Development of collaborative real-world analysis models for physics teacher candidates

T Firdaus$^{1,2}$, I Hamidah$^3$, W Setiawan$^2$, and I Kaniawati$^2$

$^1$Departemen Pendidikan IPA, Sekolah Pascasarjana Universitas Pendidikan Indonesia, Jl. Dr. Setia Budhi No. 229, Bandung 40154, Indonesia
$^2$Departemen Pendidikan Fisika, STKIP Nurul Huda, Jl. Kotabaru, Kec. Buay Madang, Ogan Komering Ulu Timur, 32161, Indonesia
$^3$Corresponding author’s email: thohaf@stkipnurulhuda.ac.id

Abstract. The initial stage of the research has been carried out to develop learning models for physics teacher candidates. The study was conducted by instrument validation which aims to see the standard validity of a learning device. The validation of this instrument consisted of problem-solving test instruments, analytical skills instruments, creativity ability rubrics, student worksheet instruments, and video analysis guide instruments. The method used in this study uses quantitative analysis methods. The results of the study have been made to develop collaborative real-world analysis models to achieve the goals of real-world physics learning. The results of the instrument test show that the instrument is feasible to use and ready to be used as a measurement tool for research.

1. Introduction

Physics is a science that takes a lot of information and data from the real world. This learning should be done early [1,2]. But as is known, physics learning that is applied in learning is mostly done in the classroom. Students are more emphasized in theory, and the application in real life is not applied properly. Sungkono explained that the presentation of subject matter would be easier to understand if the material presented was of a concrete nature [3].

Engaging students in the context of real-world learning has been identified by educators as an important way to help them learn to apply what they have learned from textbooks to practical problems [4]. Whereas when student learning is carried out in the laboratory, learning is not much taken from nature. Students are only given laboratory equipment, and teaching aids are only limited to a sample. It will be difficult for a teacher to transfer all real natural information to be carried in the laboratory room. A study [5] explains that real world learning can bridge concepts with relationships with society or in everyday life.

Whereas when real world learning is applied in practicum, it will achieve the goals produced in learning. These goals include improving the ability of creativity, problem solving, and analysis. It was stated that real world learning can build competencies such as problem solving [6,7,8], connecting knowledge with action, collaborative work, and applying method concepts from the field of sustainability [9].

Real world learning is important because it encourages students to gain knowledge through various experiences. To design effective real-world learning, it is necessary to analyze the various learning activities that occur in real-world learning and to develop effective strategies for learning support [10].
Physics is generally recognized as conceptually difficult because physics learning consists of concepts related to real life [11]. In previous research, several students were tested how they made a graph of variable relationships through simple examples in their daily lives. Students still make many mistakes in answering simple questions [12].

Therefore, by looking at the importance of the problem above, it is necessary to have the right learning model to achieve the goals of physics learning from the real world. Through this paper, we explain how to develop collaborative real-world analysis models for physics teacher candidates.

2. Methods
This research method uses design and development research [13,14]. The development of design and development research divides the six steps phase as shown in Figure 1. However, the research conducted only reached the fifth stage.

![Figure 1. The 6-phase design and development research approach](image)

The first step in problem identification is to find a case in the field related to learning kinematics related to understanding graphs. Many students still do not understand the shape of lines and variables from straight-motion graphs [12]. The second step in describing the objectives, is expected students can analyze physical phenomena in everyday life and can develop analytical skills, problem solving and creative thinking.

Third step in this research is to design the right learning method. Learning methods consider the goals achieved from learning. Fourth stage is to validate learning instruments. The instrument consists of learning scenarios (syntax), guidance on learning materials (in this case the video analysis guide), student worksheets, creativity assessment rubrics, and test instruments.

Even though the instruments were tested the content and constructs of the questions by three experts in the field of physics. After being declared feasible to be used, another test is performed on the student to determine the level of validity and reliability. The method used in determining the validity of the instrument is by using quantitative methods using the help of the SPSS-Statistics program. The test questions used are in the form of problem descriptions that explore analytical skills and problem-solving abilities. The fifth step is the evaluation of the test results, carried out after conducting the validation test. The input from the validator is used to carry out evaluation and improvement.

3. Result and Discussion
A learning method has been designed by promoting real-world learning. This learning consists of 6 stages which each stage represents the purpose of the learning indicator. The detailed learning steps are explained in table 1.

| Stages | Skill Ability |
|--------|---------------|
|        | Analysis      |
|        | Creativity    |
|        | Problem Solving |

Table 1. Steps of collaborative real-world analysis learning model
| Stages   | Analysis                                                                 | Creativity                                                                 | Problem Solving                                                                 |
|----------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| **Apperception** | • Analyzing the information that enters and divides information into smaller parts   | Demonstrate the subject’s ability to develop and elaborate ideas.             | • Identify variables known as problems                                           |
| Activity element: Review previous material, and present problems in everyday life. | • Identify / formulate questions                                                                 |                                                                                | • Identify the constraints and risks associated with the options identified.    |
| **Introduction** | -                                                                         | -                                                                          | Determine theories and equations to solve problems.                             |
| Activity element: An explanation of the world of physics in the real world and the importance of the subject (technology). |                                                                                |                                                                                |                                                                                  |
| **Explanation** | • Able to recognize and differentiate the causes and consequences of a complicated scenario | -                                                                          | • Make relevant options for dealing with problems                               |
| Activity element: Explanation of work systems, and demonstrations. | • Able to recognize and differentiate the causes and consequences of a complicated scenario |                                                                                | • Use / apply theories or equations to solve problems.                          |
| **Exercise** | • Identify / formulate questions                                           | • Demonstrate the subject’s ability to develop and elaborate ideas, Measuring the degree of abstract thinking outside of concrete examples. | • Make relevant options for dealing with problems                               |
| Activity element: Giving group assignments and data analysis. | • Analyzing the information that enters and divides or structures information | • Demonstrated ability to produce a number of figural images                   | • Frame questions, make predictions, and design data collection and analysis strategies. |
| |                                                                             | • Consider various information when processing information                    | • Use / apply theories or equations to solve problems.                          |
| **Presentation** | Able to recognize and distinguish the causes and consequences of a complicated scenario | • Use / apply theories or equations to solve problems                         | • Act decisively by setting options chosen for an action.                       |
| Activity element: Describe the findings and results of data analysis. |                                                                                |                                                                                |                                                                                  |
| **Reflection** | • Identify / formulate questions                                           | • Demonstrate the subject’s ability to develop and elaborate ideas           | • Reevaluating the correctness of actions.                                     |
| Elements of activity: Confirm the concept, and feedback | • Analyzing the information that enters and divides or structures information | • Measuring the degree of abstract thinking outside of concrete examples       | • Use / apply theories or equations to solve problems                          |
| 3.1. Apperception | This stage is where students are asked to remember old material that has been learned. This material has something to do with the material to be carried out. For example, in kinematics material, students | |                                                                                 |
are asked to recall material about the magnitude and unit of speed, acceleration, etc. At this stage, students will get the ability of analytical skills, problem solving, and creativity abilities.

3.2. Introduction
This is the stage of explanation about the real world that students must have. Students must be equipped with the world of physics in the real world. In order to later learning activities, students are not wrong in deciding. Because this learning is collaborative, lecturers can divide groups at this stage. At these stage students will get problem solving skills.

3.3. Explanation
At this stage, students are given provisions on workflow in learning. If the lecturer uses media in learning, then this stage is an explanation of the lecturer about the tools / media used. In this research, lecturers demonstrated video media to be analyzed using a computer. The lecturer provides important information about the media used, so that students are not wrong in taking video objects taken from the real world. At this stage, students will get analytical and problem-solving skills.

3.4. Exercise
This is the most important stage in the learning model, where the lecturer gives assignments to students. Students with knowledge capital that has been explained previously, are asked to take information from the real world / nature in accordance with the creativity they have. They work in groups, but the task is done individually which each student shows different creations. At this stage, students master the flow of the learning model. The task of the lecturer at this stage is only as a facilitator, if students experience problems, the lecturer must provide the right solution. All skills will be obtained by students at this stage.

3.5. Presentation
Presentation is the stage where students show their work taken from the real world. Each group shows the information and data they have taken. Each student in the group also shows the information according to their creativity, even though the results of the data may be the same. At the Presentation stage, all student skills will be obtained.

3.6. Reflection
The final stage in this learning model is Reflection. Lecturers confirm to students what important concepts have been learned. At this stage lecturers also provide feedback to students. All skills will be obtained by students at this stage.

Overall, the stages of the collaborative real-world analysis learning model are described in Figure 2.
The results of the analysis carried out by three experts stated that the instruments were feasible to be used with revisions related to the writing of sentence grammar, so that the questions did not cause misinterpretations for students who answered. While the results of empirical tests on physics education students at one of the South Sumatra tertiary institutions which numbered 36 consisting of semester 2, 4 and 6 students obtained Alpha Cronbach's reliability of 0.698. Gall & Borg explained [15] that the value of the reliability coefficient is in the range of 0.00 to 1.00. The coefficient value of 0.00 states that the reliability is low (not reliable), while the efficiency value of 1.00 means high reliability (reliable). The reliability test results of the test questions obtained a value of 0.698 approaching the value of 1.00 so that it can be concluded that the reliability of the questions used in this study belongs to the category of high reliability or reliability. While the results of validity and reliability of each item are explained in the following table 2.

**Table 2. Results of validity and reliability of each item.**

| Question   | Validity value | Validity category | Reliability value | Reliability Category |
|------------|----------------|-------------------|-------------------|---------------------|
| Number 1   | 0.446          | Medium            | 0.694             | High                |
| Number 2   | 0.641          | High              | 0.647             | High                |
| Number 3   | 0.633          | High              | 0.654             | High                |
| Number 4   | 0.683          | High              | 0.649             | High                |
| Number 5   | 0.757          | High              | 0.634             | High                |
| Number 6   | 0.704          | High              | 0.630             | High                |
| Number 7   | 0.653          | High              | 0.748             | High                |
| Number 8   | 0.477          | Medium            | 0.707             | High                |
4. Conclusion
The right learning model has been created to achieve the goals of real-world physics learning. This learning model aims to increase the ability of creativity, problem solving, and reliability. This learning model is called the Collaborative Real-World Analysis Model. Learning instruments in the form of learning scenarios (syntax), analytical video learning material guides, student worksheets, creativity assessment rubrics, and test instruments have also been validated and obtained feasibility by using experts. The test of the question instruments performed on students has also been declared valid and reliable.

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