Repackaging RADEC learning model into the online mode in science class

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Abstract. This study aims to formulate the RADEC learning model with full online learning mode in natural science instruction, both through synchronous and asynchronous communications. This research belongs to the type of qualitative description with the participants involved consisting of 20 students and 5 teachers taken based on a purposive sampling technique. The instruments used were a questionnaire and unstructured interviews that were processed with triangulation techniques. The results of this study indicate that 1) At the Read stage the teacher provides opportunities for students to enrich knowledge from various sources through asynchronous communication, 2) At the Answer stage, students also answer pre-learning questions through asynchronous communication, 3) At the Discuss stage, the teacher divides students into small groups. Students discuss pre-learning questions in their groups then answer them through asynchronous communication. Students’ answer is the sources information for the teacher to classify concepts based on difficulty level, 4) At the Explain stage, the teacher is a moderator who gives students opportunities to rebut or support the answers. The teacher also leads students to have scientifically conceptual knowledge with probing questions through synchronous communication, 5) In the Create stage, students agree, realize, and report ideas on the product. They have to present the product through synchronous communication.

1. Introduction

The RADEC learning model (Read-Answer-Discuss-Explain- and Create) is a universal teaching strategy in science learning that can build mastery of student concepts. This learning model initiates students to obtain or master various knowledge through a process of recalling that is based on constructivism theory [1,2]. The pre-learning questions given before class by the teacher are stimulation processes that force students to read and understand the problems presented by the teacher through the questions at the Read stage. The teacher collects and classifies the level of difficulty of the concepts based on students’ answers. The stage is a crucial point for the teacher because if the teacher incorrectly maps the level of difficulty of the concepts then he will also be wrong in setting priorities of concepts that must be taught dominantly to students. This will have an impact on time management so pragmatic
reasons will emerge such as availability and time allocation when the teacher is unable to reach the learning target or does not thoroughly teach the whole concepts.

Some research results show that the RADEC learning model can develop students’ conceptual abilities in primary, secondary, to higher education levels [1–4]. This learning model based on the proximal development zone is very contextual about the condition of students and the curriculum in Indonesia because it was created by Indonesian education experts. Implementation of the model based on these conditions is one of the efforts to create quality education for all Indonesian students with a range of diverse abilities, from students who need guidance to students with high cognitive abilities. Besides, optimizing the use of ICT is an absolute thing in learning in the 21st century and even mapped by various frameworks as a necessity and need in learning. Besides, the Covid-19 pandemic that began in early 2020 further emphasizes the supremacy of the use of ICT in the field of education which is expected to be able to provide learning opportunities to anyone, anytime, and anywhere [5–8]. The Covid-19 pandemic has popularized a teaching strategy that does not take place in one room and there is no direct face-to-face interaction between the teacher and students. This teaching strategy is called distance learning. The results of previous research revealed that the gap between the availability of time and the solid curriculum content can be bridged by combining face-to-face learning with the use of online learning platforms called blended learning [9].

RADEC as a science learning model that is contextual to the condition of students in Indonesia has high flexibility to be packaged in face-to-face learning, blended learning, and fully online learning [9]. The repackaging of the RADEC learning model in online learning must pay attention to essential things such as curriculum and carrying capacity of qualified human resources. The undeniable thing is that not all teachers and students of various levels of education have good preparedness in implementing distance learning (henceforth DL). Some of the obstacles were discovered, one of which was the absence of a special curriculum for DL. As a functional person, the teacher can take a strategic role in repackaging ICT-based learning models, one of which is the RADEC learning model. Research results related to the optimization of ICTs in learning during the Covid-19 pandemic produced a concept called flexible learning [10,11]. The learning is the main foundation for DL implementation.

Researchers reported that online learning could include various learning activities, such as initiating discussion in an online forum, conducting a personal assignment or group project, or attending exams in a virtual classroom [8]. The readiness of online learning should be a key to help students to enhance their active-learning and learn independently. ICT literacy is the key to the successful implementation of DL because the main requirement is the mastery of computer hardware and software. Basic technological skill, such as the ability to use specific applications in specific ways, is the main supported system in DL strategy. Large-scale online learning needs legal protection [12] and a guarantee of well-established internet infrastructure [6].

The mastery of computer hardware and software is known as ICT literacy. Students' ICT literacy is very diverse, from newbie to expert. This diversity is a challenge to formulate the RADEC learning model with online learning mode. If the learning model has been designed and adapted to the conditions of students and the curriculum in Indonesia, the next question is how this model is repackaged into online mode based on the diversity of students' ICT literacy. Well-investigated and tested learning model should be formulated in the pandemic time because it saves the students’ opportunities for learning through online communication [6]. Besides, the purpose of the research is to investigate the difference among conventional, blended, and online modes.

2. Methods

This research is a type of qualitative that collects and formulates a design of DL during the Covid-19 pandemic based on the viewpoints of students and teachers without the intervention of researchers. Participants involved in this study were 20 students and 5 teachers taken based on purposive sampling technique with specific goals. They are teachers who have good ICT literacy with students aged 11–14 years old. Besides, students are taught by teachers who implement teaching strategies with teaching
steps such as RADEC. Questionnaire and unstructured interviews were used then processed with triangulation techniques to obtain representative research findings.

3. Result and Discussion

3.1 the difference among conventional, blended, and online RADEC learning model

Changing the conventional mode to blended even online mode is a challenge. Teachers have commonly faced some problems such as new teaching methods for online learning, students’ learning styles, ICT literacy, or innovation of teaching resources [5]. The basic principle of conventional, blended, and online is on the way of communication and its platform. Conventional learning is a universal instructional for teachers and students who do not have internet access [8,13]. Teachers distributed pre-questions learning directly to the students. All of the stages are conducted in the class with face to face meetings. RADEC learning model is conducted with blended mode for the teachers who do not have enough time [9]. They try to deliver pre-learning questions with LMS that provide asynchronous communications. The Answer and Discuss stage are already commenced in the LMS. Teachers optimize time for emphasizing the difficult concept and giving reinforcing to students. The blended mode is good because limits the screen time. Teachers can assign handwritten and hands-on-projects by face to face communications [13] or combine online and offline learning strategies to avoid students’ burden [6]. In pandemic time, all of those processes should be conducted from home, what it is called DL. In online mode, the communication could be conducted both synchronous and asynchronous where the preference is based on the needs. In synchronous communication, recipients of information can respond immediately. However, it does not apply to asynchronous communications. Methods of synchronous online learning include Zoom Cloud Meeting or Google Meeting. It provides interaction for teachers and students in a dynamic class. But it has big technical risks such as spotty internet, crashing hard drives, and dying batteries. Besides, the methods of asynchronous online learning include posted teacher notes on the LMS or exchanged across discussion boards or social media platforms. The LMS such as Google Classroom is a smart tool where students can submit written tasks [14]. Teachers can use many LMS but they have to be able to facilitate collaborative learning [15,16]. Table 1 shows the differences among conventional, blended, and online modes of the RADEC learning model.

Table 1. The Difference in Conventional, Blended, and Online Mode

| No. | Mode of Learning | Read | Answer | Stages | Explain | Create |
|-----|------------------|------|--------|--------|---------|--------|
| 1   | Conventional     | Teacher gives the ‘clues’ directly | Answer then submitted directly in certain time | Face to face in the classroom | Face to face in the classroom | Face to face (among little team) in the classroom |
| 2   | Blended          | Teacher gives the ‘clues’ directly | Answer then submitted via Google Form | Asynchronous via Google Classroom | Asynchronous via Google Classroom | Face to face (among little team) in the classroom |
| 3   | Online           | Teacher gives the ‘clues’ via Google Classroom | Answer then submitted via Google Form | Asynchronous via Google Classroom - Synchronous via Zoom Cloud Meeting or Google Meeting | Asynchronous via Google Classroom - Synchronous via Zoom Cloud Meeting or Google Meeting | Asynchronous via Google Classroom - Synchronous via Zoom Cloud Meeting or Google Meeting (among little team) |

3.2 RADEC learning model online scenario

In conventional RADEC learning, teachers usually give pre-learning questions in class a week before the classroom instruction. But in the reading phase of DL, the teacher needs an online learning platform.
In implementing DL, all teachers prefer sending pre-learning questions through *Google Classroom* compared to *WhatsApp Group*, considering that the platform is equipped with *Google Drive, Google Docs, Google Sheets*, and *Slides* which allow teachers to share various documents. The reason teachers do not choose *WhatsApp Group* is to avoid the build-up of incoming messages so the discussion documentation is messy. Meanwhile, students do not have problems related to the platform to be used. Students only say that at this stage, they also need a summary as a headline in understanding the material and answering questions. *Google Classroom* is one of LMS (Learning Management System) that provides asynchronous communication. While *Google Meeting or Zoom Cloud Meeting* are a virtual platforms that provides synchronous communication. In the pandemic time, those platforms are examples of how technology supports education. Using those platforms is more reasonable [6]. In the *Read* stage, teachers deliver the clues of conceptual knowledge that should be mastered by students.

In the *Answer* stage, the teacher wants students to answer pre-learning questions based on knowledge gained in the *Read* stage. They deliver the answers through *Google Form* platform. It is one of the features in the *Google Classroom*. All students upload answers simultaneously in the specific time frame determined by the teacher. The teacher can make a selection of all concepts to choose which concepts will be discussed further, i.e. questions that are difficult and worth discussing. The *Answer* stage trains and builds students’ character, one of them is initiative or independent to seek the comprising sources of information.

The teacher has difficulty in carrying out the classical *Discussion* stage because he cannot ensure the involvement of all students. Therefore, the teacher divides students into small groups and forces all group members to engage in discussion. The teacher distributes students with a variety of cognitive abilities so that there are students who are intelligent, active, passive, and need tutoring in one group. The teacher wants to ensure that all students in the group are involved in the discussion and ultimately understand the basic concepts of science. The *Discuss* stage is a forum to agree or rebut the answers in the small group. Some of teachers want to conduct *Discuss* stage through synchronous communication because they can immediately agree or rebut the answers. But some teachers want students to use *Google Classroom*. Students can independently identify which parts of the material are easy and difficult because all students’ answers can ultimately be read by anyone in the forum. This is beneficial for the students as well as they also want to be able to read all answers indefinitely and can be done repeatedly in *Google Classroom*. Writing answers in *Google Classroom* is one of asynchronous communication [6,12]. In the end of the stage, they will produce answer as an official group answers.

If the previous discussion was carried out on the synchronous or asynchronous platform which divided students into groups, then the discussion on the *Zoom Cloud Meeting or Google Meeting* platform involved all students in one online discussion forum. Both platforms allow students to share presentation slides and write questions in the comments column. Regarding the selection of learning platforms, teachers tend to choose *Google Meeting over Zoom Cloud Meeting* for some reason. The results of the analysis of student answers obtained through questionnaires and unstructured interviews indicate that there is no specific selection tendency related to the learning platform at the *Discuss* stage because the main thing for students is to be able to meet face to face and discuss with teachers and other students even in the virtual meeting platform [9].

In the *Explain* stage, the students deliver their group answers in the big forum. Teacher wants students to ask questions, argue with, or add to what other students have to say during the presentation. On the other hand, students want the teacher to provide reinforcement related to the fundamental concepts of natural sciences and provide feedback on students’ opinions. At this stage, the teacher acts as a moderator whose job is to determine students as presenters, propose probing or other things to clarify the material from the presenters, the teacher wants students to ask questions, refute, or add what other students say during the presentation. Besides, the teacher can also act as a presenter if in the discussion activities all students cannot answer. It is can be conducted through synchronous and asynchronous communication. The expected *Explain* stage target is achieved if students already have conceptual knowledge related to science material before entering the *Create* stage [1].
The platform used at the Create stage is Google Classroom where students who work in groups are asked to upload the progress of the project they are working on. Activities carried out starting from sharing creative ideas, the selection of creative ideas, the planning stage, the manufacturing stage, until the testing phase. Students ask teachers to make regular schedules to provide feedback related to the projects they make. The teacher is committed to providing students with contextual learning experiences. Projects undertaken by students are expected to be able to contribute to their surroundings.

Students work in teams and the teacher directs students to collaborative projects with various parties, for example, an expert or technician. Students learn to analyze systems in the projects they make through field studies, study visits, meetings with different people, and work with real problems that are seen as important parts of school academic activities. Even though learning is carried out in fully online mode, object observation that can be carried out directly is not replaced by video or animation. Teachers cannot monitor this moment directly but students still report what they have done through the Google Classroom platform. The students’ activities at the Create stage are agreeing, realizing, reporting the ideas of products. Students work in their small group and present the progress in the Zoom Cloud Meeting or Google Meeting.

For example, the students’ project is making hand sanitizer. Each student works at their house then reports their findings. Each of students makes hand sanitizer with different ingredients and proportions. They finally find the best formulation of hand sanitizer.

The RADEC learning steps in Figure 1 are arranged based on the findings from the teachers and students. But the results of the questionnaire analysis and further interviews with teachers showed that they did not know in detail the DL standards involving ICT tools. The teacher only arranges the steps of teaching that are easy so that it can run practically. But they believe that good student ICT literacy will have an impact on the learning process. Students who do not have good ICT literacy will naturally experience difficulties in learning so that they experience delays. Technical disruption is a concern for students if RADEC is implemented in online mode so learning is not effective. If the results of the questionnaire and interview are analyzed and synthesized, the planned implementation of the RADEC learning model in online mode can be seen in Figure 1 below. Schools should actively develop instructional based-online teaching [6]. Schools also should equip teachers with virtual knowledge of innovative teaching and understand the level of devices and internet access that families have in the home [7]. They are part of a supporting system in online learning that should be well-prepared.

![Figure 1. Steps of RADEC Learning Model in Online Mode](image)

4. Conclusion
RADEC learning model is a solution in applying science instruction in online learning mode. The Read and Answer stages are used as student preparation before starting online instruction. This stage measures the extent of students' knowledge related to the material to be learned in class so that the teacher can develop strategies that will be applied in the instruction. The platform that can be used is Google Classroom which is LMS with asynchronous communication. At the Discuss stage, students are asked to discuss and agree to answers of problems given by the teacher to the group so that students get agreement on the correct answers. The platforms used in the Discuss stage are Google Classroom or
Google Meeting. The Explain stage encourages students to explain the results of the discussions that have been carried out so that a meaningful learning atmosphere is created. The platform used is Google Meeting which provides synchronous communication. Students are encouraged to think of ideas to create an innovative work at the Create stage through the Google Classroom and Google Meeting platform. This research is expected to make a real contribution to the world of education, especially policymakers in creating natural science instruction with online learning mode in the DL era during the Covid-19 pandemic. This research is also expected to stimulate other researchers to formulate RADEC learning models with online mode for various disciplines and levels of education.

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