Development of online learning tools based on problem solving on circular motion materials

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Abstract. Online learning device is a device used in the online learning process. During the Covid-19 pandemic, teachers are required to change the learning system directly into online learning. This research aims to developing online learning tool based on problem solving in effective circular motion material in the midst of the covid-19 pandemic. This learning tool was made online in order to facilitate teachers and students to conduct teaching and learning activities on physics subject matter by using problem solving learning models. Learning tools were validated by three experts, namely media experts, material experts, learning experts and one physics teacher, and tested on students. The trial subjects were carried out in class X SMA as many as 25 students. Data collection instruments use a questionnaire guide through Google's forms. The development of this research includes ADDIE research with the stages of development: 1. Analysis, 2. Design, 3. Develop, 4. Implement, 5. Evaluate. From the results of research on the development of problem solving based online learning tools on circular motion material obtained learning devices (learning implementation plan, student activity sheet and online media) have been tested for eligibility by experts and field trials with good criteria and are suitable for use.

1. Introduction
During the Covid-19 pandemic, online learning tools were needed, because the teaching system was changed through online or distance learning, therefore online learning tools were the right solution for teaching and learning. Learning device is a device used in learning at school. Therefore, teachers must develop interactively, imperatively and motivate students to learn actively. The learning tools needed in the learning process are syllabus, learning implementation plan (RPP), student activity sheet (LKS), and modules. In this study, the learning tool used is the Learning Implementation Plan [3].

The Learning Implementation Plan (RPP) is an implementation plan in learning that describes the steps and management of learning that must be implemented by teachers and students in a learning process at school to achieve learning objectives. However, along with the times caused by technology, RPP has several changes and types. One of them that was developed in this research is the Merdeka Belajar lesson plan.

Merdeka Belajar Learning Implementation Plan (RPP) is a statement from the Minister of Education and Culture Nadiem Makariem about Learning Implementation Plan (RPP) one sheet, which includes education units, subjects, classes / semesters, subject matter, time allocation, basic competencies, learning objectives, learning activities, and assessment. During Covid-19 pandemic, teachers are required to change the learning system directly into online learning.
Online learning is a series of instructional experiences using digital networks to interact, study and discuss. The learning does not require in person meetings at a physical location. Similar learning such as web-centric learning or commonly called hybrid (blended learning) is a supplement to online learning, but requires regular class or in person meetings. Online learning is applied using a problem solving learning model [14].

Problem solving is learning that is implemented to train students to face various problems that are solved alone or together (Alipandie, 1984: 105). Learning problem solving is how to find solutions that make the problem the main point to be analyzed and synthesized in presenting learning material [1]. Thus, problem solving is a method by activates and trains students to deal with various problems and can look for problem solving. The focus of material from this research is class X physics material, namely on circular motion material [2].

Research relevant to this research are as follows, this study discusses how a lesson plan is prepared and implemented in the educational process for comparison of lesson plans in US and Turkish education [18]. Furthermore, the development of a questionnaire to measure educators' attitudes towards lesson planning and the level of educational differences in an effort to survey 93 English teacher views about the lesson plan in junior secondary schools and institutions [4]. Next, research that discusses collaborative learning planning, learning observations, and student learning exams in professional development to encourage educators to reflect on teaching practices through the learning cycle process. [6]. Next, this study discusses the development of digital modules using the Problem Based Learning (PBL) model on physics subject matter, namely temperature and heat to improve students' Science Process Skills. [15].

The first step in this research is to analyze the needs of teachers and students about the online learning tools developed in this study. The results of the analysis of the needs of teachers and students are as follows:

![Figure 1. Results of analysis of student needs in Lebak](image-url)
The next step is to develop problem solving-based online learning tools on circular motion material which consists of the Free Learning Implementation Plan (RPP), Student Activity Sheets (LKS), rubrics and cognitive, affective and psychomotor assessments and online learning media through schoology and zoom. After the online learning tools were developed, researchers validated the learning tools developed by media experts, material experts and learning experts as well as physics teachers. Then it was tested on 25 class X students. This research aims to developing online learning tool based on problem solving in effective circular motion material in the midst of the covid-19 pandemic.

1.1 Learning Media

In the learning process cannot be separated from the learning device. Because the learning device is a teacher's equipment in the learning process. Learning devices can be interpreted as completeness tools used for learning. From this understanding, we can know that learning tools are important in the learning process. Because this learning tool can be used as a guide for both teachers and students. In the learning device, there are several components, which consist of:

a. Syllabus

Syllabus is a learning plan for a particular group of subjects / themes that includes core competencies, basic competencies, subject matter / learning, learning activities, indicators, assessment, time allocation, and learning resources / materials / tools. Besides the syllabus is also a translation of core competencies and basic competencies into the subject matter / learning, learning activities, and indicators of achievement of competencies for assessment.

b. Learning Implementation Plan (RPP)

RPP is a guide to teacher activities in learning activities as well as a description of student activities related to teacher activities. Learning implementation plans can also be interpreted as plans that describe the procedures and organization of learning to achieve a basic competency set out in the Content Standards and outlined in the syllabus.

c. Student Book

Student books are learning resources in the form of writing used by students to support learning activities.

d. Student Worksheet (LKS)

Student worksheets are student guides used for conducting investigations or problem-solving activities. This activity sheet can be a guide for developing cognitive aspects of the exercise or a guide for developing all aspects of learning in the form of an experimental or demonstration guide. So that
we can know that LKS is a student's guide who is used to solve a problem in the development of cognitive, affective, and psychomotor aspects of students.

1.2 Lesson Plan (RPP)
Simplification of the Learning Implementation Plan (RPP) in accordance with Permendikbud number 14 years 2019 dated December 13, 2019 were one of the new breakthroughs made by Minister of Education and Culture Nadiem Makarim, he mentioned that the simplification of this RPP was dedicated to teachers to ease the administrative burden on teachers, he also added that the Ministry of Education and Culture would provide several examples of short RPPs that were sufficiently done in one page. Responding to the new policy, teachers appreciated the Ministry of Education and Culture's Basic Education Policy, which would simplify the Learning Implementation Plan (RPP). So far, the administrative burden arising from the preparation of lesson plans is often complained by teachers. As reported previously, Minister of Education and Culture Nadiem Makarim will simplify the RPP to just one sheet, but includes the elements needed in learning. Based on Permendikbud Number 22 of 2016 concerning Basic and Secondary Education Process Standards, the Learning Implementation Plan (RPP) is a plan of in person learning activities for one or more meetings. The lesson plan is developed from the syllabus to direct the learning activities of students in an effort to achieve Basic Competence (KD). Dozens of RPP components are simplified into three core components that can be made on one page, namely learning objectives, learning activities, and assessment or learning assessment. The remaining components are only as a complement and can be chosen independently by the teacher as needed. According to Nadiem, it can be the focus of building students' character education. Based on the existing Learning Implementation Plan (RPP), the teacher must fill in with at least 13 components in the lesson plan, but now the long component is only three main components. The three main components are contained in one sheet far less than dozens of sheets that had to be filled. The existing lesson plans have only been a burden on teachers. Various RPP formats start from the curriculum implemented until the revision curriciles have undergone various concept changes. The term also experienced various changes. The goal remains the same, namely learning planning before entering class. The concept of RPP with the existing format so far is considered rigid. In addition, there are too many formats with 13 components in one lesson plan. Then the teacher arranges their own RPP per Basic Competency (KD) according to the field of study they are in. The important thing in an RPP is not about writing, but about the teacher's reflection process towards learning, that occurs, with the RPP itself the teacher can reflect on learning in class. Besides being able to improve its performance in the future, the preparation of lesson plans efficiently and effectively is done so that teachers have plenty of time to prepare and evaluate the learning process. That is what is called the Free Learning RPP. With the RPP itself, the teacher can reflect on learning in the classroom. Besides being able to improve its performance in the future, the preparation of lesson plans efficiently and effectively is done so that teachers have plenty of time to prepare and evaluate the learning process. That is what is called the Free Learning RPP.

1.3 Online Learning
Online learning was first known because of the influence of the development of electronic-based learning (e-learning) introduced by the University of Illinois through a computer-based learning system. Online learning is a system that can facilitate students to learn more broadly, more widely and in a variety of ways. Through the facilities provided by the system, students can learn anytime and anywhere without being limited by distance, space and time. Online learning covers hardware aspects (infrastructure) which consist of computers that are interrelated with one another and have the ability to send data, whether in the form of text, messages, graphics, or sound. With this ability, online learning can be interpreted as a computer network that is interconnected with other computer networks
that are in accordance with the corners of the world (Kitao, 1998). However, the notion of online learning is not only related to the hardware. It is also approved related to software that consists of data sent and stored, when-can be accessed. Some computers that are interconnected with each other can create a sharing function that can be called a network. Online learning as a method or means of communication that provides great benefits for teachers, and students, the instructors need to understand the characteristics or potential of online learning in order to make optimal use of it for the learning needs of students [13].

1.4 Problem Solving
Problem solving learning model is a method of learning activities by training students to deal with various problems, both personal problems and group problems to be solved alone or together [7]. The orientation of learning is investigation and discovery, which is basically problem solving [9]. Thus the learning model problem solving aids a learning method that activates and trains students to deal with various problems and can find solutions to problems or solutions to those problems. The syntax of the problem solving learning model consists of six stages, as follows:

a. Identify the problem
   The skills needed are: knowing and formulating the problem clearly.

b. Look into the problem
   The skills needed are: using knowledge to detail, analyze problems from various angles.

c. Formulate a hypothesis
   The skills needed are: to imagine and appreciate the scope, cause and effect of alternatives.

d. Collecting and classifying data as material to prove hypotheses
   The skills needed are: the ability to find and arrange data. Present data in the form of diagrams, figures or tables.

e. Proof of a hypothesis
   The skills needed are: the ability to study and discuss data, the ability to connect and count, and the skills to take decisions and conclusions.

f. Determine Settlement Options.
   The skills needed are: the ability to make alternative solutions, the ability to assess choices by calculating the consequences that will occur on each choice.

1.5 Circular Motion
Circular Motion is the motion of an object whose path is a circle around a fixed point. For example, you can see in the Moon movement around the Earth and the spinning motion of the ball hanging on the rope. In circular motion, frequency and period, terms are often mentioned. Frequency \( (f) \) is the number of turns the object takes about one second. Period \( (T) \) is the time it takes as the object to complete one full turn. Circular motion is motion whose trajectories are circular. Examples of circular motion in everyday life are curving cars, windmills, the motion of the moon around the earth, the roller coaster motion and the motion of a bicycle wheel that rotates on its axis. The principle of circular motion is also widely applied to vehicle or factory engines. Indirectly, the understanding of circular motion has lightened human labor. Therefore, it is important for students to understand about circular motion [5].

2. Research Method
This research is a research development. This study uses a research and development model ADDIE. This research was carried out through five steps: 1. Analysis, 2. Design, 3. Develop, 4. Implement, 5. Evaluate.
Figure 3. ADDIE model

The first step is to analyze the needs of teachers and students with a problem solving-based online learning tools on circular motion material. Data obtained from teachers and students through a Google form questionnaire. Secondly, online learning tools are designed to be developed, consisting of the Free Learning RPP on circular motion material using problem solving learning models, worksheets, and online media. Third, developing online learning tools that are needed by schools, teachers and students who were previously designed. The fourth step is the implementation of media developed in high schools. Students try problem-based online learning tools on circular motion material as a learning medium, implement the sequence of learning information that has been made on the online media 'Schoology'. The fifth step is an evaluation conducted by material experts, media experts, learning experts and physics teachers to assess the feasibility of the developing media.

3. Result and Discussion

The product of this research is a problem-based online learning tool on circular motion material. Display products online learning tools (RPP independent learning) in the picture below.

Figure 4. Products online learning tools (RPP)
The first step in this research is to analyze the needs of teachers and students related to online learning tools. The following results of the analysis of the needs of teachers and students created in Google Form.

3.1. **Results of the analysis of teacher needs made in Google Form.**

![Graph of teacher needs in Banten](image)

**Figure 5.** Results of analysis of teacher needs in Banten

The results of the analysis of teacher need consisting of five indicators: 1). 100% during the learning process at school teachers use learning tools, 2). 100% of teachers agree on the use of problem-based online learning tools, 3). achievement in circular motion material about 60%, 4). The use of computers or android for learning and teaching is about 92%, 5). The need for online learning tools class work classwork is around 100%.

3.2. **The results of students' needs analysis are made in the Google form**

![Graph of student needs in Lebak](image)

**Figure 6.** Results of analysis of student needs in Lebak

The results of the analysis of student need consisting of five indicators: 1). The use of learning tools during the learning process at school is about 93%, 2). The use of online learning tools based on problem solving around 93%, 3). Achievement in circular motion material about 50%, 4). The use of computers or android for learning and teaching is about 93%, 5). The need for online learning tools using class work is around 96%.
Then the problem solving-based online learning tool was developed on circular motion material consisting of the Free Learning RPP, LKS, rubric and cognitive, affective and psychomotor assessment as well as online schoology and zoom learning media. After online learning, tools have been developed, researchers validator experts by media experts, material experts and learning experts and physics teachers using the Likert scale via Google Form with criteria 5 = Strongly Agree, 4 = Agree, 3 = Agree, 2 = Disagree, 1 = Strongly Disagree. Following is the results of expert validation by media experts, material experts and learning experts and physics teachers.

a) Results of media expert validation

![Figure 7. Results of media expert validation](image)

Based on the five indicators the average percentage of validator one shows 82% and the average validator two shows 84%. Based on the results of the overall percentage of validator one and validator two showed 83% in the good category (according to the Likert score).

b) The results of the material expert validation

![Figure 8. Results of material expert validation](image)
Based on the five indicators the average percentage of validator one shows 80% and the average validator two shows 79%. Based on the results of the overall percentage of validator one and validator two shows 79% in the good category (according to the Likert score).

c) The validation results of learning experts

![Learning Expert Validation Results](image)

**Figure 9.** Results of expert learning validation

The results obtained by the validation of learning experts on validator 1 and validator 2 on the indicator of the Skill of the content of the material with KI, and KD shows the percentage of 80% validator 1 and 80% validator 2. On the Rule indicator the presentation of learning material shows the percentage of 80% validator 1 and 75% validator 2. On the indicator of the suitability of the material with the learning objectives shows the percentage of 82% validator 1 and 80% validator 2. On the indicator of the suitability of the presentation of daily problems with the material taught shows the percentage of 80% validator 1 and 82% validator 2. On the indicator of the effectiveness of time allocation listed shows the percentage of 85% validator 1 and 80% validator 2. Based on the five indicators the average percentage of validator 1 shows 81% and the average validator 2 shows 79%. Based on the results of the overall percentage of validator 1 and validator 2 shows 80% in the good category (according to the Likert scale).

d) Physics teacher validation results.

![Physics teacher validation results](image)

**Figure 10.** Physics teacher validation results
The results obtained by the validation of the physics teacher, on the indicator of the suitability of the material with the learning competence (KD) showed a percentage of 75%. In the Clarity indicator, the information contained in the RPP shows the percentage of 80%. In the Indicators of Conformity between question exercises, the description of the material and the video that is shared shows the percentage of 78%. The suitability indicator concept developed in learning tools with daily experience shows the percentage of 80%. On the indicator of the suitability of the sentence used with the correct Indonesian rules, it shows the percentage of 75%. Based on the five indicators the average percentage of validator shows 77% in the good category (according to the Likert score).

Table 1. Validator Expert Validation Results

| Validator           | Validation Result | Overall percentage |
|---------------------|-------------------|--------------------|
| Media Experts       | 83%               | 80%                |
| Material Expert     | 79%               |                    |
| Learning Expert     | 80%               |                    |
| Physics Teacher     | 78%               |                    |

Then it was tested on 25 class X students using zoom and schoology applications. Zoom app for virtual distance learning and schoology to pin details of activities and tasks that need to be done.

4. Conclusions

Problem-based online learning tools on circular motion material can make it easier for students and teachers in the online teaching and learning process of the Covid-19 pandemic. This media has been tested by experts and physics teachers and has good interpretation and is suitable for use as a learning medium in schools. So, the development of online learning tools based on problem solving on circular motion material has proven to be effective in school learning.

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