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# Proceeding of the 2018 Internasional Conference on Research and Learning of Physics (ICRLP 2018)

Theme  
Innovative Research and Creative Learning of  
Physics for Improving a Competitive and Dignified Nation



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## Preliminary research of developing a research-based learning model integrated by scientific approach on physics learning in senior high school

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# Preliminary research of developing a research-based learning model integrated by scientific approach on physics learning in senior high school

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**Abstract.** This research is based on the important of developing a learning model that emphasizes knowledge building through active learning in order to develop students'4Cs (communication, collaborative, critical thinking and problem solving, creativity and innovation) skill. One of learning models that support the goal is Research Based Learning (RBL) model. Implementing RBL model can be implemented with integrated by scientific approach. The aim of the research is to analysis Developing a RBL model with integrated by scientific approach. This research was research and development. Model used in this research was Plomp model that consisted to Preliminary Research, Development or Prototyping Phase, and Assessment Phase. This research has just done at Preliminary Research that consists of Need and Context analysis, literature review, developing conceptual theory. The result of need and context analysis shows that most of teachers tend to used conventional model thus physics learning activity does not involve students to build concepts in learning activity. Literature Review phase it is got that RBL with integrated by scientific approach based constructivist, behaviourist, and cognitive learning theory. Based on need analysis and literature review, it can be said that it is developed theories supported RBL model with integrated by scientific approach.

## 1. Introduction

Life in the 21st century and industrial revolution 4.0 requires a variety of skills that must be mastered by someone, so that education is expected to prepare students to master these various skills in order to become a successful person in life. Important skills in the 21st century are still relevant to the four pillars of life which include learning to know, learning to do, learning to be and learning to live together. Each of the four principles contains specific skills that need to be empowered in learning activities, such as critical thinking and problem solving, communication, collaboration, and creation and innovation skills. Achieving 21st century skills is done by improving the quality of learning,



helping students develop participation, adjusting learning personalization, emphasizing problem-based learning, encouraging collaboration and communication, increasing student involvement and motivation, cultivating creativity and innovation in learning, using learning facilities right, designing learning activities that are relevant to the real world, and developing student centered learning.

The government has made various efforts in order to improve the quality of learning in Indonesia. One of the government's efforts is to improve the curriculum. The curriculum developed by the government at this time is the 2013 curriculum. *Permendikbud No 70 of 2013* explains that the 2013 curriculum aims to prepare students to have life skills as individuals and citizens who are faithful, productive, creative, innovative, and able to contribute to the life of society, nation, world state and civilization. Strengthening the learning process in the 2013 curriculum is carried out through a scientific approach, namely learning that encourages students to be better able to observe, ask, collect data, associate, and communicate. Implementation of the 2013 curriculum through a scientific approach is carried out on all subjects in the school, including physics subjects.

Physics is one of the science subjects that can develop analytical, critical, inductive, and deductive skills in problem solving through scientific activities [13, 20, 25, 26]. Physics learning activities are carried out through exploration, experimentation and problem solving to explain various phenomena that occur through scientific activities. Exploration activities carried out aim to provide opportunities for students to obtain information comprehensively. Experimental activities carried out in the laboratory aim to prove or find scientific concepts and principles [12, 25, 26]. The process of communicating experimental results becomes a very important part in solving the problems faced. Therefore, physics learning should accommodate these activities to realize effective physics learning goals.

However, some research results show that physics is a subject that is less desirable because most students consider physics to be abstract so that it affects the low critical thinking skills and problem solving of students [7, 20]). Furthermore, Usmeldi [25] also revealed that physics learning is more likely to be teacher centered where students have not been actively involved in finding facts, concepts, and principles of physics. Learning models that tend to be teacher centered make students less creative because they do not reflect learning by doing [30]. This is allegedly causing the 4C (Communication, Collaboration, Critical Thinking and Problem Solving, and Creativity and Innovation) skills in physics learning to be relatively low.

The US-based Partnership for 21st Century Skills (P21), identifies the skills needed in the 21st century namely "The 4Cs" communication, collaboration, critical thinking, and creativity. These skills are important to be taught to students in the context of the core field of study including physics adapted to the 21st century theme. 4C skills consist of the following skills: 1) communication (ability to transfer information both orally and in writing. 2) collaborative (the ability to work together, synergize, adapt in various roles and responsibilities; work productively with others; place empathy in place; respecting different perspectives) 3) critical thinking and problem solving (the ability to understand a complex problem, connect one information with other information, so that various perspectives emerge, and find solutions to a problem) 4) creativity and innovation (ability to develop, implement, and convey new ideas to others, be open and responsive to new and different perspectives). 4C skills are a type of soft skill which is the main objective of the implementation of the 2013 curriculum.

The development of 4C skills in all four aspects has not been achieved maximally. This is evidenced by a study conducted by Trilling and Fadel [24] which shows that high school, diploma and higher education graduates are still not competent in terms of: (1) oral and written communication, (2) critical thinking and problem solving, (3) work ethics and professionalism, (4) working in teams and collaborating, (5) working in different groups, (6). using technology, and (7) project management and leadership. The 2014 ASEAN Business Outlook Survey also reported the results of its study and stated that Indonesia was one of the countries that had a workforce with still low numbers.

The low 4C skills of students were also shown by the results of observations made by the author

on February 12, 2017 in SMAN 1 Koto Baru where the average 4C skills of new students arrived at the ability to recognize a number of basic facts, and students were not able to communicate and

associate that ability with various science topics, let alone apply complex and abstract concepts. In physics learning teachers lack training in 4C skills and are more dominated by theoretical studies and still have not optimized the use of laboratories as a means of learning to support the achievement of students' 4C skills. The learning approach used also still does not fully accommodate students' comprehensive 4C skills. In addition, students are still not fully actively involved in finding facts, concepts and principles to solve physical problems in everyday life. Therefore, it is important to develop a physics learning model that encourages students to improve reasoning skills by involving directly in learning activities. One effort that is considered strategic is to develop and implement a learning model that is considered effective by the Research Based Learning (RBL) model Integrated by Scientific Approach.

## 2. Literature review

### 2.1 Research based learning

The RBL model is a student centered learning model that integrates research in the learning process [18, 14, 8]. The RBL model is based on the philosophy of constructivism which includes four aspects: learning that builds students' understanding, develops prior knowledge, develops patterns of social interaction, and meaningful learning is achieved through real experience. This opinion is emphasized [6, 27, 29] which states that RBL is a learning that uses authentic learning, problem-solving, cooperative learning, contextual, and inquiry discovery approaches based on a constructivist philosophy that focuses in the continuous and sustainable development of students.

The steps of the RBL model consist of: exposure stage (the introduction stage begins to build knowledge through literature studies), experience stage (implementation stage through work and independent learning), and capstone stage (final project preparation stage) [3, 5] The RBL model gives students the opportunity to search for information, form hypotheses, collect data, analyze data, and make conclusions on the data that has been arranged. This activity applies to learning with the "learning by doing" approach. Furthermore, Wardoyo [28] explained that there are seven characteristics of the RBL model that include in the learning process, namely: systematic, active, creative, innovative, effective, objective, and scientific. These seven characteristics are in accordance with the nature of physics learning in the 2013 curriculum with a scientific approach. This is also confirmed by Yahya [31] which states that the advantages of the RBL model provide opportunities for students to practice observing, formulating hypotheses, collecting and analyzing data, and concluding it. The RBL model in physics learning can help students construct physical concepts or principles, making learning more meaningful.

Meanwhile, Puspitasari et al [19] explained that there were several attempts to integrate the RBL model empirically, namely; (1) enrich teaching materials with research results, (2) use recent research findings and track history, (3) enrich learning activities with contemporary research issues, (4) integrate research method material in the learning process, (5) enriching the learning process with research activities on a small scale, (6) enriching the learning process by involving students in activities, (7) enriching the learning process by encouraging students to feel, and (8) enriching the learning process with values that must be possessed by researcher. But in this study focused on the integration of research methods in the learning process through research by involving students in learning so as to realize learning by doing.

The RBL model emphasizes scientific activities to improve students' 4C skills, especially in the context of solving problems by looking at the facts they meet. The RBL model can be implemented with a learning approach through simple research activities in the form of practicum (Kynäslahti, et al, 2006; Jyrhämä et al, 2008; Aripin, 2010; Wannapiroon, 2014; Angkana and Junpeng, 2014). Through a simple research activity in the form of practicum, it is expected to improve students' 4C skills. An important feature of this learning model is the emphasis on scientific activities. Scientific activity guides students to obtain information widely related to the problems faced in order to become the basis for problem solving. Through the RBL model students have more space to activate themselves freely and directed in finding the concepts learned. Efforts to optimize scientific activities

in finding concepts, teachers must be able to carry out their role as facilitators comprehensively. One of the ways that can be done by the teacher in optimizing the implementation of the RBL model is through a scientific approach.

### 2.2 Scientific approach

The scientific approach is the basic concept behind the formulation of learning by applying scientific characteristics and procedures [10, 23]. The implications of the scientific learning process include three domains, namely attitudes, knowledge, skills. The scientific approach which is observing, asking, reasoning, trying, and presenting. Aktamis and Ergin (2008) define the scientific approach as a student-centered learning approach. In addition, Sugiyarti, et al [22] revealed that the implementation of the 2013 curriculum in learning with a scientific approach is a learning process designed in such a way that students actively construct concepts, laws or principles through stages of observing forms, identifying or finding problems, formulating problems, propose or formulate hypotheses, collect data with various techniques, analyze data, draw conclusions and communicate concepts, laws or principles found.

The application of the scientific approach to learning involves process skills such as observing, classifying, measuring, predicting, explaining, and concluding [21]. In carrying out these processes, teacher assistance is needed, but the teacher's assistance must diminish with the growing adult students or the higher class of students. Learning with a scientific approach has the following characteristics: 1) student-centered, 2) involves science process skills in constructing concepts, laws or principles, 3) involves cognitive processes that are potential in stimulating intellectual development, especially high-level students' skills, and 4) can develop the character of students.

Although in the scientific approach characterized by student centered, but the teacher also has an important role as a facilitator and observer in the learning process. Teacher activities in learning using a scientific approach are: 1) providing learning resources, 2) encouraging students to interact with learning resources, 3) asking questions so students think about the results of their interactions, 4) monitoring students' perceptions and thought processes and providing scaffolding, 5) learning encourage the improvement of students' thinking skills, 6) learning to improve student learning motivation and motivation to teach teachers, 7) provide opportunities for students to train their skills in communication, 8) the process of validation of concepts, laws, and principles constructed by students in their cognitive structure

### 3. Research method

Preliminary research of this research is the preliminary research stage of Plomp's development design. The procedure of activities carried out on this research is shown in Table 1.

**Table 1.** The Preliminary Research Stage

Stages	Research Analysis	Activity Description
<b>Preliminary Research</b>	Needs and context analysis	The initial investigation of the need for the RBL model integrated by scientific approach is to senior high school physics learning. Analyzing the learning model is used previously Analyzing the objectives and contents of senior high school on physics subject
	Theoretical and concepts analysis	Analyzing theories and concepts related to the RBL model integrated by scientific approach is to senior high school physics learning
	Design of theoretical and concepts framework	Design a conceptual framework and theoretical framework for the RBL model integrated by scientific approach to senior high school physics learning.

#### 4. Results and discussion

This research has just done at preliminary research phase on physics learning in senior high school based on Plomp's development procedure [16]. The following phases of this research can be seen as follows:

##### 4.1. Needs and context analysis

At this phase an initial investigation was carried out on the need for the RBL model integrated by scientific approach at senior high school physics learning. From preliminary studies that have been conducted in SMAN 1 Koto Baru. Based on the results of preliminary studies at SMAN 1 Koto Baru, it showed that 66.7% of physics teachers have not applied research based learning model by scientific approach on physics learning. The learning process is still using traditional methods, namely by order to explain the theory, give examples and give training. Thus the learning outcomes do not signify. The traditional teaching methods are not appropriate for improving students' 4Cs (communication, collaborative, critical thinking and problem solving, creativity and innovation) skill, because students become less creative.

Overall characteristics of learners gained from data analysis of the four indicators was achieved an average value of 58%. The observed characteristics was the ability to think critical thinking and problem solving (52%), communicate skill (57%), collaborative skill (65%), creativity and innovation skill (58%) during the physics lesson. Characteristics of students during the learning process affected the achievement of the learning objectives of physics. This is indicated by the less optimal learning outcomes of students of class X SMAN 1 Koto Baru in the second semester of the 2017/2018 academic year. The mastery level of for physics subject of class X IPA 1 only resulted 44.2% from 34 students while class X IPA 2, obtained lower score of 34.3% from 35 students. This indicated that the learning completion in the classical style classes was still below 80%. *4.1.2 Theoretical and concepts analysis.*

Based on the results of an analysis of the theory related to the RBL model integrated by scientific approach, this model is based on constructive, behavioral and cognitive theories. The model is a student-centered learning model that integrates research in the learning process. The RBL model integrated by scientific approach provides opportunities for students to seek information, formulate hypotheses, collect data, analyze data, and make conclusions on the data that has been compiled; in this activity learning applies to a "learning by doing" approach. There are several strategies in integrating learning and research that are empirical, namely; (1) enriching teaching materials with the results of educator research, (2) using recent research findings and tracking history, (3) enriching learning activities with contemporary research issues, (4) teaching the material of research methods in the learning process, earning process with research activities on a small scale, (6) enrich the learning process by involving students in activities, (7) enrich the learning process by encouraging students to feel, and (8) enrich the learning process with values that must be owned by researchers.

##### 4.2. Design of theoretical and concepts framework

Based on the needs and context analysis, analyzing theories and concepts related to the model, the theories that support the RBL model integrated by scientific approach in senior high school physics learning are developed, including constructivist learning theory, cognitiveistic learning theory, behavioristic learning theory and learning theories. relevant to the RBL model integrated by scientific approach to senior high school physics learning.

#### 5. Conclusion

Based on the results of the preliminary research of developing a research based learning model integrated by scientific approach on physics learning in senior high school can be summarized as follows:

- a) Based on the results of preliminary studies at SMAN 1 Koto Baru, it showed that 66.7% of physics teachers have not applied research based learning model by scientific approach on physics learning
- b) Overall characteristics of learners gained from data analysis of 4 Cs indicators achieved an average value of 58%. The observed characteristics are the ability to think critical thinking and problem solving (52%), communicate skill (57%), collaborative skill (65%), creativity and innovation skill (58%) during the physics lesson.
- c) In the development phase of the theoretical framework, it is found that the theories that support the RBL model are scientific approaches in high school physics learning, including constructivist learning theory, cognitivist learning theory, behaviouristic learning theory and relevant learning theories.

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# UNIVERSITAS NEGERI PADANG

## FACULTY OF MATHEMATICS AND NATURAL SCIENCE

The 2018 International Conference on Research and Learning of Physics (ICRLP 2018)



### CERTIFICATE

014 - ICRLP 2018

is here by given to

**ESTUHONO**

as **PRESENTER**

in ICRLP 2018 with theme Innovative Research and Creative Learning of Physics  
for Improving a Competitive and Dignified Nation in Padang, West Sumatra, Indonesia  
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Padang, August 10, 2018  
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