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Polymer learning design using Read, Answer, Discuss, Explain and Create (RADEC) model based on Google Classroom to develop student's mastery of concepts

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Abstract. Polymer is topic of chemistry which full of the concept and the application polymer is often found in everyday life. But based on the results of a survey with Chemistry teachers from different provinces, student's mastery of concepts polymer is low level of concept mastery. Most of the teachers ignored the development student's mastery of concepts polymer. This study aims to obtain a polymer learning design using the RADEC model based on google classroom to develop student's mastery of concepts. The researcher used the Greivemeijer & Cobb Design-Based Research (DBR) research method consisting of 3 stages: Preliminary Design, Design Experiment and Retrospective Analysis. Participants in this study were senior high school students, Chemistry teachers and 3 observers who understood the RADEC model. Data collected by interviewing, testing (pre-teaching questions) and observing the activities of teachers and students. The results of the study indicate that the learning design developed by the researcher is valid, accessible and teachable. This is indicated by the results of expert validation and RADEC based on google classroom can develop student's mastery of concepts.

1. Introduction

Until now, research attention to conceptual understanding was very intensively carried out as in several studies Holme, et al [1,2]; Nielsen [3]; Tomaswesky [4]; Widarti, et al [5] and Aubreg [6]. This shows the importance of submitting concepts because students who are considered to have mastered the concept of students who can respond to questions / stimuli that vary in the same group or category [7]. According to Dahar [8] the concept is the basis for higher mental processes to formulate principles and generalizations. Hahn & Ramscar [9] reveal the concept of cognitive elements that help simplify and summarize information. Thus, mastery of concepts can produce the level of intelligence of a person with various interests in producing his own ideas. This process is derived from student-centered learning that requires students to be active in understanding concepts.

One of the chemicals that is full of the concept of a low level of concept mastery is polymeric which the application is often found in everyday life. We will find it hard to imagine life without polymers, both natural without synthetics. Despite the direct application of these chemicals to their lives, students have little knowledge or understanding of this important composition category. For example, most students will not like paper in their printed books are cellulose, polymer [10]. This explains how the very low concept of polymers is mastered by students. This is convincing with the results of a survey of researchers with several teachers in Indonesia who acknowledged the low mastery of students' concepts on the topic of polymers.

Teacher's learning still tends to be conventional, namely learning that is still teacher-centered where lectures are the mainstay method throughout learning. Students only hear, record and then memorize students. The ability of teachers to design learning is very low. According to Kemp, Morison and Ross, the essence of learning design refers to four core components, namely students, learning objectives, methods and evaluation [11]. Reiser [11] added that learning design takes the form of a series of procedures as a system for developing educational and training processes consistently and tested. So that designers are required to



make continuous improvements to create conducive learning centered on students to achieve learning goals. Therefore, an education practitioner in Indonesia named Wahyu Sopandi with more than 30 years of experience in education is also called upon to provide solutions in making a student-centered learning model. The model is named RADEC (Read, Answer, Discuss, Explain and Create).

The RADEC model provides opportunities for students to gain direct experience in the learning process. According to Sopandi [12] the stages in the RADEC learning model have five stages, namely: (1) Read, in this step, students read various sources; (2) Answer, students answer pre-teaching questions based on the knowledge obtained in the Read step compiled in the worksheet; (3) Discuss, students learn in groups to discuss their answers from pre-teaching questions, in this way the teacher can also find out groups that already have creative ideas as a form of applying concepts that have been mastered; (4) Explain, the presentation is done and the teacher ensures that what the presenter explains is scientifically correct and other students understand the explanation; (5) Create, teachers inspire students to learn to use the knowledge students have mastered to generate ideas or creative thinking. Thus, students can gain an understanding of their own concepts after going through these five stages. As a result, learning becomes more active and student-centered in accordance with the demands of the curriculum.

The revised curriculum in 2013 has provided creative space for teachers. Teachers can utilize virtual media in developing students' mastery of concepts without space and time constraints. Virtual learning refers to the learning process that occurs in virtual classes that are in cyberspace through Internet networks [13]. One of them is by using the google classroom application. Google classroom can help make it easier for teachers and students to carry out teaching and learning activities because students and teachers can collect assignments, distribute assignments, and discuss lessons anywhere without being bound by class time or time constraints [14]. As a result, learning is more interesting and more efficient in terms of time management. Therefore, the RADEC model is very well combined with google classroom virtual media. The following is the initial view of google classroom at figure 1:



Figure 1. Figure symbol google classroom.

Researches on RADEC can be seen in the research of Lyesmaya, et al. [15], Adi Kuncoro [16], Jumanto [17]; Pratiwi [18]. Based on the research conducted, there are several advantages in the RADEC model, namely: (1) students are motivated to read teaching materials from chemical textbooks even though the material has not been taught because the teacher always gives tests before the lesson begins [12]; (2) the actual level of student development in learning new teaching materials always increases in line with the practice of often reading chemistry textbooks so that students can develop their potential [12]; (3) the

RADEC learning model provides children with opportunities to develop language skills [15]; (4) learning with the RADEC model has a significant effect on improving students' creative thinking skills [17]; (5) the RADEC learning model can improve students' knowledge and understanding [18]. However, RADEC model research combined with google classroom media has never been done. Therefore, researchers are very interested in researching the RADEC model combined with google classroom media. Based on the description described above, the researcher was interested in examining "How does Polymer Learning Design with the Read, Answer, Discuss and Create (RADEC) Model Based on Google Classroom to Develop Students Mastery of Concepts?". The research question is elaborated into the following:

- How student's mastery of concepts through learning with the RADEC-based google classroom model on the topic of polymer?
- How do teachers and students respond after learning with google classroom-based RADEC models on the topic of polymer?

2. Method

The method used in this study is DBR/Design-Based Research (research-based design), because researchers want to put the design process (design) as a strategy to develop mastery of student concepts. DBR is part of qualitative research. According to Plomp [19] DBR is a systematic study of designing, developing and evaluating educational interventions (such as programs, strategies and learning materials, products and systems) as solutions to solving complex problems in educational practice, which also aim to advance our knowledge of characteristics of the intervention as well as the design and development process. Therefore, the DBR study is appropriate in this study. The DBR model in this study is the Greivemeijer & Cobb model. The Greivemeijer & Cobb model consists of 3 stages, preliminary design, design experiment and retrospective analysis [20]. The Greivemeijer & Cobb model can at figure 2 below [21]:

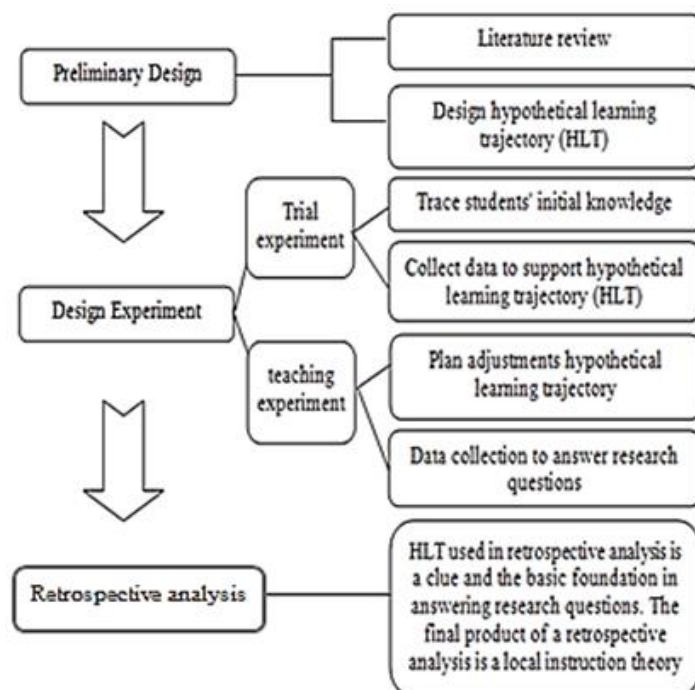


Figure 2. Figure symbol google classroom [21].

Figure 2 shows that the Greivemeijer & Cobb model. The research procedure includes the following stages: (1) Phase I: Preliminary Design (Preliminary Design), review literature related to research, 2013 curriculum analysis revised in 2016, google classroom initial setup, preparation of learning devices and LKS, making instruments and repairing instruments, early Observation of students and teachers to know more about the initial conditions of students and teachers related to mastery of students' concepts before the research is conducted, design along with other chemistry teachers; (2) Stage II: Design Experiment (Implementation) namely : the trial phase of learning design using the RADEC model with google classroom media,

documentation of design implementation; (3) Stage III: Retrospective Analysis (Retrospective Analysis) namely : after the implementation phase activities, all data obtained will be analyzed to obtain a conclusion from the results of this study. Data were analyzed by comparing the designs that had been compiled at the Preliminary Design stage with the Design Experiment stage using test, interview and observation instruments. Participants in this study were 29 students in the senior high schools, chemistry teachers and 3 observers who understood RADEC models. Data collected by interviewing, testing (pre teaching questions) and observing the activities of teachers and students.

3. Results and discussion

3.1. Lesson design polymer and mastery of student's concepts

The entire learning process is arranged in the form of design lessons. Lesson design is the steps chosen by the researcher and anticipation prepared by researchers to overcome misconceptions that occur from polymer concepts and develop mastery of students' concepts. Lesson design polymer at figure 3:

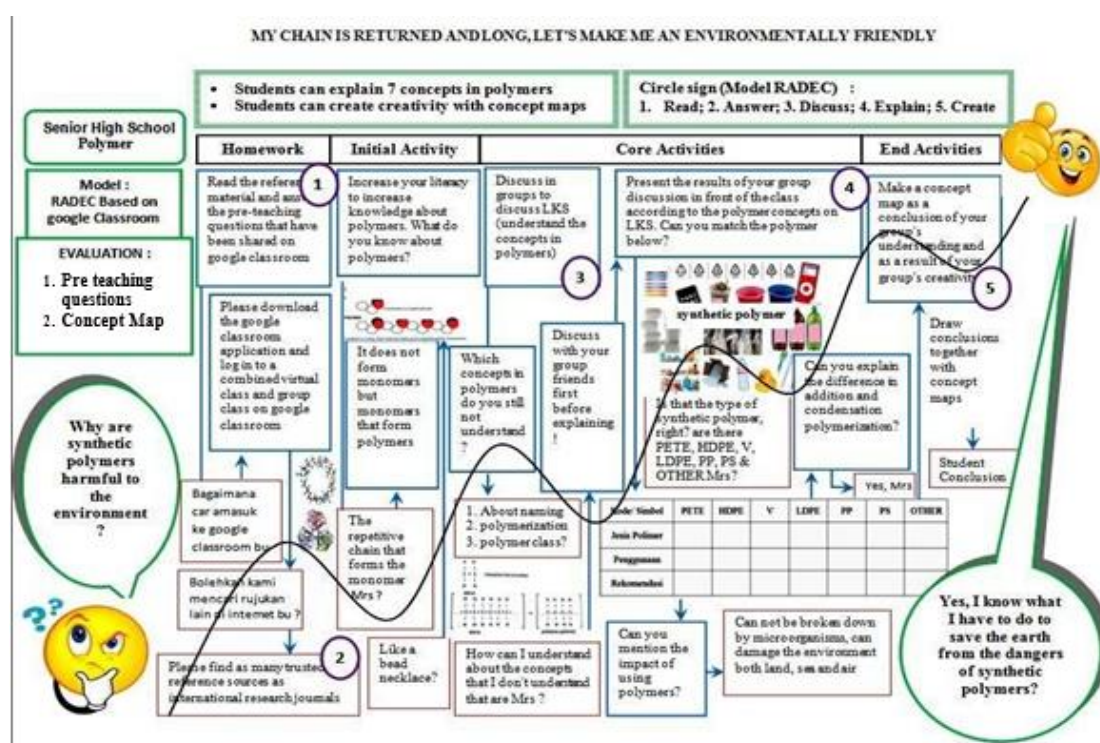


Figure 3. Lesson design polymer.

Figure 3 shows that lesson design consists of five stages in the RADEC model: read and answer (homework), discuss and explain (core activities) and create by creating concept maps (closing activities). In essence, the activities carried out at each stage of the RADEC model based on google classroom greatly facilitate students to understand the concepts in the topic of polymer. The blue box section is the teacher's command or anticipation, while the bottom of the red box is the prediction of the student's response. If many students' responses mean student-centered learning activities. The lower left side is a parable of student expressions before learning with questions. The upper right side is the parable of student expression after learning (after students understand all the concepts in the topic of polymer). Teachers imagine as if they are students to understand the predictions of student confusion when learning. So that it can be concluded that on a piece of paper that describes lesson design, all activities in learning can be described.

The most crucial finding in this study is in terms of time management in the division of each stage of RADEC. In the design above it can be seen that at the read and answer (at home) stage discuss, explain and create (in the class). Please consider the following Table 1 to show the overall findings every stage in RADEC:

Table 1. The most crucial finding every stage in RADEC model.

Stage	Findings
Read (at home)	This is very appropriate and saves time because students have studied the material before learning starting. This means that at the read stage students already recognize the concepts on the topic of polymer by increasing their literacy.
Answer (at home)	When students were answering pre teaching questions, teacher felt easy to teach because teacher didn't start from the beginning when learning starts in the classroom. Students more responsible for their duties and independent (because understanding concepts starting from themselves does not depend on the teacher's explanation alone). Student assignments are collected on Google classroom
Discuss (at classroom)	While in discuss stage, the most crucial finding in the study is very little discussion time if the discussion stage begins in the classroom, so the good learning design for the discuss stage is that discussion should have started on google classroom so that students only stay in class to equating perceptions and answers in groups. It is because the most important stages in the RADEC model are the explain stage.
Explain (at classroom)	This was obtained from the results of interviews with 7 students where they were very enthusiastic at the explain stage. It is because at the explain stage, students scramble to present the results of their discussions and tend not to want to be limited in time to explore their ability to appear in front of the class. At the explain stage, can argue with other groups and be confirmed by the teacher. At the stage of explaining in the RADEC model the learning design should have more time compared to the discussion stage and the create phase. In this stage, students more understand all of concepts in the topic of polymer.
Create (at classroom)	In this stage, students make concept map according student's mastery of concepts and collect in google classroom.

Table 1 shows that lesson design consists of five stages in the RADEC model based on google classroom, it can make it easier for students to understand the concepts of polymers. Student activities in each stage of the RADEC model in figure 4:

**Figure 4.** Student activity in each stage of RADEC model.

Figure 4 shows that five stages in the RADEC model is an active instructional. An active instructional method whereby students are motivated to learn, and gain the knowledge required to meet the expected learning outcomes of the course by addressing various challenges through asking questions and solving problems [22]. Display of google classroom at figure 5:

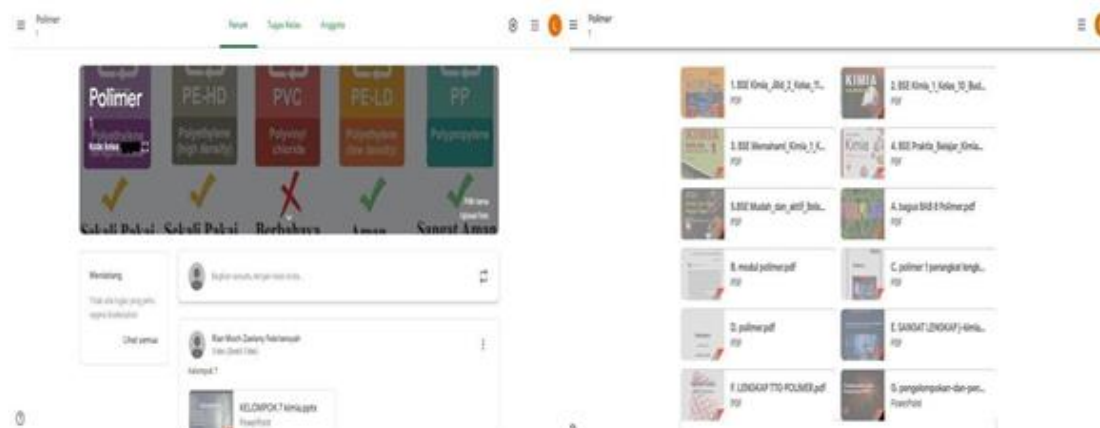


Figure 5. Display of google classroom.

Figure 5 shows display of google classroom on the left. The picture on the right shows the display of teaching materials given by the teacher on Google classroom so students can understand concept of polymer first at home. In the beginning of the RADEC model, at the read stage of the RADEC model, students are given a lot of learning resources for students to read at home.

3.2. Student's mastery of concepts and making concept maps

There are 7 concepts that exist in the topic of polymer, namely: (1) the definition of polymers; (2) polymer structure and nomenclature; (3) polymerization; (4) polymer properties; (5) classification of polymers; (6) the benefits of polymers in everyday life; (7) the impact of using polymers for the environment. Label concepts at figure 6:

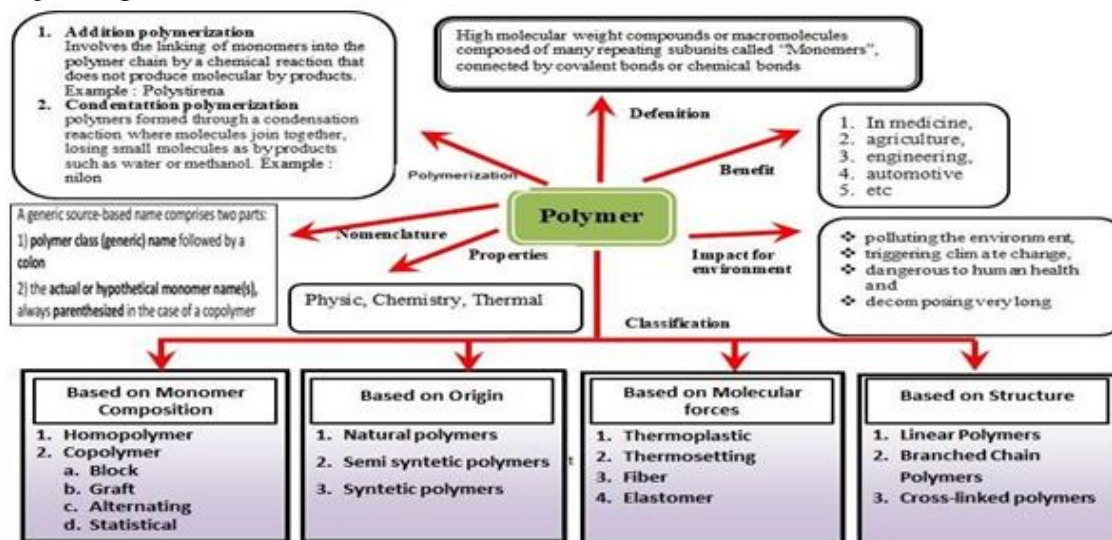


Figure 6. Concept map of polymer.

Figure 6 show concepts Map of polymers. The measurement mastery of concept is done by answers to pre-teaching questions. And obtained a result of research that mastery of student concepts in accordance with predictions in the design of learning. This means that it turns out that students can easily carry out independent learning activities after being given pre-teaching questions and added to the RADEC model there are discussion activities that can provide opportunities for students to further deepen these concepts. Understanding the concept of polymerization is the most difficult concept for some students. But at the explain stage, students are more critical and more interactive than other polymer concepts. There is misconception from students in answer stage of RADEC model but after explain stage, students understand the whole concept of the polymer correctly.

3.3. Teachers and students' responses to the implementation of the RADEC model based on Google Classroom

Response is a reaction to the actions taken, either in the form of impressions or messages. The response can be in the form of positive and negative form in accordance with the perceived by the respondents. At the beginning of using google classroom, students appear confused because they are not familiar and feel difficult to access. Various findings in the field prove that the readiness of students to use their internet package quota for learning is very low. This happens because some students are still difficult to reduce their habit of using internet quota in addition to learning needs such as the use of social media and online games. This is a challenge for researchers to make a transformation of the use of handphone from being used for less useful activities to activities that focus on learning to use virtual media. But along with communicating habits that are often done by researchers on google classroom media. Students can take lessons at each stage of the RADEC model better. This is evidenced by the increasing conversation between students and teachers.

The interview technique was used by researchers with several responses that were representatives of each group. This is done by researchers to identify whether the RADEC model based on google classroom makes it easy for teachers to teach polymer concepts (easy to teach) and makes it easy for students to access google classroom. The interesting thing to find is that there is an increased understanding of polymer concepts with the ease that students use google classroom. In addition, after further tracing the use of this media, it turned out that the use of handphone for learning activities increased compared to before. So, the RADEC model based on google classroom can be accessed by students and teachers who are easy to teach. Students can obtain learning resources that have been designed by the teacher in available internet learning packages. This is reinforced by several studies on google classroom that have been done a lot. Among them are: Mustaniroh [23]; Hammi [24]; Afrianti [25] and Albantani, et al [26]. These studies confirm that google classroom can be used easily by students and teachers and can improve student learning outcomes. The optimal use of google classroom media is done using the RADEC model. The RADEC model and the use of google classroom media are very suitable for developing mastery of student concepts without being constrained by time and place.

4. Conclusion

The results of the study indicate that the learning design developed by the researcher is valid, accessible and teachable. The RADEC model bade on google classroom can develop mastery of student's concepts and very suitable to be taught on the topic of polymers, models and media support each other. This is indicated by the results of expert validation and validation of the results of the trial and can develop mastery of student's concepts.

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