serve as a reference for revising the CBSL Model. Further analysis to strengthen validity and reliability analysis of the CBSL model use single measured interferer coefficient correlation (ICC) and Cronbach's coefficient alpha. Validity and reliability of the CBSL model is determined by the validity formula as following:

$$r_{\alpha} = \frac{(\text{Mean Square people-Mean Square residual})}{(\text{Mean Square people} + (k-1) * \text{Mean Square residual})}$$

and

$$\text{Cronbach's alpha } \alpha = \frac{k r_{\alpha}}{1 + (k-1) r_{\alpha}} [12-13].$$

The CBSL model is said to be valid if $r_{\alpha} > r$ Table and invalid if $r_{\alpha} \leq r$ Table.

III. RESULTS

The content and construct validation results of CBSL model is presented in Table 1. Table 1 shows that the content validity of the CBSL Model includes: 1) CBSL Model Development Needs; 2) State of the art of knowledge; 3) Thinking Framework of CBSL Model Formation; and 4) Description of CBSL Models in which all of them have a minimum r_{α} of .86 and is greater than r Table (.16), so that each component is valid. While for the reliability of each component in terms of the α value, all of them are between the value of .96 and .99, so that each component is declared reliable. In addition to the FGD process, the validators provide suggestions to improve the quality of the CBSL

obtained results and following by discussion in Section IV. Finally, Section V concludes this work.

Model. Suggestions from validators are used as reference for the CBSL model revision process in order to be able to be implemented.

TABLE I. THE VALIDITY AND RELIABILITY OF THE CBSL MODEL

Components	Validity and reliability of CBSL model			
Content Validity	r_{α}	Validity	α	Reliability
1. CBSL Model Development Needs	.89	Valid	.98	Reliable
2. State of the art of knowledge	.90	Valid	.99	Reliable
3. Thinking Framework of CBSL Model Formation	.88	Valid	.98	Reliable
4. Description of CBSL Model	.86	Valid	.98	Reliable
Construct Validity				
1. Consistency of CBSL Model Development	.88	Valid	.96	Reliable
2. Thinking Framework of CBSL Model Formation	.89	Valid	.99	Reliable
3. Description of CBSL Model	.86	Valid	.98	Reliable

Table I shows that the construct validity of the CBSL Model includes: 1) Consistency of CBSL Model Development; 2) Thinking Framework of CBSL Model Formation; and 3) Description of CBSL Model in which all of them have a minimum r_{α} of .86 and is greater than r Table (.16), so that each component is valid. While for the reliability of each component in terms of the α value, all of them are between the value of .96 and .99, so that each component is declared reliable. In addition to the FGD process, the validators provide suggestions to improve the quality of the CBSL Model. Suggestions from validators are used as reference for the CBSL model revision process to be able to be implemented. Syntax of the CBSL Model presented in Table II.

TABLE II. SYNTAXS OF THE CBSL MODEL

Teacher Activities	Student Activities
Phase I: Motivation and Problem Orientation	
1. Teacher motivates students, convey the purpose of learning, and provide direction on learning and assessment of critical thinking skills and responsibilities.	1. Students are motivated by trying to understand the purpose of learning, pay attention to the direction of the learning process and assessment of critical thinking and responsibilities conveyed by the teacher.
2. Teacher provides collaborative issues.	2. Students pay attention and try to understand the problems given by the teacher.
Phase II: Critical Thinking Activity Based Collaboration	
1. Teachers divide students into heterogeneous groups (4-5 students) and distribute student worksheets (i.e. LKS 1) that will be used as guides for collaborative critical thinking activities.	1. Students gather in heterogeneous groups (4-5 students) and distribute student worksheets (i.e. LKS 1) to be used as guides for collaborative critical thinking activities.

Teacher Activities	Student Activities
2. Teachers guide students in collaborative critical thinking activities (solving academic problems) in LKS 1 as an effort to train critical thinking skills and inculcate responsibilities during the learning process.	2. Students are active in collaborative critical thinking activities (solving academic problems) in student worksheets (i.e. LKS 1) as an effort to train critical thinking skills and instill responsibility during the learning process.
Phase III: Communicating Results	
1. The teacher guides the students to learn to communicate the results of collaborative critical thinking activities to other students and other students' responds to foster student responsibility through presentation activities.	1. Students communicate the results of collaborative critical thinking activities to other students and other students' respond to foster student responsibility through presentation activities.
2. Teachers clarify to students if there is a wrong concept.	2. Students listen to clarifications related to the concept presented by the teacher.
Phase IV: Advanced Exercises	
1. Teachers provide follow-up tasks in the form of student worksheets (i.e. LKS 2) critical thinking skills (authentic) that must be solved individually as a stage to improve the critical thinking skills that have been owned and improve student responsibility.	1. Students do follow-up work in the form of student worksheets (i.e. LKS 2) critical thinking skills (authentic) that must be solved individually as a stage to improve the critical thinking skills that already have and improve student responsibility.
2. Teachers guide students when they have difficulty.	2. Students are allowed to ask if they have difficulty.
Phase V: Reflection	
1. The teacher guides the student to reflect on the process and outcomes in critical thinking and responsibility activities.	1. Students reflect on the processes and outcomes in their critical thinking activities and responsibilities.
2. Teachers provide follow-up tasks for collaborative groups.	2. Students in collaborative groups obtain and undertake follow-up tasks outside of school hours.

IV. DISCUSSION

The developed hypothetical CBSL model has been validated by 2 experts in FGD. Experts in the FGD consist of 1 doctor of science education expert and 1 doctor of biology expert. The discussion of Table 1 on the content validity of the CBSL Model is described as follows. The validity of the content focuses on there is a need for the intervention and its design is based on state-of-the-art (scientific) knowledge [8-9]. The aspects of the CBSL Model Development Needs includes: 1) The importance of developing the CBSL Model to meet the needs of the 21st century competency framework as written in Partnership for 21st century skills. 2) CBSL model can meet the needs of 21st century skills-based research trends, namely the skills of critical thinking and responsibility to be successful in the present life and the future. 3) The CBSL model refers to meet the demands of the times according to the 2013 Curriculum. 4) The benefits of the CBSL model meets the needs of critical thinking skill and the responsibility to be successful in present and future life. 5) The objectives of CBSL model refers to meet the need for critical thinking skill and the responsibility to be successful in present and future life.

The aspects of advance knowledge from CBSL models include: 1) CBSL models is built to meet the state of the art

of knowledge by improving weaknesses based on the recommendations of existing researchers: a) PBL model [14-23], b) Inquiry modes [24-26], and c) POGIL [27-31]. 2) By using the theoretical foundations of educational psychology figures listed in the standard book [10,32-34].

The thinking framework of the CBSL model formation includes: 1) the standard reference literature study that meets the state of the art aspect about science learning in junior high school. 2) Study of standard reference literature that meets the state of the art aspects of critical thinking skill. 3) Study of standard reference literature that meets the state of the art aspect of responsibility. 4) Study of standard reference literature that meets the state of the art aspect of collaborative learning. 5) Study of standard reference literature that meets the state of the art aspects of the PBL, Inquiry, and POGIL models in improving critical thinking skill and responsibility. 6) The development of the Collaborative Problem Based Learning (CBSL) model is supported by the theories of: Independent positive, Constructivism socio-cognitive theories, cognitive theories of learning, behavioral theories of learning, and motivation theories of learning and supported by empirical foundation and standard reference needs on the innovative models to improve critical thinking skill and responsibility.

The description of CBSL model includes: 1) Characteristics of Learning Model that includes: a) The objectives of CBSL Model; b) Model Stages and Arguments; Syntax Planning; c) Implementation of the Social System; Application of Reaction Principles; Support System; d) as well as the Instructive and Companion Impacts. 2) Classroom Learning and Management Environment based on standard references that meet the state of the art aspect. 3) Implementation of Evaluation: Critical thinking skill and responsibility based on standard references that meet the state of the art aspect. The results of this study showed that the CBSL model has been valid in content to improve students' critical thinking skill and responsibility.

The discussion about Table 1 on construct validity of the CBSL model is described as follows. Construct Validity focuses on the intervention is 'logically' designed [8-9]. Consistency of CBSL Model Development includes: 1) Development of CBSL Model with 21st century competency framework as written in Partnership for 21st century skills is designed logically. 2) The suitability between CBSL model and the needs of 21st century skill-based research trends, that is critical thinking skill and responsibility to be successful in present and future life are designed logically. 3) The suitability between the CBSL Model and the demands of the times according to the 2013 Curriculum is designed logically. 4) The conformity between the rational importance of model development, model development goals, and the benefits of model development is logically designed.

Thinking Framework, the CBSL model includes: 1) the standard reference literature study that meets the logical aspects of science lessons in junior high school. 2) The study of standard reference literature that meets the logical aspects of critical thinking skills. 3) The study of standard reference literature that meets the logical aspects of responsibility. 4) The study of standard reference literature that meets the logical aspects of collaborative learning. 5) The study of standard reference literature that meets the logical aspects of

PBL, Inquiry and POGIL models in improving critical thinking skill and responsibility. 6) The existence of consistency between theory support and empirical support for the development of Collaborative Problem Based Learning (CBSL) model (Supported by the theory of: Independent positive, Constructivism socio-cognitive theories, cognitive theories of learning, behavioral theories of learning, and motivation theories of learning, and supported by an empirical foundation and a standard reference to the need of innovative models to improve critical thinking skill and responsibility). 7) The CBSL model is built consistently and logically to correct the weaknesses based on the recommendations of existing researchers that are: PBL [14-23]; b) The Inquiry Model [24-26]; c) POGIL [27-31]. 8) The CBSL model that was built on the theory of educational psychology figures listed in standard books [10,32-34] is logically designed.

The description CBSL model includes: 1) Characteristics of learning model, consistently and logically includes: a) The Purpose of the CBSL Model; b) Model Stages and Arguments; Syntax Planning; c) Implementation of the Social System; Application of Reaction Principles; Support System; d) as well as the Instructive and Companion Impacts. 2) The Classroom Learning and Management Environment are designed logically. 3) Implementation of Evaluation: Critical Thinking Skill and Responsibility are designed logically.

The results of this study supported the results of previous research that innovative learning models must fulfill the valid criteria can be implemented to find the practicality and effectiveness of learning models developed [35-36]. The valid learning models and materials can be implemented to see the effectiveness and effectiveness of developed learning models and materials [37-41].

The results of this study prove that CBSL model has been constructively valid to improve students' critical thinking skill and responsibility. Theoretical and validation results by experts through FGD proved that CBSL model have been validly legal and also reliable for improving students' skills and responsibility.

V. CONCLUSION

The syntax of CBSL model includes: 1) Motivation and problem orientation, 2) Collaborative-based critical thinking activity, 3) communicating the results of collaborative critical thinking activity, 4) Advance practice of critical thinking and responsibility, and 5) Reflection. The results show that CBSL Model has fulfilled the validity requirements ($\alpha = .86$) and reliability ($\alpha = 1.00$), so the CBSL Model qualifies the validity and reliability. The implications of this study suggest that valid and reliable CBSL models can be used theoretically to improve the students' critical thinking skill and responsibility. Further research can be conducted to test the practicality and effectiveness of the CBSL Model to improve the critical thinking skill and responsibility of junior high school students.

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