Development of discovery learning-based on online learning tools on momentum and impulse

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Abstract. Covid-19 pandemic affects all aspects of lives including, education. In line with large-scale social restriction policy, Education and Culture Ministry issued a policy to close schools and replace the face-to-face learning activity with online learning or known as distant learning. This research is aimed at developing discovery learning-based online learning tools on momentum and impulse. The learning tools that were developed are Lesson Plan, Student Worksheet, and Handout. Discovery learning model could improve students’ active learning as they find and investigate on their own. As the result, the comprehension they get will last long in their memory. This research uses ADDIE development model consisting of five stages, namely Analysis, Design, Development, Implementation and Evaluation. The Data was analysed using descriptive analysis technique. The learning tools was tested at SMK Negeri 53 state vocational high school Jakarta by 35 students at tenth grade of Motor Cycle Business Technique (TBSM) class as well as through teacher’s response questionnaire. The research resulted in online learning media that is appropriate for distant physics learning on momentum and impulse with subject expert’s validation at 85.38%, learning expert’s validation at 86.25% and media expert’s validation at 88.50%. The online learning tools is categorized as ‘good’ with validation result percentage at 86.71%.

1. Introduction
In early 2020, COVID-19 becomes world health problem. The case started with the information from World Health Organization (WHO) on 31 December 2019 saying the appearance of pneumonia cluster case with unclear etiology in Wuhan, Hubei Province, China. On 30 January 2020, WHO set COVID-19 as Public Health Emergency of International Concern (PHEIC). On 12 February 2020, WHO officially set the name of this novel coronavirus on human as Coronavirus Disease (COVID-19), and on 11 March 2020, WHO had set the COVID-19 as a pandemic [1].

COVID-19 became an Extraordinary Event (KLB) in Indonesia and event worldwide. The pandemic affected all sectors of lives including education. In line with large-scale social restriction policy, Education and Culture Ministry issued a policy to close schools and replace the face-to-face learning activity with online learning or known as distant learning (PJJ). On 25 March 2020, Indonesia’s Education and Culture Ministry issued Circular Letter Number 4/2020 About Education Implementation Policy during COVID-19 Pandemic. The letter stipulates that learning process will conducted at home via online learning [2].

COVID-19 could cause longer disruption in education sector if no solution for coronavirus is found, and the pandemic continues. School closure comes with clear implication on global education
industry, namely increasing the global demand of online learning [3]. Therefore, this research is conducted to develop online learning tools with title of “Development of Discovery Learning-Based Online Learning tools on Momentum and Impulse”. The learning tools that were developed are Lesson Plan, Student worksheet, dan Handout.

Physics learning that implements 2013 curriculum emphasizes on scientific approach, marked by five points of learning experience, namely: 1) observing; 2) proposing question; 3) collecting information; 4) associating information; 5) communicating result. The choice of learning tools used in the learning process is important for teachers [4]. As written in the research of Juli Asmida Rambe, learning tools is a guideline which directs teachers in implementing learning process that has been arranged systematically, that previously compiled by the teachers [5]. The use of learning tools gives good impact and teachers would be more creative and innovative in learning process [6].

According to Moore, Dickson-Deane & Galyen, online learning is a learning that uses internet network with accessibility, connectivity, flexibility, and ability to trigger various learning interactions [7]. According to Isman, online learning is a utilization of internet in learning process. Through online learning, students could have flexible learning period and are able to learn anytime and anywhere [6].

There are many online learning applications that could be implemented in education sectors lately, such as a free and familiar application. Google Classroom and Edmodo. The applications are quite similar and have interesting features such as polling, gradebook, file and links, quiz, library, assignment, award badge, and parent code. The applications also have an advantage as parents could monitor them simultaneously, so that they are suitable for elementary to middle education students who need more control then teachers and parents. The other online learning is also conducted via video conference by utilizing Zoom Cloud meetings application. Lesson explanation mostly conducted by sharing file via WhatsApp and other social media [8].

Online learning that is synergized with right learning basis could optimize learning effect [8]. One of learning models that can be used in online learning is Discovery Learning model. The choice of discovery learning in this research is because it could develop students’ active learning as they find and investigate on their own. As the result, the comprehension they get will last long in their memory. Self-found comprehension is a comprehension that is mastered and is easily used or transferred in another situation. Through discovery learning, students learn to master one of scientific methods that they can develop on their own. In addition, the students also learn to think analytically and try to solve problem on their own. This habit will be transferred to their social lives [9]. Therefore, online learning with discovery learning model is expected to give meaningful learning experence for the students. According to a research conducted in SMP Negeri 1 state junior high school Pekanbaru, implementation of the learning model could stimulate students to think critically and eventually they could solve problems assigned to them. It is expected to improve students’s skill and eventually improve student learning outcomes [10].

In accordance to Government Regulation (PP) Number 19/2005 about National Education Standard Article 20 that says ‘learning process planning includes syllabus and lesson plan that consist of at least learning goal, teaching material, teaching method, learning sources, and assessment of learning outcomes’. Learning tools is a vital thing used in learning process. Every teacher in schools is required to compiled learning tools to have interactive, inspiring, fun and motivating learning for students to actively participate [11].

Learning tools is one of action plans prepared by teachers before they conduct learning process, it includes syllabus, lesson plan, learning module, student activity worksheet, and assessment instrument. Learning tools development is a series of activity conducted by teachers to produce learning tools in the form of syllabus, lesson plan, learning module, student worksheet and assessment instrument based on existing development theory [12].

According to Rusmiati, learning tools is a number of material, media, instruction and guideline which will be used in learning process [13]. The design of learning tools is one of the plans that should be prepared by teachers to achieve learning goal. Learning tools consists of syllabus, lesson plan, student worksheet (LKS), learning outcomes test [14].
An extraordinary educator that we call teacher or lecturer is an important factor in education as educator is the one who deal with students in learning process. In the implementation, learning should be more innovative [15]. A teacher should be able to develop learning system that used discovery learning model that is integrated to 21st century learning [16]. Learning tools being used should consider current technology development [4]. A good learning tools could improve thinking skill and motivation of students in understanding facts, concept, principle, and procedure [17].

Discovery learning is a learning that connects concepts and their implementation in solving problems. It is one of models that allows students to be involved directly in learning, so that they could use their mental process to find concept or theory they are learning. [5]. Discovery learning allows student to find information and learn concept independently. The characteristics of discovery learning is a process of discovery by stimulating students. Stimulus is the first step of a discovery [18].

Discovery learning model has five syntax, namely orientation, generating hypothesis, testing hypothesis, conclusion and regulation [19]. ‘Orientation’ is students’ behavior to develop initial understanding by involving information and knowledge that they had gained previously. ‘Generating hypothesis’ is students’ behavior to compile hypothesis from the initial problem. ‘Testing hypothesis’ is student’s behavior to plan and experiment to test the hypothesis. ‘Conclusion’ is students’ behavior to review the result of the test and associate it with previous hypothesis. ‘Regulation’ is students and teacher’s behavior to review the test result and come up with final conclusion [20].

Discovery learning is a learning model recommended for 2013 curriculum to develop students’ critical thinking [21], because the students try to find their own concept through scientific method, not through information given or understanding concept directly from the teacher [22]. Students are expected to follow learning process that can empower their critical thinking skill so that they can find concept through independent knowledge [23]. This learning model could improve critical thinking [24]. The improvement of students’ critical thinking through the use of discovery learning model will affect their learning outcomes. Discovery learning also have positive impact on students’ physics learning outcomes [25].

Based on analysis of students’ need in SMK Negeri 53 state vocational high school Jakarta, 65% of the students use internet to help them in learning activity, especially in physics subject, in which 71.4% of them use the internet during the day with the average use duration of 1-2 hours as shown by the diagram below.

![Figure 1. Internet Use Intensity Diagram](image)

However, the availability of online learning tools in physics learning is still limited. According to teachers, online learning tools in physics learning availability is only at 38%, while according to 35 students, the availability is at 48%. It means that the online learning tools availability in the school is not good enough.

In addition, students’ achievement in understanding and mastering the concept of momentum and impulse is still at 41%. Students deemed that physics learning process on the concept of momentum and impulse in schools is not good enough. Therefore better learning strategy is needed. There are several factors that can affect student learning outcomes, especially in physics learning, including the way of teachers choosing learning approach. A research on student learning has identified that learning approach is an important factor determining outcomes quality as it describes how students
relate with learning assignment [26]. Analysis of students’ need showed that 91% of SMKN 53 Jakarta students need online learning model especially in physics learning on the concept of momentum and impulse. Meanwhile, analysis of teachers’ need showed that 93% of the teachers need online learning mode.

Based on the findings above, the development of discovery learning-based online learning model on the concept of momentum and impulse is really needed. Therefore, this research aim to develop a discovery-based online learning tool on the concept of momentum and impulse.

2. Research Method

This research uses ADDIE model of research and development (R&D) method consisting of analysis, design, development, implementation, and evaluation. The research has developed lesson plan, student worksheet, and student handout.

![ADDIE Framework](image)

**Figure 2. ADDIE Framework [27]**

Steps of ADDIE model implemented in this research are:

1) *Analysis*

Analysis is the first step in ADDIE model. In this step, program designer should analyze the needs to collect information related to the problem faced by the students. Analysis is a process to define what the student will learn. In this step the need of student and educator (teacher) is analyzed. The analysis determines components needed in the next step.

2) *Design*

The second step is design, learning tools is designed to achieve goal and competence of physics subject on the concept of momentum and impulse. This step is also known as creating blueprint. Necessary actions in this step are formulating learning goal, determining appropriate learning strategy to achieve the goal. There are many option of method and media combination that can be chosen or from other relevant learning sources. In this research, discovery learning model and zoom, edmodo and whatsapp media are chosen.

3) *Development*

Development is the third step of ADDIE. It is a process to realize design by developing discovery learning-based online learning tools on the concept of momentum and impulse.

4) *Implementation*

Implementation is a step to implement learning system made previously. Implementation step in this research was conducted through direct testing. Media testing was conducted in two stages. First stage was a validity test by subject expert, learning expert, media expert and teachers. Second stage. Second stage was practical testing by the students. The result of the test served as foundation to conduct evaluation step.

5) *Evaluation*

Evaluation is the final step of ADDIE model. In this step, the online learning tools is evaluated to improve its efficiency and effectiveness. The discovery learning-based online
learning tools on the concept of momentum and impulse is improved based on the evaluation.

Data in this research was collected with using several methods, namely validation questionnaire with likert scale model and testing questionnaire result by teachers spread via google form. The instrument used in this research included validation sheet of subject expert, validation sheet of learning expert, validation sheet of media expert, and testing sheet and feasibility test by teachers. Data analysis used in this research is analysis of validation result of expert and teachers.

3. Result and Discussion

The product of this research is learning tools consisting of Lesson Plan, Student Worksheet and handout. Based on the copy of Education and Culture Ministry Regulation number 65/2013 about Standard of Basic and Middle Education Process, Lesson Plan (RPP) is developed from syllabus to direct learning activity to achieve Basic Competence (KD). Student worksheet (LKS/LKPD) is sheet containing assignments that should be done by students. The worksheet commonly contains guideline or steps to complete an assignment, and the assignment should have clear basic competence objective. Meanwhile, handout is a piece (or several pieces) of paper containing assignment or test given by teacher to student. In other words, a learning material package is categorized as handout if a teacher makes a topic summary, topic paper, student worksheet, practicum guideline, assignment, or test which are given separately to the students (not compiled in a single worksheet, for example).

Here are description of products from this research: 1) Lesson plan. Lesson plan that has been develop is Merdeka Belajar lesson plan consisting of component of learning objectives, steps of learning activities, and assessments. (Figure 3); 2) Student worksheet. LKPD 1 Momentum & Impulse (Figure 4) is student worksheet that has been develop consisting of observation activity instruction sheet and observation sheet; 3) Handout. Handout 1 Momentum & Impulse (Figure 5) is handout consisting of learning objectives, summary of momentum and impulse, and HOTS problem examples. Students must have joined in their class on Edmodo. Student worksheet and handout can be accessed by student on Edmodo (Figure 6).
Next is learning tools that is validated by the experts. The validation used likert scale interval. The scale was used to measure behavior, opinion and perception on problem of social phenomena [28]. The data obtained then interpreted as follows:

| Skor Rata-rata | Interpretation |
|----------------|----------------|
| 0%–20%         | Very Bad       |
| 21%–40%        | Bad            |
| 41%–60%        | Sufficient     |
| 61%–80%        | Good           |
| 81%–100%       | Very Good      |
Based on the table above, the discovery learning-based on online learning tools on momentum and impulse that has been developed has very good categories. Validation result of subject expert showed average score at 85.38%. The Indicators of subject validation are material feasibility, material coverage, conformity of media component with physics material, and writing language conformity. Based on the result of the subject/material expert, the material in the learning tools is feasible to use.

Validation result of two learning experts was 86.25%. The indicators of learning validation are learning tools component, learning activity based on discovery learning model, conformity with physics material, and include learning assessment. From the result, it can be concluded that the learning tools can be used on the concept of momentum and impulse.

Validation result of media experts showed the score of 88.50% with very good category where expert 1 gave score of 83.67%, expert 2 with 88% and expert 3 with 93.83%. The indicators of media validation are learning media component (edmodo), handout component, student worksheet component, and video or animation choice (link). The media in the learning tools could be used very well.

Next, the learning tool is tested to teacher and students of SMK Negeri 53 Jakarta. The testing showed following score or validation:

### Table 3. Result of Testing by Teacher

| Category                          | Result    |
|----------------------------------|-----------|
| Conformity of Learning tools Component | 84.00%  |
| Writing Language of Learning tools | 80.00%  |
| Characteristic of Learning Module (LKPD and Handout) | 80.00%  |
| Learning Media Application       | 80.00%  |
| Average Percentage               | 81.00%  |
| Interpretation                   | Very Good |

**Figure 7. Validation Result of Subject Expert**

![Expert Validations Result](image)

**Table 2. Validation Result**

| Category     | Result |
|--------------|--------|
| Material Validation | 85.38% |
| Learning Validation        | 86.25% |
| Media Validation            | 88.50% |
| Total Percentage            | 86.71% |
| Interpretation             | Very Good |
Validation result or testing by teacher showed the score of 81.0% with category of very good. It can be concluded that the learning tools can be used very well.

4. Conclusions
In overall, validation score for the learning tools was 86.70% with category of ‘very good’. Therefore, the online discovery learning-based learning tools on the concept of momentum and impulse if appropriate to use.

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