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# The Practicality of OR-IPA Learning Model to Improve Critical Thinking Skill of Prospective Physics Teachers

**[1]Binar Kurnia Prahani, [1]Budi Jatmiko, [1]Zainal Arifin Imam Supardi, [1]Munasir, [1]Utama Alan Deta, [2]Rosyid Althaf, and [3]Saiyidah Mahtari**

[1]Physics Education, Faculty of Math and Science, Universitas Negeri Surabaya, Indonesia
[2]Public Senior High School 3 Jember, Indonesia
[3]Physics Education, Faculty of Teacher Training and Education, Universitas Lambung Mangkurat, Indonesia
binarprahani@unesa.ac.id

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**Abstract:** The Indonesian National Qualification Framework in higher education requires universities to develop a curriculum that makes students have superior competence with a variety of skills that are in line with the demands of the 21st century, including Critical thinking skills. The main objective of this research is to analyze the practicality of the OR-IPA learning model, which has been developed by design to improve the critical thinking skill of prospective physics teachers on the fundamentals of physics courses. The subject of practical observations was a physics lecturer who used the OR-IPA learning model. The observation sheet of the OR-IPA learning model practicality has been declared valid and reliable by the validators. The data analysis technique uses descriptive qualitative. The results showed that the OR-IPA learning model to improve the critical thinking skill of prospective physics teachers was considered practical (3.69). Lecturers and students can use the OR-IPA learning model without significant obstacles. This research implies that the OR-IPA learning model can be an alternative to improve the critical thinking skill of prospective physics teachers in the fundamentals of physics courses.

**Keywords:** fundamentals of physics, practicality, critical thinking skill, OR-IPA learning model.



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## INTRODUCTION

In this 21st century, education has an important role in producing Human Resources (HR) who have the needed skills by the workforce. Meanwhile, curriculum demands and the development of the globalization era require educational institutions to make innovation that gives benefits to the 21st-century skills-based education world (Turiman, Omar, Daud, & Osman, 2012; Griffin & Care, 2015). The Indonesian National Qualification Framework in higher education requires universities to develop curriculum that makes students have superior competence with a variety of skills that are in line with the demands of the 21st century including critical thinking skill, skills to utilize Information and Communication Technology (ICT), and problem-solving skills (Griffin & Care, 2015).

Critical thinking, according to Marin & Halpern (2011), is also known as thinking skills, creative thinking, high-order thinking. In critical thinking, there are two important dimensions, namely the framework of thinking and specific mental work. Michael Seriven and Richard Paul, as quoted by Jenicek (2006), said that critical thinking is an intellectual process by making concepts, applying, synthesizing and or evaluating information that is obtained from observation, experience, reflection, thought, or communication as a basis to believe and take action. Snyder & Snyder (2008) & Forawi (2012) said that critical thinking is thinking that is based on appropriate and trustworthy knowledge, or reasonable reasoning, illustrated, responsible, and proficient. In this sense, a person is said to think critically when asking a thing and looking for information appropriately. Then the information is used to solve problems and manage them logically, efficiently, and creatively so that acceptable conclusions can be made (Cheong & Cheung, 2008).

Defining higher order thinking with certainty is indeed rather difficult, although it is not as difficult as implementing it. Burbach, Matkin, & Fritz (2004) based on the APA Consensus Definition, stated critical thinking as a decision that is accompanied by goals and is done alone, is the result of the activities of interpretation, analysis, evaluation, and inference, as well as an explanation of considerations based on evidence, concepts, methodology, criteria and contextual. The process underlies the decision to be taken by someone. Furthermore, Ernst & Monroe (2004) explained critical thinking as cognitive skills, in which there are activities of interpretation, analysis, evaluation, inference, explanation, and self-management. From a pedagogical point of view according to Miri, David, & Uri (2007), there are generally four different concepts in terms of critical thinking: critical thinking as a generic skill, critical thinking as an embedded skill, critical thinking as a component of learning skills throughout life, and critical thinking to be critical.

The 21st-century learning requires human resources with competencies and achievements that are directed at learning skills and innovations, among others are critical thinking skill, problem solving skills, decision making, creative thinking, responsible, and able to learn independently (Jatmiko et al., 2018; Griffin & Care, 2015). Based on these competencies, Surabaya State University (Unesa) has a significant role in striving for the quality of the learning processes and outcomes, including the learning process and outcomes of fundamentals of physics at Unesa through effective and efficient learning.

In connection with improving the quality of the learning process and outcomes mentioned above, there are essential problems faced by the education world today, namely how to pursue students' critical thinking skills through learning (Marzano, 1993). This needs to be done because it is suspected that there are quite a lot of students who do not have critical thinking skills (Brookfield, 2017). Critical thinking skill is an important thinking skill and must be taught, but there are still many lecturers who do not understand how to teach critical thinking skill. The results of Patrick, Fallon, Campbell, Cretchley, Devenish, & Tayebjee (2014) and Pithers & Soden (2000) research showed that critical thinking skill must be taught, besides that research also shows that there are still some lecturers who do not know how to teach critical thinking skill effectively.

In order to improve the quality of fundamentals of physics learning in Unesa, Physics Education Study Program, to facilitate the development of students' critical thinking skills, it is necessary to find alternative solutions. As an alternative solution, among others, is by implementing the "Science Orientation" Learning Model.

The Science Orientation Learning Model is a problem-based learning model through a multi-representation approach based on multiple intelligence theory, constructivist theory, cognitive theory, and multi-representation theory that is specifically developed by design to improve critical thinking skills. The "Science Orientation" Learning Model has 5 (five) syntaxes, namely: Problem orientation, Problem representation, Group investigation, Presentation, Analysis-evaluation, and follow-up (Althaf, Budi, & Supardi, 2013a; Jatmiko et al., 2018). In this study, "Science Orientation" here in after is abbreviated as OR-IPA. Previous research has developed a valid science orientation learning model, practical and effective, to improve the critical thinking skills of high school students (Althaf, Budi, & Supardi, 2013b). Still, in this study, there is no evidence of the validity, practicality, and effectiveness of the science orientation learning model to improve the critical thinking skill of prospective physics teachers.

Recent research by Jatmiko et al. (2018) showed that the OR-IPA learning model's validity and effectiveness could improve the critical thinking skill of prospective physics teachers, but this study has not revealed the practicality of the OR-IPA learning model to improve the critical thinking skill of prospective physics teachers. Therefore, the focus of the purpose in this study is to analyze how is the practicality of the OR-IPA learning model that has been developed by design to improve the critical thinking skill of prospective physics teachers.

## METHOD

This research is a part of development research. The research design used one–shoot case study. After the OR-IPA learning model and lecture, instruments are declared valid and reliable by the validator. The practicality of the OR-IPA learning model in research is the feasibility of the OR-IPA learning model that was assessed by three observers by using instrument an OR-IPA Model Practical Observation Sheet with minimal a good category. To measure the feasibility of learning in the classroom by using observation (Ngurahrai, Farmaryanti, & Nurhidayati, 2019). The instrument of the OR-IPA Model Practical Observation Sheet has been declared valid and reliable by the validators. Therefore, this instrument can be used to assess the practicality of the OR-IPA Model in an effort to improve the critical thinking skill of prospective physics teachers in the fundamentals of physics courses.

The research subjects in the OR-IPA Learning Model trial were 31 undergraduate students in the Physics Education Study Program, Surabaya State University in the first semester of 2017/2018 academic year who take fundamentals of physics courses. The research subjects were determined by purposive sampling. The time of the OR-IPA Learning Model trial run was from August to October 2017. The research site was conducted at the Faculty of Mathematics and Natural Sciences, Surabaya State University. The considerations on choosing Physics Education Study Program, Faculty of Mathematics and Natural Sciences, Surabaya State University as a testing ground are: 1) Physics Education Study Program is a study program that has an "A" accreditation. 2) The academic community is ready to accept and support the implementation of the OR-IPA Learning Model, and 3) The students' critical thinking skills, in general, are in a low category.

The data analysis technique of the OR-IPA Learning Model implementation uses quantitative descriptive. The value of the learning implementation conducted by three observers who have understood the observation sheet correctly. The observation of each observer gave an evaluation (4: Very Good, 3: Good, 2: Less Good, and 1: Not Good). The assessment criteria obtained by comparing the average rating scale are given by the three observers with the assessment criteria below:

$3.25 <$ Very Good $\leq 4.00$

$2.50 <$ Good $\leq 3.25$

1.75 < Less Good ≤ 2.50
1.00 < Not Good ≤ 1.75
(Jatmiko et al., 2018)

The reliability calculation of the OR-IPA Model, Practical Observation Sheet, is supported by using Cronbach's Alpha analysis (Fraenkel, Wallen, & Hyun, 2012; Hinton, McMurray, & Brownlow, 2014). The fundamental of physics learning by using the OR-IPA learning model is carried out during four meetings to practice the critical thinking skills of the prospective physics teacher. Indicators of critical thinking skills that are trained by design by using the OR-IPA learning models include analysis, evaluation, interpretation, and inference. An example of the OR-IPA learning model syntax in one meeting in the fundamental of physics subject is presented in Table 1.

Table 1 Fundamental of physics learning based on OR-IPA learning model

| **Description of OR-IPA Learning Model** |
|---|
| **Introduction** (20 minutes)<br>**Phase 1: Problem Orientation**<br>The lecturer facilitates students by presenting physical phenomena that are often seen and experienced by students in their daily lives about Curved Motion Materials.<br>The lecturer facilitates students so that students are able to use and develop their basic abilities to determine the purpose of the experiment, formulate problems, and identify variables in the Material of Curved Motion.<br>**Main** (110 minutes)<br>**Phase 2: Problem Representation**<br>The lecturer facilitates students so that students are able to present and demonstrate models of physical phenomena reviewed in the Curved Motion Material.<br>The lecturer facilitates students by presenting various representations that are reinforced by serving animations or simulations on Curved Motion Materials.<br>**Phase 3: Group Investigation**<br>The lecturer facilitates students so that students are able to carry out investigations in groups so that students are expected to be able to gather the information that is appropriate in the Curved Motion Material.<br>The lecturer facilitates students so that students can carry out investigations step by step, looking for explanations and solutions to build **critical thinking skills (analysis, evaluation, interpretation, and inference)** on the Material of Curved Motion.<br>**Phase 4: Presentation**<br>The lecturer facilitates students so that students can plan, prepare, and present appropriate work such as experimental reports, models on Curved Motion Materials.<br>The lecturer facilitates students by directing and guiding the course of presentations on the Curved Motion Material.<br>**Closing (20 minutes)**<br>**phase 5: Analysis-evaluation and follow-up**<br>The lecturer facilitates students so that students can analyze and evaluate the problem solving process of the investigation and the process of various forms of representation in the Material of Curved Motion.<br>Lecturers give assignments and evaluations to students on Curved Motion Materials. |

## RESULT AND DISCUSSION

The OR-IPA Learning Model that has been declared valid by the results of the validation conducted by the researcher is then implemented in the study of fundamentals of physics in the Physics Education Study Program at the State University of Surabaya. Implementation activities were carried out in September - October 2017 for six times, including four meetings for face-to-face learning. The data on the practicality results of the OR-IPA learning model at the time of implementation is summarized in Table 2.

Table 2 Practicality results of OR-IPA learning model

| Practicality | First Meeting | | Second Meeting | | Third Meeting | | Fourth Meeting | |
|---|---|---|---|---|---|---|---|---|
| | Score | Category | Score | Category | Score | Category | Score | Category |
| Phase I | 3,25 | Good | 3,63 | Very good | 3,75 | Very good | 3,88 | Very good |
| Phase II | 3,58 | Very good | 3,67 | Very good | 3,92 | Very good | 3,83 | Very good |
| Phase III | 3,38 | Very good | 3,50 | Very good | 3,88 | Very good | 3,88 | Very good |
| Phase IV | 3,25 | Good | 3,75 | Very good | 4,00 | Very good | 3,88 | Very good |
| Phase V | 3,13 | Good | 3,50 | Very good | 3,75 | Very good | 3,88 | Very good |
| Social System | 3,65 | Very good | 3,65 | Very good | 3,90 | Very good | 3,90 | Very good |
| Reaction Principal | 3,50 | Very good | 3,75 | Very good | 3,94 | Very good | 3,94 | Very good |
| Average | 3,39 | Very good | 3,63 | Very good | 3,88 | Very good | 3,88 | Very good |
| α | 0,55 | *Moderate reliability* | 0,67 | *Moderate reliability* | 0,67 | *Moderate reliability* | 0,74 | *Moderate reliability* |

**Notes:**
Phase I (Problem Orientation), Phase II (Problem Representation), Phase III (Investigation), Phase IV (Presentation) and Phase V (Analysis, Evaluation, and Follow Up)

Table 2 shows that in general at the first meeting (measurement) the practicality of the OR-IPA Learning Model in phase I (problem orientation), phase II (problem representation), phase III (investigation), phase IV (presentation), phase V (analysis, evaluation, and follow-up), the social system, the reaction principle in the row are good and very good. Cronbach's Alpha result reliability is 0.55 in the Moderate Reliability category. This means that this reliability shows that at the first meeting, there was consistency between the three assessors in using observational instruments for the implementation of the OR-IPA learning model.

At the second meeting (regular straight motion) the practicality of the OR-IPA Learning Model in phase I (problem orientation), phase II (problem representation), phase III (investigation), phase IV (presentation), phase V (analysis, evaluation, and follow-up), the social system, the reaction principle in the row are very good. Cronbach's Alpha results reliability is 0.67 in the Moderate Reliability category. This means that this reliability shows that at the second meeting, there was consistency between the three assessors in using the instrument in observing the implementation of the OR-IPA learning model.

At the third meeting (straight movements change regularly) the practicality of the OR-IPA Learning Model in phase I (problem orientation), phase II (problem representation), phase III (investigation), phase IV (presentation), phase V (analysis, evaluation, and follow up), the social system, the reaction principle in the row are very good. Cronbach's Alpha results reliability is 0.67 in the Moderate Reliability category. This means that this reliability shows that at the third meeting there was consistency between the three assessors in using observational instruments for the implementation of the OR-IPA learning model

At the fourth meeting (curved motion) the practicality of the OR-IPA Learning Model in phase I (problem orientation), phase II (problem representation), phase III (investigation), phase IV (presentation), phase V (analysis, evaluation, and follow-up) ), social system, the reaction principle in the row are very good. Cronbach's Alpha results reliability is 0.67 in the Moderate Reliability category. This means that this reliability shows that at the fourth meeting, there was consistency between the three assessors in using the instrument in observing the implementation of the OR-IPA learning model.

The data feasibility of each phase in the OR-IPA Learning Model during implementation is briefly presented in Table 2. It is also seen from the value of feasibility and reliability (Cronbach alpha), as in Table 2. The results of this study are supported by Bruner (1979) who provide theoretical support for discovery learning, namely that a teaching model emphasizes the importance of helping students understand the structure or key ideas of a scientific discipline, the need for active student involvement in the learning process, and the belief that true learning occurs through personal discovery (personal discovery). This theory forms the basis of the third phase of the OR-IPA learning model, the investigation phase. The Investigation Phase aims to gather information with the help of the student worksheet, and then the lecturer guides the investigation step-by-step, looking for explanations and solutions to build critical thinking skills. When discovery learning is applied in the fields of natural science and social science, Bruner emphasizes inductive reasoning and the process of inquiry that characterizes the scientific method (phase 3: Investigation) (Althaf, Budi, & Supardi, 2013c). Problem-based learning also awakens itself to another concept from Bruner, namely the idea of scaffolding. According to Bruner, scaffolding as a process of students who are helped to overcome certain problems that are beyond their developmental capacity with the help of lecturers or more capable people. Scaffolding becomes the basis for lecturer guidance to students in all phases of the OR-IPA model. The OR-IPA Learning Model that has been able to be implemented well has an impact on the increase of prospective physics teachers' critical thinking on significant fundamentals of physics material (Jatmiko et al., 2018).

The interactive tasks designed by the OR-IPA Learning Model are to foster critical thinking skill which refers to the phases in the syntax (Althaf, Budi, & Supardi, 2013c), namely: (1) Problem Orientation aims to attract students, focus students' attention, and motivate them to play an active role in the learning process; (2) Problem Representation aims to assist students in understanding material and solving fundamental of physics problems that will be discussed through various approaches that can be adapted to the learning objectives and characteristics of the presented material; (3) Investigation aims to gather information with the help of the student worksheet, then the lecturer guides the investigation step by step, seeks explanations, and solutions to build the critical thinking skill, which includes (a) formulating the problem; (b) formulating a hypothesis; (c) identifying variables; (d) write the operational definition of the variable; (e) write tools and experimental materials; (f) conduct experiments; (g) organize experimental data; (h) analyze experimental data; and (i) make conclusions; (4) Presentation aims to guide students in making conclusions and discussion of the investigation results in various representations, and assist in planning, preparing, and presenting the work; and (5) Analysis, Evaluation, and Follow-up aims to analyze and evaluate the problem solving process of investigations and processes in various forms of representation, see students' work as proof of learning, and facilitate follow-up learning through the provision of structured assignments.

The second phase of the OR-IPA learning model requires lecturers to facilitate students to present a variety of representations (multi representations), which are reinforced with animation or simulation presentations on fundamental of physics material. Multi representations have three main functions, namely as a complementary, limiting interpretation, and understanding builder (Ainsworth, 1999; Heyde, 2016). As for traps, multi representation is used to provide representations that contain complementary information or help to complete cognitive processes. As a limitation of interpretation, multi-representation is used to limit the possibility of misinterpretation in using other representations. As an understanding builder, multi representation is used to encourage students to build an understanding of situations in depth. Multi representation also means to represent the same concept in different formats, including verbal, mathematical, drawing, and graphic (Saalmann, Kirkcaldie, Waldron, & Calford, 2007).

To optimize the impact of applying the OR-IPA Learning Model and PBL Model, that is to increase the critical thinking skill, both instructional and accompanying impacts, will be described regarding the implementation of the model with regard to the way lecturers manage learning, which includes: (1) planning tasks; (2) interactive tasks; (3) learning environment and task management; and (4) evaluation. The things done on these planning tasks are: (1) formulating goals, (2) choosing content, (3) doing task analysis, and (4) planning time and space.

Learning outcomes explicitly contained in the lesson plans made by lecturers as general guidelines in carrying out learning in the classroom. Good learning objectives need to be specifically oriented towards students, contain clear descriptions of the assessment situation, and contain levels of performance achieved in the form of success criteria in learning. In general, the selection of subject matter must refer to the basic competencies and indicators that have been determined. Lecturers can choose which parts of the material is needed to be presented directly and which parts can be studied independently by students in the student book. Lecturers must identify the compatibility between the fundamentals of physics materials taught with the OR-IPA Learning Model to prospective physics teachers. The order of discussion of the material, whether conducted directly by the lecturer or presented in the student book must be arranged logically, so students can easily see the relationship between facts and key concepts of the subject matter in various representations. This model emphasizes investigation through practicum/experimentation. So the choice of material must be related or connect to a phenomenon in everyday life.

## CONCLUSION

The OR-IPA learning model is a problem-based learning model through a multi-representation approach based on multiple intelligence theory, constructivist theory, cognitive theory, and multi-representation theory that is developed specifically by design to improve critical thinking skills. The OR-IPA learning model has 5 (five) syntaxes, namely: Problem orientation, Problem representation, Group investigation, Presentation, Analysis-evaluation, and follow-up. The results showed that the OR-IPA learning model to improve the critical thinking skills of prospective physics teachers was considered practical (3.69) in the fundamentals of physics courses. This research implies that the OR-IPA learning model can be an alternative to improve the critical thinking skills of prospective physics teachers in fundamentals of physics courses.

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