Development Of An Instrument For Assessment Of Creative Thinking Skills Based On Collaborative Problem Based Learning

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Abstract.
Learning model Collaborative Problem Based Learning (CPBL) has the potential to improve students' creative thinking skills by providing collaborative learning and students are trained in how to solve problems that are very close to their lives. To find out the students' creative thinking skills, standard, valid, and reliable CPBL- oriented assessment instruments are needed. In connection with the description of the thoughts and research results above, the general objective of this study: to develop an assessment instrument for creative thinking skills and the feasibility of the developed assessment instrument. The validation results show that the creative thinking skills assessment instrument has a score of 3.67-4.00 with a very valid category. The results of the reliability test showed that the instrument for assessing creative thinking skills had a Cronbach's Alpha value of 0.864 in a very strong category.

Keywords : *Creative thinking, collaborative learning, and assessment*

I. INTRODUCTION

The industrial revolution 4.0 has become a major topic and has received attention, both in developed and developing countries. Various sectors in the world have started to respond to this problem, including the education sector. The emergence of the industrial revolution 4.0 brings challenges for students to have learning and innovation skills (Yuberti et al., 2019). Students must have several abilities, including critical thinking skills, problem solving, communication and collaboration skills, creativity, metacognitive, and innovation (Zainudin & Istiyono, 2019).The 21st century skills framework in the cognitive, affective, and social cultural domains (Kang et al., 2012). The cognitive domain is divided into sub domains: the ability to manage information, namely the ability to use tools, resources and inquiry skills through the discovery process; the ability to construct knowledge by processing information, giving reasons, and thinking critically; the ability to use knowledge through analytical processes, assess, evaluate, solve problems; and the ability to solve problems by using metacognitive abilities and creative thinking, so that students are expected to be able and ready to overcome all the problems they face when they enter society.Piaget's cognitive constructivist theory states that students of all ages are actively involved in the process of processing knowledge and constructing their knowledge (Arends, 2012).

Students will have the ability to think critically, solve problems by starting in collaboration then students will be able to solve their own problems. The social constructivist view by Vygotsky states that interactions with other individuals can construct a shared understanding that cannot be built personally (Mayer & Moreno, 2010). Critical thinking, problem solving, collaborative developed by integrating Problem Based Learning (PBL) and models Collaborative Learning. PBL is used in an effort to hone the ability to investigate and have critical thinking, problem solving, and social skills in accordance with adult behavior, abilities independence (Skinner et al., 2015). Model collaborative problem based learning aims to solve problems collaboratively.Collaborative problem solving activities can be successful if there is interaction between group members (Hesse et al., 2015). The results of the research above show that innovation is still needed in the PBL model and CL model which are specifically developed to improve critical thinking, problem solving and collaborative skills. CPBL is used to improve students' creative thinking and metacognitive abilities as follows.

1. Students have creative thinking through observing, analyzing, providing problem solving in real life and being creative in responding to all problems. Creative thinking skills are a stage in obtaining information by solving problems collaboratively (Brown & Walter, 2005). The ability to think creatively focuses on learning activities by involving several activities, analyzing, synthesizing, making conjectures, making something new, and implementing the information obtained in real terms. Students can develop creative ideas, appreciate various products of imagination, and see mistakes as a process towards success in learning (Blascova, 2014).
2. Students are able to collaborate in a team with peers to solve problems. Collaborative is an approach by combining cognitive and social abilities in problem solving through teamwork (Griffin et al., 2015). Collaborative can foster the ability to collaborate in solving problems. Social ability is a person's ability to share tasks in solving problems (Mercier & Higgins, 2014).
3. Students have the ability to solve problems that occur in their environment by conducting investigations. Problem solving is a planned process with the following steps: understanding the problem, identifying the characteristics of the problem, determining hypotheses to solve the problem, testing different hypotheses, and selecting appropriate alternatives (Mayer & Moreno, 2010).

Creative thinking is a skill possessed by someone in seeing problems from new perspectives and different points of view (Fardah, 2012). Someone who is able to think creatively, is able to find new ways and solve problems encountered in new ways and not imitate 100% on existing terms. However, being able to modify and develop existing methods to be more efficient and effective. One form of creative thinking can be used in learning related to chemistry, especially those that discuss various kinds of compounds. One of the chemistry lessons that can use creative thinking methods is when learning with compound material produced in the manufacture of plastics.The process of making plastic requires the help of alkene compounds (Chandra, 2015). Plastics are goods and products that are found in the environment. Techniques that can be used in their learning, students are given questions about how the process of making plastics through alkene compounds and what types of compounds are needed in making plastics. Through these problems, students then form small groups which are coordinated by the group leader. The main task of the group leader is to guide and coordinate the discussion among the group.

All students from the group were given the opportunity to convey their arguments and opinions about making plastic using alkene compounds.The conclusions obtained in the group discussion resulted, in the manufacture of plastics which focus on making use of alkene compounds requires three types of alkene compounds. The first is ethylene which functions as a raw material for making polyethylene, the second requires propene to make polypropene, which is a polymer so it is formed to make synthetic fibers and the third requires butadiene compounds which function as forming pure polybutadiene which is sticky and weak (Coll & Taylor, 2002). These three compounds which are types of alkenes are needed in the process of forming plastics. The problems presented by lecturers to students regarding the stages of making plastic using alkene compounds are problems obtained from the surrounding environment.The formulation of problems that utilize chemical reactions is not limited to the material presented by the lecturer, but students can propose about objects around them and examine the stages and processes of their formation through chemical reactions. Such as the manufacture of cement, manufacture of drugs such as paracetamol and so on (Tyas, 2017).Creativity has four dimensions, namely the ability to generate a large number of ideas or problem solutions (fluency), the number of different categories of relevant responses (flexibility), the ability to generate new ideas and original (originality), and provide detailed and systematic responses (elaboration) (Cohen & Ambrose, 1999).

In detail it can be explained as follows (Torrance, 1995):

1. Fluency, relates to the continuity of ideas, links between knowledge, and the use of basic and universal knowledge, writes down what is known, writes down what is asked, and writes sketches of problems.
2. Flexibility, associated with various kinds of ideas, to solve a problem in various ways, and produce various kinds of solutions, able to provide various interpretations of an image, story, or problem.

3. Novelty, characterized by a new and unique way of thinking resulting from mental or artistic activity, capable of generating different solutions/ideas.
4. Elaboration, refers to the ability to describe, explain, and generalize ideas, checking the correctness of the results at every step that has been taken.

The ability to think creatively is characterized by 4 dimensions. First fluency, second flexibility, third novelty, and the last elaboration (Warsono, 2017). These four stages of creative thinking can be used in chemistry learning.

Creativity is a process of sensitivity to problems, identifying problems, formulating hypotheses, testing hypotheses, possibly modifying and retesting hypotheses, and communicating the results (Torrance, 1995).Students try to engage in every stage of creativity when they feel some lack or discrepancy, tension or stimulation. Habit to avoid the usual solutions by investigating, diagnosing, manipulating, making guesses and testing guesses, modifying and retesting until the desired solution is found. Creativity is the process of placing elements together to form a coherent or functional unit, namely the reorganization of elements into a new pattern/structure (Krathwohl, 2002).Learning model Collaborative Problem Based Learning (CPBL) has the potential to improve students' creative thinking skills by providing collaborative learning and students are trained in how to solve problems that are very close to their lives. To find out the students' creative thinking skills, standard, valid, and reliable CPBL-oriented assessment instruments are needed.In connection with the description of the thoughts and research results above, the general objectives of this research are: to develop an assessment instrument for creative thinking skills and the feasibility of the developed assessment instrument. The general research objectives above are broken down into several specific objectives, namely:

1. To determine the validity of the developed creative thinking skills assessment instrument
2. To determine the reliability of the developed creative thinking skill assessment instrument

II. DESIGN/METHODOLOGY/APPROACH

This study was designed with a research design Research and Development (R&D). The research steps used are in accordance with the workflow in the 4-D (Four D) development method. This model was developed by S. Thagarajan, Dorothy S. Semmel, and Melvyn I. Semmel. The 4-D model consists of four main stages, namely: 1) define (definition), 2) design (planning), 3) develop(development), and 4) disseminate (spread). In this study using the 4-D model, but only up to the third stage, namely stage develop (development).

The flowchart of the research to be carried out is depicted in Figure 2 below.

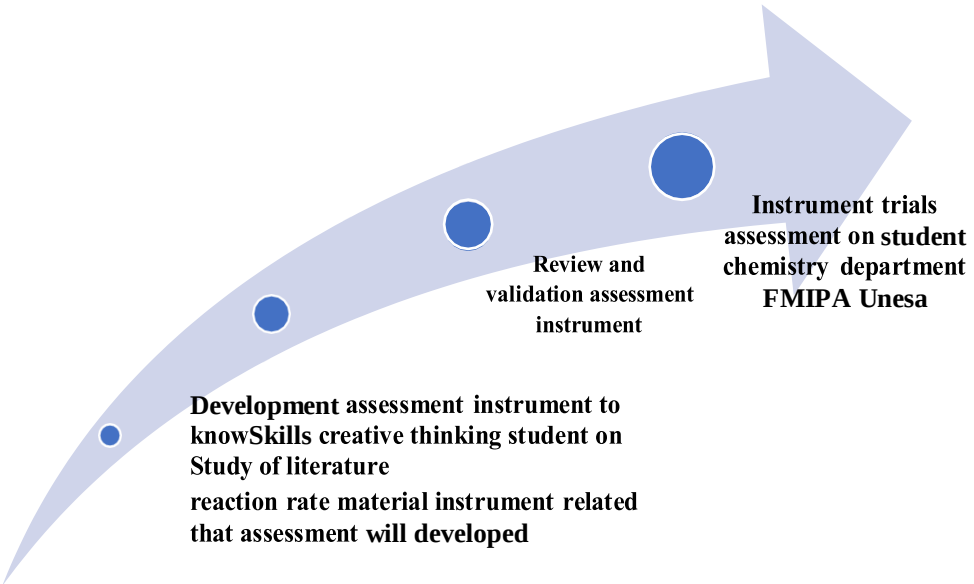

Fig 2. Research Flowchart

The method of data analysis is carried out according to the data obtained and adjusted to the needs to answer the problem formulation and research objectives. the validity of the assessment instrument developed is based on content and construct validity by converting the score to the score given by the validator on the

learning device developed. The scores obtained are converted in percentage form and interpreted according to the following criteria:

Percentage	*Score*
0 – 20	Invalid
21–40	Invalid
41–60	Valid Enough
61–80	Valid
81–100	Very Valid

Table 1. Interpretation of Scores for Validity [21] (Akdon, 2012)

After being tested on students, the reliability of the assessment instrument will be calculated in the form of a description using the Cronbach-Alpha test with the formula (Sugiyono, 2018) :

$$r_{11} = \frac{n}{n-1}\left(1 - \frac{\sum_{i=1}^{n} s_i^2}{s_t^2}\right)$$

where:

r11 is the reliability coefficient

n is the number of items

s_i^2 is the variance of the score of item i

s_t^2 is the total score variance

After obtaining the price rcount, then to ascertain whether the instrument is reliable or not, the price is consulted with the price rtablefor an error rate of 5% or 1%, it can be concluded that the instrument is reliable and can be used for research. To interpret the level of reliability of the instrument, as follows (Akdon, 2012):

The magnitude of r	*Interpretation*
0.80-1.00	Very strong
0.60-0.79	strong
0.40-0.59	Strong enough
0.20-0.39	weak
0.00-0.19	Very weak

Table 2. Interpretation of the value of r

III. RESULT

The stages of this research are 1) define (definition), 2) design (planning), 3) develop (development), and 4) disseminate (deployment).For stagedefine, a needs analysis is carried out related to creative skills for students majoring in chemistry and will later be implementedcollaborative problem based learning and also the applicable curriculum in the chemistry department, especially in general chemistry courses. for stagedesign, the design of creative thinking skills instruments is carried out according to the material on the rate of reaction and the characteristics of students majoring in chemistry. for stagedevelop, a process of review and validation as well as testing was carried out on the creative thinking assessment instrument. for stagedisseminatenot carried out in this study.Sheets for review, validation, and the resulting creative thinking assessment instrument are in the appendix. The results of the validation can be seen in the following table:

No. Question	*Criteria*	*Validation Result Score*			*Average*
		V1	*V2*	*V3*	
1.	a. Suitability question with subs Theory learning	4	4	4	4
	b. Appropriate question with question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	4	4
	g. Sentence use language which is good and true	4	4	4	4
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
2.	a. Suitability question with subs Theory learning	4	4	4	4

	b. Appropriate question with question indicators	4	4	3	3.67
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	3	4	3.67
	g. Sentence use language which is good and true	4	3	4	3.67
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
3.	a. Suitability question with subs Theory learning	4	4	4	4
	b. Appropriate questionwith question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	4	4
	g. Sentence use language which is good and true	4	3	4	3.67
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
4.	a. Suitability question with subs Theory learning	4	4	4	4
	b. Appropriate questionwith question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	3	3.67
	g. Sentence use language which is good and true	4	3	4	3.67
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
5.	a. Suitability questionwith subs Theory learning	4	4	4	4
	b. Appropriate question with question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	4	4
	g. Sentence use language which is good and true	4	3	4	3.67
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
6.	a. Suitability question with subs Theory learning	4	4	4	4
	b. Appropriate question with question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	3	3.67
	g. Sentence use language which is good and true	4	3	4	3.67
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
7.	a. Suitability question with subs Theory learning	4	4	4	4
	b. Appropriate question with question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	4	4
	g. Sentence use language which is good and true	4	3	4	3.67
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
8.	a. Suitability question with subs Theory learning	4	4	4	4
	b. Appropriate question with question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	4	4
	g. Sentence use language which is good and true	4	4	4	4
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
9.	a. Suitability question with subs Theory learning	4	4	4	4
	b. Appropriate question with question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4

	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	4	4
	g. Sentence use language which is good and true	4	3	4	3.67
	h. Arrangement of sentences does not generate double interpretation	4	4	4	4
10.	a. Suitability question with subs Theory learning	4	4	4	4
	b. Appropriate question with question indicators	4	4	4	4
	c. Appropriateness of questions with skills creative thinking	4	4	4	4
	d. Problem reflects tested concept	4	4	4	4
	e. The truth of the concept in question	4	4	4	4
	f. The arrangement of sentences communicative matter	4	4	4	4
	g. Sentence use language which is good and true	4	3	4	4
	h. Arrangement of sentences does not generate double interpretation	3	4	4	4

Table 3. Results of the Validation of the Creative Thinking Assessment Instrument

From the table above, it can be seen that all questions are valid with a range of scores 3.67-4.00. It can be concluded that all questions can be used for limited trials for students majoring in chemistry in the chemistry education study program class of 2021 who have received reaction rate material in general chemistry courses, totaling 74 students in PKA, PKB, and PKU classes.The reliability results of the assessment instrument for creative thinking skills with the Cronbach-Alpha test obtained a result of 0.864 with a very strong category. Details regarding this test can be seen in the appendix. From the validity and reliability it can be seen that the instrument is appropriate to be used to assess creative thinking skills in the reaction rate material for students who have received general chemistry courses.Instruments for creative thinking skills are very important for students because they are able to know broadly the techniques of creating ideas and know how to recognize failure and distinguish between failure and difficulty in overcoming something. This ability is one of the skills desired by the world of work. The ability to think creatively also determines the superiority of a nation. The competitive power of a nation is largely determined by the creativity of its human resources

IV. CONCLUSIONS

The conclusion obtained is that the instrument for assessing creative thinking skills on the material on the rate of reaction can be used as a measuring tool in collaborative problem-based learning models in the Chemistry Department of FMIPA Unesa.

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