Physics innovative learning: RODE learning model to train student communication skills

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Abstract. Effective communication skills are 21st-century demands and are important to be mastered and developed by students in the Industrial Revolution 4.0 (4IR) era. Communication skills consisting of written and oral communication skills can be trained in physics learning through innovative efforts to develop learning models. The purpose of this study is to produce a hypothetical RODE model that aims to practice communication skills. Therefore, the development of the RODE learning model was designed. The hypothetical RODE model was designed by analyzing the strengths and weaknesses of the Project-Based Learning model and the Problem Solving learning model, learning theories and empirical studies by examining scientific journals and related research results. The research was carried out by conducting needs analysis, literature analysis, and field observations. The results of the study showed the hypothetical RODE learning model composed of the syntax Read-Outline-Discussion-Evaluation has theoretical and empirical support of research results and is designed to address the weaknesses of the Project-Based Learning and Problem-Solving models. The hypothetical learning model RODE that has been designed must be tested later to meet the aspects of validity, practicality, and effectiveness in training student communication skills.

1. Introduction

Innovation in the learning process by developing learning models is needed in achieving programmed learning outcomes. Learning model is a frame of mind that guides a teacher to design and implement the learning process to help students acquiring and mastering information, ideas, skills, values, ways of thinking, and the meaning of expressions that they have [1]. In the era of the industrial revolution 4.0 (4IR), the 21st-century communication skills are essential to be developed. Greenhill and Petroff suggested that a learning framework requires students to have knowledge, skills, and expertise. Students are expected to develop themselves through the activities of critical thinking, creative thinking, problem-solving, collaborating, and communicating effectively. Students’ skills to communicate effectively becomes one of the demands and challenges for the education process [2]. The National Science Standard also states that communicating and defending scientific arguments is one of the main things students need to learn besides (i) identifying questions and concepts that guide
scientific inquiry; (ii) designing and conduct the investigations; (iii) utilizing technology and mathematics to improve investigation and communication; (iv) making the formulation and revision of explanations and models based on evidence and logically; and (v) identifying and analyzing exposures as well as alternative models [3]. Communication as a skill used in activities to disclose information that is owned (for example knowledge or results of experiments/observations) both in written and spoken. Communication itself is the process of sorting, choosing, and sending symbols in such a way that helps listeners generate meaning or response from thoughts that are similar to those intended by communicators.

Communication is essential to be developed in learning. It refers to several studies such as [3] make communication capabilities as one of the scientific abilities developed by physics education research groups in addition to (a) the ability to represent physical processes in various ways; (b) the ability to compile and test qualitative or quantitative relationships; (c) the ability to modify qualitative or quantitative relationships; (d) the ability to design experimental investigations; (e) the ability to collect and analyze data; and (f) the ability to evaluate predictions and experimental results, conceptual claims, problem solutions, and models. Engineers need communication skills and must be trained. Engineers need particular logical arguments because engineers not only explore the world and solve problems, but an essential part of their work is to explain why the specific solutions they provide for a problem are the best [4]. Kulgemeyer and Schecker stated that communication skills are essential for scientists as well as for citizens as it enables them to participate in decision-making dialogue as a literate society [5]. Nielsen argues that science as communication must be taught explicitly, and teaching must allow students to identify aspects or modes of scientific communication, describe the role of communication in science, and reflect on the relationship between knowledge production and scientific communication. Seeing the importance of communication skills developed in learning encourages the researchers of this study to design a learning model that can train communication skills in learning activities [6].

Communication skill is essential to conduct in a learning process based on the study of the American Association of Colleges of Teacher Education (AACTE) and the Partnership for 21st Century Skills (P21). Communication skills, work productivity in teams, self-evaluation, time management, and problem-solving skills are competencies that workers must-have in the era of information technology development and global economic growth in the 21st century [2]. Some research results in improving communication skills in learning have been done by using learning models such as application of open-inquiry [7], Cooperative Problem-Solving [8], Creative Problem-Solving [9], Problem-Based Learning (PBL) [10–13], and Inquiry Learning Assisted by Two Stay Two Stray (TSTS) [11]. In addition to successful claims to improve students' communication skills in learning, the previous studies recommend that interventions are still needed to pay attention to time efficiency, inspire motivation, and train communication skills explicitly in learning. Therefore, this study focuses on correcting the weaknesses of the PBL and PS models in improving student communication skills. To accommodate the recommendations of the previous studies results, this study aims to develop a valid, practical and efficient RODE learning model to train student communication skills in a learning process.

Physics is a science that covers the material structure, phenomena, and interaction of natural events [14]. Some important aspects of life abilities are useful in solving the problems of daily life such as communicating, thinking skills, working, and being scientifically grown in physics learning. In physics learning, students are faced with the process of building understanding and explaining phenomena, objects as well as events, recording observation data into tables, creating and interpreting a graph, asking questions, testing explanations, and communicating ideas [15]. As a result, lecturers must present physical learning that is able to train communication skills as a provision of students to face competition in the global era of the 21st century.

In designing RODE learning model that trains student communication skills in physical learning, the researchers conduct theoretical studies and empirical studies of some of the results of research on models of learning - communication skills. Each learning model has specific characteristics to teach certain learning outcomes, as well as the learning model that will be developed. The learning model
designed aims to train students’ scientific communication skills needed in the era of industrial revolution 4.0 (4IR). Some of the benefits expected from this study include: (1) an innovative learning model and choice of the learning model that can be used to train students' scientific communication skills. (2) the availability of the learning model that can bridge scientific communication skills needed in the era of industrial revolution 4.0 (4IR). (3) as a reference material in developing learning model relating to communication skills.

Based on the above background, an innovation step is necessary to design and develop a valid, practical, and effective learning model in training student communication skills with the title “Physics innovative learning: RODE learning model to train student communication skills.”

2. Research Method
The method used in this study was a study of literature that examines various theories of learning psychology and the results of research on learning models-communication skills that have been done. The researchers examined the strengths and weaknesses of several learning models claimed by previous researchers to improve communication skills. In addition to conducting field observations and needs analysis, the researchers also examined learning theories that can support the syntax construction of the learning model that would be designed.

3. Result and Discussion
The researchers conducted field observations, preliminary tests of communication skills, and literature studies on the importance of communication skills taught as the first step in this study. A written communication skills test given to 40 students of Primary School Teacher Education Study Program in the Faculty of Teacher Training and Education Lambung Mangkurat University. The results showed that 62.5% of the students were still in the low category. Most of the students with written communication skills in the low category are still mistaken in answering questions on the indicators: graphing based on the observational data and formulating conclusion based on the observational data. The observation of the learning process is also recorded that most students seem to tend to listen passively and do not give questions as well as opinions during the learning process. This result is in line with the results of studies conducted by the PISA, stating that students in Indonesia are still low in acquiring scientific knowledge, communication skills, making explanations, and arguments based on the evidence and critical analysis [16]. This result indicates that a learning model that can be used to activate and train student communication skills is needed.

Some empirical studies of the learning models such as the implementation of an open-inquiry model can improve communication skills of physics students. This study also recommends that experimental lectures should be designed to develop social competence and communication competency [7]. Cooperative Problem Solving can also improve scientific communication skills. This study showed that the average score of scientific communication skills of students with Cooperative Problem-Solving learning model is better than the students with Cooperative Learning model. An obstacle arising in the application of the Cooperative Problem-Solving learning model is generating student motivation in learning. Motivation is important in the learning process. It creates the activeness of students in the learning process to achieve learning goals [8]. The Two Stay Two Stray (TSTS) assisted inquiry learning can improve communication skills and students' understanding concepts. The Two Stay Two Stray requires students to ask questions, answer, and argue. This strategy can motivate students to train communication skills [17]. The effect of the Problem-Based Learning model with scientific approach is better than the conventional learning model to improve the scientific communication skills [13]. From several previous studies about efforts to improve communication skills, Project-Based Learning models and Problem-Solving learning model are the most frequently used models. Therefore, the researchers are interested in examining the strengths and weaknesses of Project-Based Learning and Problem-Solving learning models in improving student communication skills.

Project-Based Learning is a learning innovation that teaches many essential strategies for success in the 21st century. The benefits of the Project-Based Learning approach are students can acquire new
technological skills, become proficient communicators, and become advanced problem solvers [18]. Communication is one of the skills enhanced by Project-Based Learning (PBL) in addition to social skills, independent learning, group work, investigation, problem-solving, and group work skills [10–13,18]. PBL can provide real problems for students to improve communication and critical thinking skills. However, there are some weaknesses in the implementation of PBL such as time consumed in order to complete delivery of materials, learning objectives, unclear scoring system, and unfamiliarity of some teachers with the Project-Based Learning implementation [13]. Project-Based Learning is recommended to use with a variety of methods and provide trial time in supporting Project-Based Learning implementation in learning. Another learning model that can be used to improve communication skills is problem-solving [19]. Problem-solving models were useful and practical in improving inference skills and communicating with very high categories. This learning model also has a significant effect on improving students' inference skills and has a substantial effect on improving students' communication skills in the buffer solution material [16]. The learning using a problem-solving learning model has high effectiveness and influence in improving communication skills and mastery of students' chemical concepts. However, the implementation of the problem-solving learning model requires more time to discussion when the students have solved the problem and complete the learning process, need a quality problem to presented, the different experience and age-level of students must be controlled by teacher [18].

The strengths and weaknesses of the Project-Based Learning, Problem-Solving models, physics learning characteristics, and communication skills studied theoretically and empirically became the basis for designing the RODE learning model that is more efficient and optimal learning model to train student communication skills. The RODE learning model consists of four phases namely Read, Outline, Discussion, and Evaluation with the primary objective to train students communication skills more efficiently and optimally in a learning activity. The rationality of the sequence of each phase of the RODE model to be developed is based on theoretical studies, empirical studies, and researchers' arguments with the following exposure.

The first phase is Read. In this phase lecturer conveys learning objectives and assessment criteria, and he/she motivates students to be actively involved in lectures. The ARCS theory states that students should pay attention (A) to learn so curiosity and interest/response (R) appear on students. This will evoke hope for success (C) and positive feelings (S) that will arouse students enthusiasm to learn [20]. In order to make the learning outcomes stays for a long time, students must be motivated by lecturers by making the students feel happy, accepted and honored, in learning. The importance of this motivation is supported by the results of the study stating that the environment that motivates students to learn will affect individual success in learning. Based on Vygotsky’s social constructivist theory, in this phase students are also divided to heterogeneous working groups (3-4 students) to provide students opportunities to share different ideas or to construct a shared comprehension [8, 21–24].

The next phase is Outline. Students have the same roles and responsibilities in the process of acquiring and building their knowledge. In this phase, students actively take part in planning and sharing ideas; search, arrange and present data in diagrams, figures and tables; formulate and choose alternatives to complete the tasks assigned; select the form and make a group presentation to present in the discussion phase [25]. The learning environment must be arranged so that the students are actively involved, asking questions, answering, and arguing to have a better influence on communication skills [8,10,11]. The lecturers provide tiered guidance in the process of completing assignments and sharing ideas as a form of communication skills training. This is in line with Vygotsky’s social constructivist theory that students learn through interaction with an adult or peers whom are more capable and the concepts must be taught in the closest next level zone of proximal development (ZPD) [26].

The discussion phase is the third phase in the RODE model design. In this phase, providing sufficient space for students to interact freely to convey and share ideas, ask questions, answer, and argue as recommended by [8,10,11] is also adapted in this phase through discussions controlled by agreed before the class discussion activity begins. In general, students are divided into two groups, presenters and listeners. The presenter deliver a presentation on the results of mutual understanding in
a group discussion that would be given responses, opinions, and questions from the audience group. This is following Vygotsky’s theory which states that the process of building personal knowledge and skills is obtained through extraction with other people and the environment. Extensive collaborative activities that allow students to find and understand difficult concepts more easily when problems can be discussed [24]. To control the discussion activities, lecturers can apply behavioral learning theories that state the students’ frequencies to perform similar behaviors in learning will increase if they have pleasant consequences afterward, while unpleasant consequences will reduce the frequency of students’ learning behavior [26, 27].

The Fourth phase is evaluation. In this phase, lecturer and students have to assess learning programs that can be carried out continuously by lecturers, and the results can be used directly to make improvement. The evaluation activities can be done by asking students to make claims about the value of something and explain their reasons [28]. These evaluation activities require active participation in the evaluation process by teachers and students and the need for cooperation [29]. In this phase, the presenter group conveys the lecture topic conclusions that the audience group will respond to it. The audience group gives an appreciation for the presentation conducted by the group of presenters and the assessment of the work results of each group. Lecturers award (praise) and rank the student working group based on the products of the group work and the student assessment by referring to the theory of behavioral learning that states the pleasant consequences will Strengthening learning behavior, while unpleasant consequences weaken learning behavior [25]. Praise refers to contingent praise as well as well-defined behavior [26]. Before ending the lecture, the lecturer gives the lecture topic for the next meeting. The evaluation phase is used as the last phase in the model developed is rational because it is based on the theoretical, empirical, and arguments of the researcher.

The RODE model has a social system that describes the role of students and lecturers, interactions between students, interactions between lecturers and students, and expected targets. Students are expected to have personal and social awareness and responsibility to train and improve communication skills during the learning process. Lecturers have a role in generating, facilitating, improving, and strengthening student communication skills during the learning process, as well as evaluating their achievements based on specified assessment standards. Lecturer and student interactions occur in the whole phase; the lecturer conveys motivation and learning goals along with the criteria for assessment, apperception of learning material, and group formation. The guidance provided by lecturers refers to learning scenarios that present assignments to stimulate student communication skills such as sharing responsibility for accomplishing assignments in working group, presenting the results of group performance, evaluating the results and learning process, and determine follow-up and material for the next meeting. Student communication skills are targeted to increase after following the learning process with the RODE learning model.

The RODE learning model is also designed to have a reaction principle that is a reference for lecturers in responding to student-student performance results. The lecturer respects and responds to student behavior during the learning process by: (1) giving exemplary behavior when arousing, training and strengthening student communication skills, as well as during evaluating its performance, (2) applying the principle of justice in accommodating all student ideas or opinions and immediately giving feedback based on predetermined assessment criteria. The instructional impact expected from the application of the RODE learning model is the improvement of student communication skills including (1) Explaining the trial/observation procedure, (2) Delivering conclusions, (3) Listening, (4) Responding to opinions, (5) Asking questions, (6) Answering questions, (7) Exploring and reading learning resources and materials (8) Creating tables/graphs/chart results of experiments/observations, (9) Interpreting tables/graphs/charts of experimental/observation data results, (10) Formulating conclusions. The impact of accompaniment is also called the indirect impact; namely, the impact obtained because of experiencing the environment created by the model. The Impact of accompanying learning with the RODE Model as follows: (1) Improve student communication skills; and (2) Providing opportunities to practice mastery of 21st century skills in addition to communication, beside creativity, critical thinking, collaboration, and skills in using information, media, and technology.
4. Conclusion
The RODE learning model has a solid theoretical foundation and the latest empirical foundation that is sufficient to support its use. The RODE learning model aims to train communication skills with four phases namely (1) Read, (2) Outline, (3) Discussion, (4) Evaluation. It can be used as a choice for lecturers in carrying out learning that trains communication skills. The RODE learning model provides an opportunity for students to collaborate on new ideas and solutions to solve problems. Students can practice communication skills to support the process of adaptation to dynamic community change. By having excellent communication skills, opportunities for students to achieve success are more open than mastering conceptual knowledge. The RODE model may still have several obstacles that must be overcome so that its use is widespread.

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