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Colloidal Learning Design using Radec Model with Stem Approach Based Google Classroom to Develop Student Creativity

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A B S T R A C T

This study aimed to examine the feasibility of a RADEC model of colloidal learning design using the STEM approach based on Google classroom to increase student creativity. The method used was descriptive research. This study involved two experts, one teacher, and three high school students in Class XI. Data was collected through an internal feasibility test, the suitability of the creativity sub-indicator with learning activities, and an external feasibility test carried out with a limited test to 3 high school students. The results showed that the learning design uses the RADEC model with a STEM approach based on Google Classroom that deserved to be used to increase student creativity. From this research it is concluded that this learning design can be used to increase student creativity.

1. Introduction

Wahyu (2015) emphasized that one of the mentalities which must be addressed immediately is creativity. Education does not only focus on aspects of knowledge but also the skills that must be possessed by students, including creativity skills (Shulman, 1987). Amabile (2012) explains that creativity is a comprehensive model of the social and psychological components required for a person to produce creative work. The importance of creativity is stated in Law No. 20 of 2003 concerning the National Education System, which points to the mandate that through education, it is expected that the potential of students can be developed to become creative people.

The curriculum applied in Indonesia today is the 2013 Curriculum, which is designed to develop a balance between the development of spiritual and social attitudes, curiosity, creativity, and collaboration with intellectual and psychomotor abilities. This curriculum was also supported by Regulation of the Minister of Education and Culture of the Republic of Indonesia No.81 A of 2013 concerning

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the Implementation of the 2013 Curriculum (Kemendikbud, 2013). One of the implementations is to develop creativity by considering the moral and values of Pancasila and live in a society (Kemendikbud, 2013).

In the 21st Century, learning media in schools are required to use the latest technology or commonly known as ICT learning media. Law et al. (2008) showed that teachers, principals, and the community tended to have positive attitudes towards the use of ICT in their schools. Therefore, an application named "Google Classroom" as a tool for teachers to create and share every assignment to the students paperless and indirectly supports the "Go Green" movement. Relevant research on Google Classroom shows that students and teachers can use Google Classroom easily and improve student learning outcomes (Afrianti, 2018).

The success of increasing students' creativity is also affected by the ability of a teacher to design learning. Despite having adequate educational qualifications, Law No. 14 of 2015 confirms that professional teachers have four basic professional competencies: pedagogical competence, personality competence, professional competence, and social competence. Pedagogical competence, in this case, is the ability to manage the learning of students.

Various innovative learning models have been created to meet the challenges of the 21st Century in increasing student creativity, such as the inquiry learning model, Project Based Learning (PjBL), and problem-based learning (PBL). According to Sopandi (2019), in the Indonesian context, the innovative learning model did not necessarily improve the quality of Indonesia's education. This learning model is most likely to occur because teachers in the field have problems in implementing these innovative learning models; hence, there are problems in educational practices in Indonesia. Sopandi (2019) adds that the difficulties of teachers in Indonesia to organize learning following the demands of the times are required to provide alternative solutions by developing a learning model that is suitable to the Indonesian context. The learning model is the Read-Answer-Discuss-Explain-And Create learning model, abbreviated as RADEC.

This research also uses the approach of Science, Technology, Engineering, and Mathematics (STEM). The STEM approach refers to integrating technological design concepts with science and mathematics concepts in learning. Quang et al. (2015) state that learning with the STEM approach provides students experiential learning, active, and meaningful learning. Becker and Park (2011) state that the STEM approach offers a positive influence on student learning. The purpose of STEM in the world of education is in line with the demands of 21st-century education, which make students have scientific and technological literacy from reading, writing, observing, doing science, and develop their skills in dealing with problems in daily life, related to STEM science (Bybee, 2013; National STEM Education Center, 2014).

Colloid topics, including understanding, character, role, and making colloid are more accustomed to memorization by students. When the students encounter a natural event related to colloids, students do not realize that they are part of colloids. This can be demonstrated by a variety of student learning handbooks that only present colloidal topics as a collection of concepts students must master. Besides, students still have weaknesses in drawing conclusions from facts given related to colloidal topics. The difficulty of students understanding the topic of colloids in school is alleged because the design used in learning has focused more on completeness of subject matter.

Based on this, this study was conducted to examine the feasibility of a RADEC model of colloidal learning design with the STEM approach based on Google classroom to improve student creativity.

2. Methodology

The methodology used in this study was descriptive research. Descriptive research is defined as research that does not aim at examining hypotheses, but only explains the actual state of variables in the field (Arikunto, 2007). According to Noor (2016), descriptive research has specific steps in its implementation, namely: beginning with a problem, determining the type of information needed, determining data collection procedures, determining information processing procedures or data and drawing research conclusions.

The study involved some participants in answering research questions. The feasibility test of the design of the colloidal learning involved two experts and one senior teacher for the internal feasibility test. Three Class XI high school students whose locations were close together (due to being in a pandemic corona outbreak condition) were involved for an external feasibility test. Eligibility criteria were assessed using eligibility criteria according to Wiersma and Jurs (2009), which were then processed into scores and interpreted using score interpretations, according to Riduwan (2015).

The instrument used in this study was the feasibility test of colloidal learning design that would obtain data on the suitability of the creativity sub-indicator with learning activities. Creativity indicators used were Williams' indicators of creativity (Munandar, 1992) consisted of fluency, flexibility, originality, elaboration, and evaluation.

3. Results and Discussion

Colloidal learning design using radec model with STEM approach based google classroom followed the syntax of the RADEC model (Read, Answer, Discuss, Explain, and Create) with the STEM approach based on Google Classroom. The findings obtained from each stage in the RADEC model were shown in table 1.

Table 1. Findings in Each Stage of the RADEC Model

Steps	Findings
Read	Students read at home on colloidal topics from various literacy sources. These sources made learning more effective because students coming to virtual classes already had information / prior knowledge.
Answer	Students answered various questions in LKS 1 that had been uploaded in google classroom. At this stage, students responded to questions individually to train their responsibility and encourage their enthusiasm to learn colloidal topics. In addition, the teacher was also increasingly facilitated because, at this stage, students would list the problems encountered regarding colloid topics.
Discuss	Students discussed in a virtual classroom to equalize the perceptions and answered to the questions in LKS-1. Students in groups shared their answers and arguments; then, they determined one answer to each question as to the group's answer.
Explain	Students in the explain stage were very enthusiastic. They delivered and explained group answers. At this stage, it required more time than the discussion stage, despite giving answers, students also practiced to explore themselves and speak in public.
Create	Students made a colloidal topic project design, where they were making nature watercolors. Students exchanged their ideas to determine tools, materials, steps, and time to work. Upon having an agreed project design, students uploaded it to Google Classroom.

Table 1. showed that the RADEC model colloidal learning design with the STEM approach based on Google Classroom consisted of 5 stages; some documentation of student learning activities was shown in Figure 1.

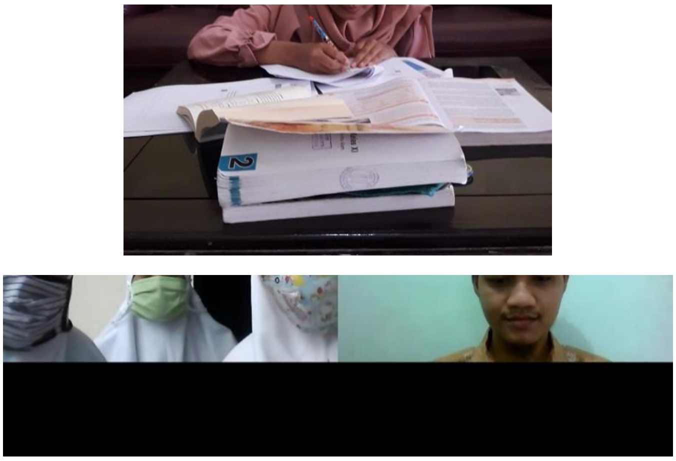

Figure 1. Student Learning Activities at Home in the Read and Answer Stages (above). Student Learning Activities in Virtual Classrooms at the Discuss, Explain, and Create Stages (below).

Figure 1 shows that learning activities in the five stages of the RADEC model were active learning that encouraged students to understand colloid topics more quickly. The display of students collecting assignments in google classroom is in Figure 2.

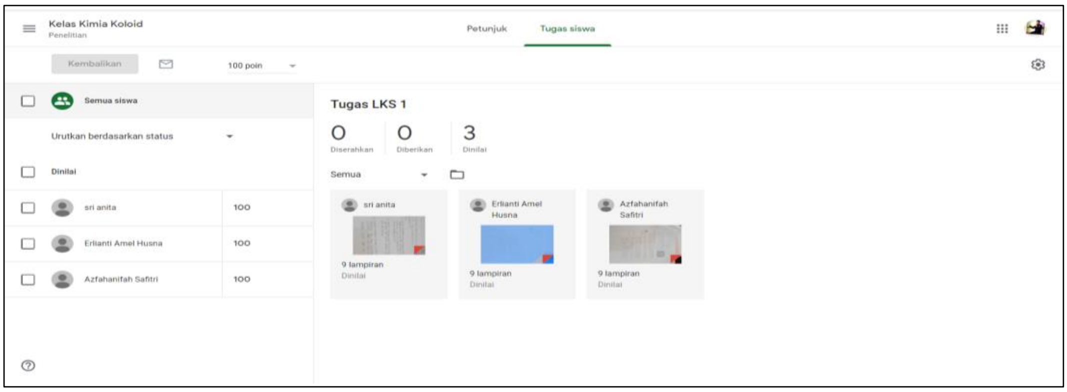

Figure 2. Display Task Collection in Google Classroom.

Indicators of creativity used in this study were Williams' indicators, which consisted of fluency, flexibility, originality, elaboration, and evaluation. The results of the due diligence by experts and teachers on the compatibility of learning activities with Williams's creativity sub-indicators are shown in Table 2.

Table 2. The Suitability of Learning Activities with Williams's Creativity Sub-Indicators

RADEC Learning Model Stage	Learning Activities	Creativity Sub Indicators	Score
Read	Students marked problems found in colloidal material	Thinking about issues that nobody else could think of *(Originality)*	91.6%
Answer	Students answered the *pre-learning* questions on LKS-1	Solving with several answers if there were questions (*Fluency)*	100%
Discuss	Students could communicate with a group of friends about the answers from *pre-learning* queries and the problems received in colloidal material.	Giving various interpretations of an image, story, or problem *(Flexibility)*	100%
Explain	The teacher allowed the group to communicate the results of the discussion of both answers to pre-launching and difficulties found in the zoom application.	Fluently expressing their ideas *(Fluency)*	91.6%
Create	Each group discussed determining the project to be made in making watercolors with natural ingredients, as well as filling out the stage 1 in LKS-2 (project design stage)	Developing or enriching other people's ideas. *(Elaboration)*	91.6%
	Students wrote down each group member's idea, make a schedule for the project to make watercolors made from natural materials in groups and the results of joint decisions.	Designing a work plan of triggered ideas *(Evaluation)*	83.3%
	Students chose and counted the materials needed for the project to make natural watercolors. Each group decided different material from the other groups.	Choosing another method than the others *(Originality)*	91.6%

In Table 2, the Answer and Discuss stages got the highest average score among the other RADEC stages, which was 100%. According to Riduwan's (2015) interpretation, it was categorized as very strong. Meanwhile, in the Create stage, the lowest average score was 83.3%, which, according to Riduwan's interpretation (2015), was categorized as Very Strong. Students in the Answer stage answered various questions in LKS-1 with several answers, thereby increasing student creativity in answering questions. Student learning activities at the Answer stage, which were done at their homes, will then be discussed in learning activities in virtual classrooms at the Discuss stage. This result showed a very carefully relatedness of student learning activities in the Answer and Discuss stages, making it easier for students to understand colloidal topics and increase student creativity. Documentation of student answers in the Answer and Discuss stages can be seen in Figure 3.

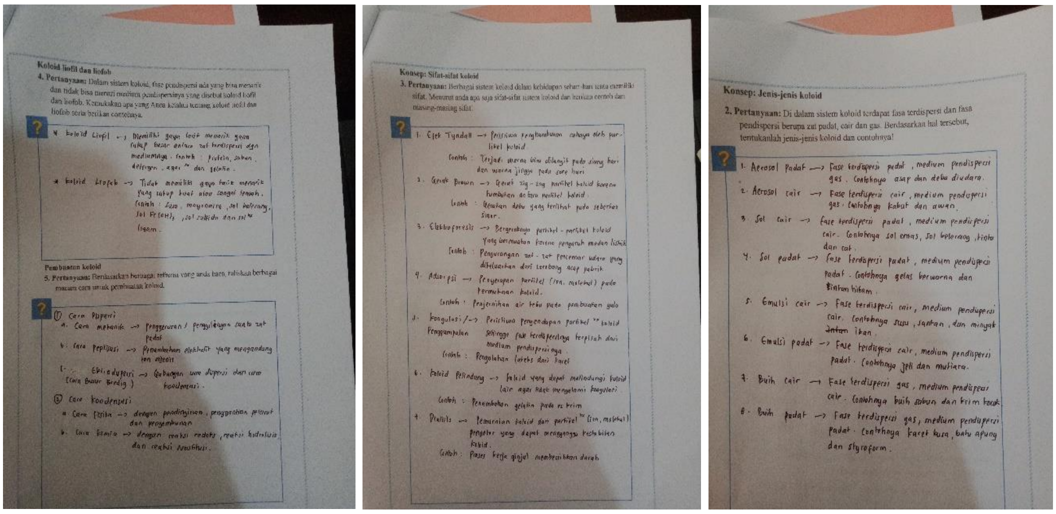

Figure 3. Documentation of student responses in the *Answer* and *Discuss* stages

Students in the Create stage discussed what materials and tools could be used to make natural-based paints. At this stage, according to the senior teachers, learning activities and sub-indicators of creativity was not appropriate. At this stage, students should not only write group members' ideas but also design and formulating work on projects to make natural watercolors. The improvement at this stage was that the students' activities at the create stage not only write ideas but design and formulate project work and timelines for making natural watercolors.

At the *Create* stage, students succeeded in making a project design to make watercolors from natural water, which will then be done at home. Documentation of students' creative work is shown in Figure 4.

Figure 4. Documentation of Students' Creative Work in Making Nature Paint

Based on Table 2, the obtained score overall average the suitability of learning activities with Williams' sub-indicators of creativity was 92.8%, where according to Riduwan (2015)'s interpretation was categorized as Very Strong. The results of an internal feasibility test by two experts and one senior teacher, as well as an external feasibility test involving three high school students in Class XI, showed that the RADEC model colloidal learning design with the STEM approach was based on *Google classroom* could improve student creativity.

4. Conclusion

Based on the results of the analysis and discussion, it can be concluded that the colloidal learning design of the RADEC model with the STEM approach based on Google Classroom is suitable to increase student creativity. The suitability of this learning design can be seen from the overall average score of each stage of the RADEC model which is categorized as very suitable.

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