The Effectiveness Of C-R-E-A-T-E Model Through TCOF in Making Natural Voltaic Cell to Build High School Students' Creativity

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Abstract. In recent, research about students' creativity is still being developed because students' creativity is a part of 21st century skills. Connecting-Restructuring-Elaborating-Applying-Tasking-Evaluating (C-R-E-A-T-E) model is an alternative model to build students' creativity. The implementation of the model has been done in SMA Labschool UPI toward 20 students as the subject of this research. The method of this research is descriptive study. The instrument used is Teaching for Creativity Observation Form (TCOF). The result of this research is that the implementation of C-R-E-A-T-E model through TCOF is effective with 'very good' category.

Keywords: C-R-E-A-T-E model, Students' Creativity, TCOF, Voltaic Cell

1 Introduction

Creativity is one of the key items for the elevation of international competitiveness [1]. However, when schools arrange for the transmission of knowledge about creativity, they generally convey such course content as "knowledge", and generally do not allow students to personally experience the creative process and discovery [2]. If students can experience and sense creativity, it would provide a key to inspiring personal creativity. Creativity could be enhanced through actual activities of creative thinking and actions, if creative thinking capabilities could be incorporated into courses, students could form and develop creative ideas and increase their imagination, allowing them to see problems from other perspectives and to cultivate problem-solving ability [3].

The character inclinations of creative behaviour include adventurousness, accepting of challenge, curiosity, imagination, and independent autonomy. The traits of a creator include autonomy, self-confidence, and tolerance of differences between oneself and others [4]. Students with high creativity show perseverance when encountering obstacles, are willing to take reasonable risks, are willing to grow, can tolerate un- clear situations, can accept new experiences, and have self-confidence [5]. When an individual emphasizes new concepts, he would express better creativity. Furthermore, creators must be adventurous and possess independent determination, their own views, a per-

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sonal style, high confidence, and perseverance. Thus, this study summarizes the indicators of creativity character traits as follows: 1) accepting of independent challenge; 2) proactivity; 3) originality; 4) high capability; 5) imagination; 6) seeking knowledge; 7) adaptability; and 8) associative ability.

Conditioning so that students can have a creative character can only be done through scientific work during the learning process. Thus, there is self-habituation in students to always be scientific which is allegedly able to form a strong character [6]. A systematic learning model can lead learning activities more directed. This learning model has a very important impact in facilitating students to develop Three Key Skills during the learning process [7]. Research on the application of learning models to build students' Three Key Skills has been developed. Learning models that have been developed include problem-based learning [8-13] and project-based learning [14-16]. Based on the results of this study, it turns out that the development of a learning model that requires student activity through problems and project assignments has a very positive effect on student creativity.

Project assignments can be facilitated through student worksheets which are arranged in a directed and systematic manner [15]. The direction and systematics in student worksheets are sequential, starting with the stage of connecting thoughts with facts (Connecting), building knowledge (Restructuring), elaborating (Elaborating), applying (Applying), giving project tasks (Tasking), and making decisions based on evaluation results (Evaluating), which was later shortened to CREATE or CREATE Model. The C-R-E-A-T-E model is basically a project-based model, according to the opinion referring to the philosophy of constructivism so that learning developed is student centred [16]. Project-based models also receive theoretical support from Vygotsky's social constructivism, which provides a basis for cognitive development through increasing the intensity of interpersonal interactions [17-20]. Based on the results of review of the C-R-E-A-T-E Model as a project-based model, several characteristics are stated, namely: (1) Focus on problems for mastery of important concepts in lessons; (2) Project development involves students in carrying out constructive investigations; (3) Projects must be realistic, and (4) Projects are planned by students [21].

The development of creativity using the C-R-E-A-T-E Model can be done through the making of a chemistry learning design with product of project made from blended-learning. Through efforts to design blended-learning chemistry learning, often related to the manufacture of home-based laboratory equipment, three key skills (Three Key Skills) can be built, namely: Investigating Skills, problem solving skills (Problem). Solving Skills) and creating skills.

2 Method

The method used in this research is Design-based Research (DBR). This method is generally used in learning studies [22]. The DBR method will be taken through 4 stages adapted from Reeves [23], namely (1) problem identification; (2) program development; (3) program trials, and (4) reflection on program implementation.

The instruments used in this study include: Feasibility Test Format of Model C-R-E-A-T-E based on TCOF This feasibility test format is used to test the suitability of Model C-R-E-A-T-E in building student creativity based on TCOF; Implementation Observation Format Model C-R-E-A-T-E; Student Activity Observation Format during Learning; Format for Assessment of the Quality of Creative Works Made by Students is used to assess the quality of creative works made from around.

3 Result and Discussion

There were four indicators of TCOF (Teaching for Creativity Observation Form) that were used to observe the implementation of the C-R-E-A-T-E learning model whether it built pupils' creativity or not. The implementation of the C-R-E-A-T-E model in building student creativity is seen from the results of observations on the syntax of learning activities. The observed aspects include connecting, restructuring, elaborating, applying, and tasking. Observational data can be seen in Fig. 1.

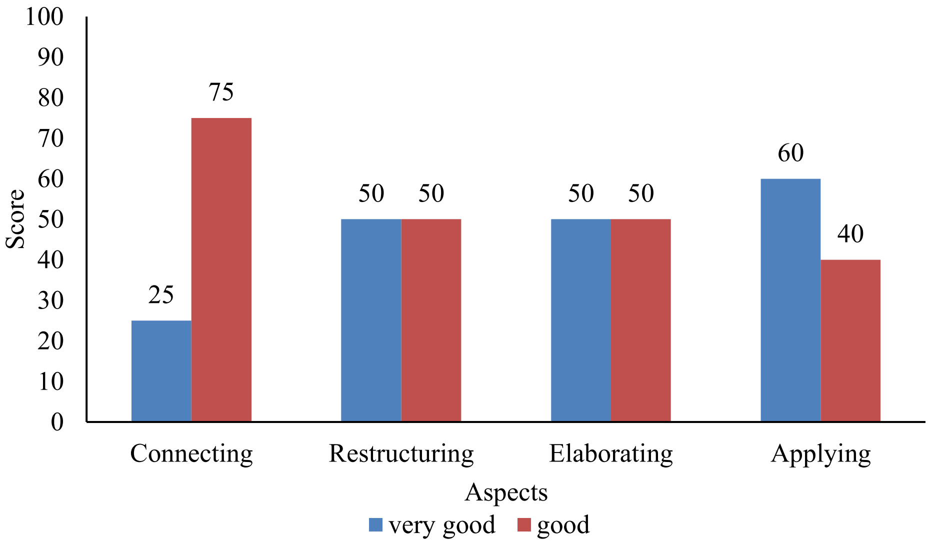

Fig. 1. The results of observations on the syntax of learning activities

Based on observational data, it was revealed that students' creativity could be built well. However, in the Connecting Stage, the lowest percentage of Very good was obtained (25%) and the highest percentage of Very Good was at the Applying Stage (100%).

There are several factors that cause the lowest percentage of connecting stage. Connecting stage is ability to link prior knowledge with creative ideas smoothly (Fluency). Students still have low metacognitive knowledge, so they are less able to link between initial knowledge and the emergence of creative ideas. This metacognitive ability occurs at a higher level of abstraction. It also results in efficiency in thinking and learning. Conceptualization at a higher level of abstraction broadens the scope of application and transfer of ideas and understanding. abilities that affect these connecting skills, can be caused by lack of understanding of the goals and objectives to be achieved, fear of doing wrong, fear of kriticism, homeostasis, not thinking proactively, and always rationalize circumstances.

Metacognitive knowledge needed to get used to designing creative works so that teachers need help in directing them. The learning strategy that can be done by the teacher is to provide directed and guide/probing questions to all students. The addition providing stimulus in the form of narrative information related to the concepts that students already have and the products to be produced. This treatment is expected to improve students' ability to express and connect their concepts with what will be done.

The stage restructuring is providing several alternative solutions flexibly (Flexibility) and elaborating the linkage of ideas with several alternative solutions (Elaboration) get an observation value of 75% categorized as good. the success of the teacher in providing opportunities for students to express concepts related to the problems at hand, reducing the barriers for students to express their opinions. This condition resulted in the restructuring stage getting a good category score.

The appliying stage is designing products with existing materials that are different from existing materials (Originality), get an observation value of 100% categorized as very good. The ability of students to restructure and elaborate ideas stronger, making a strong capital for students in designing products that are different from the product information they have received. Based on these data it can be stated that the C-R-E-A-T-E learning model can increase students' creativity.

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There were three indicators of TCOF that were used to observe the product of the C-R-E-A-T-E learning model whether it built pupils' creativity. Through efforts to design blended-learning chemistry learning, often related to the manufacture of home-based laboratory equipment, three key skills (Three Key Skills) can be built, namely: Investigating Skills, problem solving skills (Problem). Solving Skills) and creating skills.

Table 1. Assessment of the Quality of Creative Work

No.	Creative Work Quality Parameters	Rated aspect	Deskriptor	Average (%)
1	Creating Skills	Fluency	Creative work can make it easier to expedite the resolution of existing problems	90
		Flexibility	Creative works are easy to carry, can be used anytime and anywhere	85
		Originality	Creative work has its own uniqueness, something new, and different from others.	80
		Elaboration	Creative work is the result of developing ideas from works that have existed before through the results of in-depth discussions and discussions in accordance with related chemical concepts.	95
		Evaluation	Creative works have several advantages, including materials that are available in everyday life, are cheap and easy to obtain, and are not complicated to handle.	95
	Average Creating Skills Score			89

No.	Creative Work Quality Parameters	Rated aspect	Deskriptor	Average (%)
2	Investigating Skills		Creative work can be used in the investigation process in the environment around students,	92
3	Problem Solving Skills		Creative work can be a solution to the teachers problems.	80
Average Three Key Skills Score (%)				87

Based on Table 1. data, it is illustrated that the overall average score of the quality parameters of students' creative work is 87%. This shows that the creative work made by students is categorized as very good. This data shows that the implementation of the C-R-E-AT-E Model is very effective in building students' creativity.

The lowest percentage average score is originality aspect and problem-solving skills, which is 80%. Originality is the quality or state of being original, freshness of aspect, design, or style, the power of independent thought or constructive imagination. Originality is the quality of being new and inventive, it is creative and not derived from something else. In the aspect of originality, this category includes the ability of students to identify information, see the relationship between information, build ideas or models, and solve unique problems. It is difficult to find the originality of an idea unless the idea is a fresh idea and has undergone modification or development from other people's ideas. Originality can be born if someone has high literacy and experience in terms of psychomotor. Based on the description, it shows that it is difficult to produce originality from a product. Especially it is related to the low experience of students to explore reading sources and exercises that improve skills in all three skill domains.

Problem solving skill are the ability to identify problems, brainstorm and analyze answers, and implement the best solutions. In the learning process problem solving ability is how the students' creative product can help in increasing understanding of the concepts being studied and can be a solution to the teachers' problems. Problem solving is the highest skill that requires continuous training. The ability to integrate various aspects of the skills possessed by students is a step that must be done. the low level of this treatment, which is estimated to have not been maximal in the problem skills built in this study.

4 Conclusion

Based on the research results it can be concluded that the implementation of the C-R-E-A-T-E Model in building student creativity was carried out in a very good category. The quality of a student's creative work product is generally categorized as very good.

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