Validity and practicality of students worksheets in the virtual laboratory activities for nuclear fission learning materials

H Hidayati*, M Masril and R Nabila

Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Padang 25131, Indonesia

*hidayati@fmipa.unp.ac.id

Abstract. Based on the observations, the students' understanding of the nuclear physics learning materials was still quite low. Most of the nuclear physics topic are abstract and nuclear physics learning has not been supported by laboratory activities. The solution of this problem is to do laboratory activities with virtual laboratory applications. The application that will be used in this activity requires a guide that matches the characteristics of students. This research aims to develop valid and practice students' worksheets as a support in the virtual laboratory activities for nuclear fission learning materials. The student’s worksheets were developed using the ADDIE method that is limited to the development stage. The object of this research is a student’s worksheets (LKM) used as support for virtual laboratory activities. The data collection instrument used in this research is a questionnaire of validity and practicality. Based on the research that has been done, the conclusion is the students’ worksheets has been valid and practical to be used for nuclear fission learning materials.

1. Introduction

Education is an important stage that must be followed in building the next generation of the nation. Education can be understood as a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and country [1]. Quality education is expected to produce individuals who are skilled and capable in their respective fields.

Education consists of various levels, each level arranged in a particular curriculum. The curriculum includes planning and arrangements regarding graduate learning outcomes, study materials, processes, and assessments. According to the college curriculum, nuclear physics courses are one of the compulsory subjects in the physics department. Achievement of learning for nuclear physics courses is that students are able to master the concepts of nuclear structure, nuclear properties, radioactivity, radiation detectors, alpha decay, beta and gamma, radiation protection, nuclear reactions, nuclear and fission forces, nuclear energy, particle accelerator and elementary particles, as well as disseminate the results of the study in the form of reports according to scientific rules [2]. Through laboratory activities demonstrations and experiments can be carried out on several nuclear behaviors.

The results of the observation showed that students' understanding of nuclear physics teaching material was still quite low, at only 56.6%. In addition, data also obtained that most nuclear physics
teaching material is abstract and the lecture process has not been supported by practice activities. Practicum activities are important things to do in physics learning because through practicum activities the aspects of products, processes, and attitudes of students can be further developed [3]. The real practicum in core physics lectures will cost a lot of money and has a very high work risk. Efforts that can be done to overcome this problem are by holding practicum activities virtually.

Virtual lab activities or commonly called virtual laboratory activities are laboratory activities using a series of computer programs that can visualize abstract or experimental phenomena that are difficult to do in real laboratories [4]. Virtual laboratories can be done using applications that are available online which can then be downloaded by lecturers and students. One of the websites providing virtual laboratory applications is Physics Education Technology (PhET) [5]. One of the available applications is Nuclear Fission which is related to nuclear fission material. However, this application does not yet have a usage guide in Indonesian.

Guidelines for implementing virtual laboratory activities can be arranged in the form of teaching materials. Teaching materials are all forms of material used to assist learning activities [6]. One form of printed teaching material is in the form of student worksheets [7]. Student worksheets contain sheets containing assignments that must be done by students so that they can guide students to meet the desired learning outcomes [6].

2. Research Method
The research conducted was a type of Research and Development (R & D). The object of this research is student worksheets (LKM) to support virtual laboratory activities in core physics lectures. The R & D model that has been used is the ADDIE model (Analyze, Design, Development, Implementation, Evaluation). The stages of the procedure carried out in this study are limited to the stages of development (development). The steps are described as follows:

2.1. Analyze stage
The analyze stage aims to identify problems so that the need for developing a product as a solution. The analysis carried out at this stage included analysis of competency demands, material analysis, and analysis of student characteristics. The results of the analysis obtained are then evaluated, so that at the end of this stage what products can be determined to be developed.

2.2. Design stage
The purpose of the design stage is to answer what products will be developed. There are several steps that have been taken. First, researchers study virtual laboratory applications that are used namely nuclear fission. Researchers study the tools contained in the application and the experimental activities that can be done on this application. Next, researchers design the structure of the LKM to be developed. The basis for the development of this LKM refers to the Ministry of National Education in 2008 which provides guidance on the development of teaching materials. After that, the researchers designed the LKM layout including the choice of colors, fonts and the layout of the images and sentences in the LKM.

2.3. Development stage
The development stage has a purpose, namely to produce a product that is valid and practical. At this stage the design (Design) of the previous stage was developed into a product. Next is the preparation of product evaluation instruments. Products that have been developed are then evaluated using a product evaluation instrument that has been compiled, so that at the end of this stage a valid and practical product is produced [7].

3. Results and Discussion
Based on the research objectives, the results of this study are LKM that are used in virtual laboratory activities. The application used in this virtual laboratory activity comes from Physics Education Technology (PhET). The feasibility of this LKM design is assessed through validity testing and practicality testing.

The LKM that develops serves as a guide in conducting virtual laboratory activities. The design of the LKM is guided by the Ministry of National Education [5] which states that the LKM contains at
least; title, learning instructions, basic competencies to be achieved (learning outcomes), supporting information, work tasks / steps to be taken, and assessment. Based on this, the researcher developed the LKM in accordance with the components contained in the Ministry of National Education and added several supporting components. The LKM that are developed consist of cover, identity, learning instructions, learning outcomes, practicum objectives, completion time, supporting information, preliminary tasks, work steps to be taken, independent tasks, and assessment.

The initial part of this LKM product is the cover. The cover includes topic that will be discussed in the LKM, images related to the material, as well as an identity column that will be filled by students. The cover that has been developed in the nuclear reaction and nuclear reactors of learning material as shown in figure 1.

Figure 1. The cover of LKM

The next part of the LKM is as follows: 1) identity, containing information on the target users of the LKM being developed; 2) practicum instructions, consisting of steps for students to use the LKM; 3) learning outcomes, contains competencies that must be achieved by students in core physics lectures; 4) practicum objectives, including the final ability that must be achieved by students after practicing; 5) processing time consisting of time for data collection and for analyzing data; 6) summary of the subject matter, in the form of general information on the topic of the LKM developed, 7) preliminary assignment, containing questions that must be done by students before practicing; 8) work steps, contains steps that must be followed by students in carrying out practical activities; 9) independent tasks consisting of additional questions to develop student knowledge after carrying out practical activities; 10) assessment, carried out on the work process and work results of students in conducting practicum activities.

The next step is to test the feasibility of the LKM design. The feasibility test is carried out through two stages namely validity test and practicality test. Validity test functions to determine the feasibility of the LKM design in terms of its feasibility aspects of content, presentation, graphics and language. The practicality test serves to determine the practicality/ease of use of the LKM developed. This can be
seen from several aspects, namely the ease of use of LKM, the attractiveness of LKM offerings, the benefits of LKM in the lecture process and the opportunities for implementing LKM.

Next is the feasibility test of the LKM. The feasibility test is carried out through two stages namely validity test and practicality test. Validity test functions to determine the feasibility of the LKM design in terms of its feasibility aspects of content, presentation, graphics and language. The practicality test serves to determine the practicality/ease of use of the LKM developed. This can be seen from several aspects, namely the ease of use of MFIs, the attractiveness of LKM offerings, the benefits of LKM in the lecture process and the opportunities for implementing LKM.

In the validity test phase, the LKM products are validated by experts. The selected experts are lecturers in the physics department consisting of material experts, linguists, and media experts. The validators provide an assessment of the product by using a questionnaire to evaluate the validity of the LKM. Assessment is carried out covering 4 aspects of feasibility where each aspect consists of several statements. Each statement is assessed by choosing a score of 1 to 4. In addition, a comment and suggestion column can also be filled in by the validator. These comments and suggestions are useful for providing input to the LKM being developed.

Feasibility assessment of each aspect was analyzed from the scores obtained on each item statement. The feasibility value can be calculated by the total score in one aspect divided by the maximum score of the aspect then multiplied by 100. From the calculation results, the feasibility value for each aspect is obtained. The feasibility value in each aspect can be classified into several criteria, where the value of 0-20 means invalid, 21-40 means less valid, 41-60 means quite valid, 61-80 means valid, and 81-100 means very valid. The value of the validity test results can be seen in Table 1.

| No | Feasibility Aspect | Score | Criteria |
|----|--------------------|-------|----------|
| 1  | Contents           | 90.6  | Very valid |
| 2  | Presentation       | 90.6  | Very valid |
| 3  | Graphically        | 94.0  | Very valid |
| 4  | Language           | 90.6  | Very valid |
|    | Average            | 91.5  | Very valid |

Based on Table 5, overall LKM made are in very valid criteria with an average value of 91.5. The next step is practicality testing. Practical tests are carried out by lecturers in core physics courses and a group of students majoring in physics. Subjects who value practicality are called practitioners. Practitioners provide assessments of products using practical instruments in the form of questionnaires. The questionnaire contains 4 aspects, namely aspects of the ease of use of the LKM, the attractiveness of the LKM presentation, the benefits of the LKM in the lecture process and the opportunities for implementing the LKM. Each aspect consists of several statements. Each statement is assessed by choosing a score of 1 to 4. In addition, a comment and suggestion column can also be filled in by the practitioner. These comments and suggestions are useful for providing input to the LKM being developed.

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Based on the results of the practicality test questionnaire analysis given by the lecturers of core physics courses, the results of the practicality of LKM are in very practical criteria with an average value of 89.0. This value is obtained from the average value of four aspects of practicality. The first aspect is the ease of use of questionnaires with an average value of 85.4. The second aspect is the attractiveness of LKM offerings with an average value of 93.3. The benefit aspects of LKM in the lecture process get an average score of 95.8. The fourth aspect is seen from the opportunity for the implementation of LKM, which are obtained by an average of 81.3. The results of each aspect can be seen in Table 2.
The results of the practicality test questionnaire analysis from students showed the same level of practicality which was in very practical criteria with an average value of 85.9. This value is obtained from the average value of four aspects of practicality. The results of the plot of the values of each aspect can be seen in Table 3.

| No  | Practicality aspect          | Score  | Criteria     |
|-----|------------------------------|--------|--------------|
| 1   | Ease of Use                  | 84.4   | Very practical |
| 2   | Interesting presentation     | 88.2   | Very practical |
| 3   | Benefit                      | 87.3   | Very practical |
| 4   | Opportunity for Implementation | 83.8  | Very practical |
|     | **Average**                  | **85.9** | **Very practical** |

Table 3. Result of practicality test by students

4. Conclusion

Based on the results of the research that has been done it can be concluded that LKM as supporting virtual laboratory activities in nuclear fission learning material are valid and practical.

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