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DEVELOPMENT OF BASIC CHEMISTRY LAB WORK MODULE AS SCIENCE PROCESS SKILLS ASSESSMENT

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Abstract: In this research, a lab work module daily life base has been successfully developed in the basic chemistry 1 lab work. This module was created to make practicum implementation easier in the chemistry laboratory due to limited tools and materials. This research aims to assess students' science process skills. The lab work module development process uses the ADDIE model research approach. After that, the validation tests carried out were media experts and material experts, each consisting of two experts, and average validation test scores for material and media experts were found to be 4.67 and 4.54, respectively. These results indicate that the module is suitable for use as a learning resource. The next step was to test its practicality and effectiveness using pretest and posttest instruments, students' score results, and questionnaires. Data analysis was carried out using descriptive statistical methods and the results obtained were that the module was suitable and practical for use as a learning resource with a practicality percentage of 89.47%. Furthermore, the student's learning completion results were 100% and the N-Gain value was 0.71, which proves that the module created is effective. In conclusion, the product that has been developed is successful in improving students' science process skills.

Keywords: labwork module, basic chemistry, science process skills

INTRODUCTION

In the 21st century, science and technology transformations developed quickly. This development has varying impacts on the social order system in society [1]. The effect is the competition for job vacancy opportunities among undergraduate students. So educational institutions play an important role in the preparation of graduates.

Education plays an important role in preparing the quality of labor. The quality of education in college influences the competency and quality of the graduates [2]. Education is the effort of a person to improve their capacity and quality. The goal of education is to produce the high competitiveness of human resources. Because of education, humans can solve their problems and fulfill their daily needs [3]. This is in line with the mandate of national education that the function of education is to improve the quality of a person's abilities and character to form a dignified nation so that the mandate of the 1945 Constitution, can be realized. The role of national education is to develop the potential of students to become human beings who have faith and noble character, who are capable and creative and have strong character [4]. The results or products of education are superior graduates, and will certainly have an impact on a workforce that is highly competent, and able to compete globally, even in industrialized developed countries [5]. Therefore, the implementation of education must be serious and carried out as well as possible.

Education can't be separated from the learning process in class. Learning is related to objectives, materials, media, and learning strategies [6]. All these processes are integrated and neatly arranged. Human components, materials, facilities, and infrastructure, as well as procedures, work together to achieve learning objectives. Teaching and learning activities involve interaction between lecturer and students both in the classroom and through learning in the laboratory. Here, the lecturer's ability to design the learning process is required to make the teaching-learning process conducive and interesting, so students get meaningful patterns for creating their knowledge, attitudes, and skills. So it can be concluded that lecturers play a big role in teaching-learning processes [7].

In the learning process, apart from the role of lecturers, the role of supporting facilities and infrastructure is also needed. The use of media and methods in the learning process must be appropriate. The purpose of using media is to achieve learning goals effectively and efficiently. Media can make college students motivated and the teaching-learning process will become effective [8]. The development of the teaching-learning process must be continued so the learning objectives can be achieved effectively and efficiently. The method is by using interactive learning. Besides teaching in class, there are other learning models such as the laboratory approach. A laboratory approach is usually required for natural sciences subjects. In laboratory learning, testing of a

theory is provided so that students can discover scientific concepts independently [9].

Natural science lessons discuss natural events related to students' daily lives [10]. Chemistry is one of the science groups. The material studied in chemistry is related to the structure and composition of a material or substance as well as the energy that accompanies it. Therefore, material in chemistry is difficult and abstract so it is difficult for students how to understand a concept, and makes it less attractive to students [11]. Studying chemistry and/or natural sciences can be easier through experiments and lab work. Lab work is related to students' scientific skills and critical thinking abilities because it involves students when conducting scientific exploration. Therefore, experiments or lab work activities are important in the learning process for natural sciences. The step in lab work activities allows the college students to carry out and experience a process on an object and be allowed to analyze and draw conclusions about what happens to the object [12]. In lab work activities, supporting teaching materials are needed so that college students can learn independently. The teaching materials are lab work modules. With the lab work module, students will be able to learn independently and be motivated in lab work activities. Students can independently carry out activities in the laboratory without needing full assistance from lecturers [13].

The lab work module aims to explore and stimulate students' creativity and critical thinking skills. The module consists of measurement tests of student learning outcomes. The lab work module contains complete practicum implementation guidelines for 1 (one) semester of teaching and learning activities in the laboratory for 1 (one) course. The contents of the module are guidelines for implementing lab work starting from preparation, implementation, data analysis, and reporting. The basic concept of the lab work module developed in this research is to make teaching-learning in the laboratory effective and efficient. The contents are related to our daily life so it will be easier to provide tools and materials considering the limited materials in the laboratory. The goal is that teaching-learning in the laboratory works effectively and efficiently, and it can improve students' skills. The module developed in this research is a module for basic Chemistry 1 lab work that is daily life-based. The objective is to improve students' science process skills. Students are expected to be able to create their knowledge so that they can find concepts according to the material studied. Science process skills are a scientific way to think critically. So it can be concluded that science process skills involve cognitive, manual, and social skills. Apart from that, science process skills are also a reflection of methods for producing information in the form of concepts obtained from information retrieval.

RESEARCH METHODS

The research is a research and development (R&D) model. In this research, a basic Chemistry 1 lab work module was developed based on materials from everyday life. The definition of development research is a method to develop educational products which is followed by validating the product [14]. The development of the lab work module in this research uses the ADDIE type. The ADDIE stages are (1) analysis; (2) design; (3) development; (4) application; and (5) assessment [15].

The research sample was students who took basic chemistry 1 lab work courses, consisting of students in semester 1 of the chemistry class, chemistry education A and B, Faculty of Mathematics, Natural and Earth Sciences, Manado State University. The data collection techniques use observation sheets, pretest, posttest, student semester scores, questionnaires, and validation questionnaires for material experts and media experts. Preliminary and needs analysis in this research was carried out using observation techniques.

The module feasibility test was carried out using a media expert and material expert questionnaire sheet. The number of each expert is 2 (two) people. The questionnaire was created using a Likert scale of 1-5. The validity interval is listed in Table 1 below [16].

Table 1. Validity level determination interval

Interval	*Details*
$1 \leq Va < 2$	Invalid
$2 \leq Va < 3$	Not valid
$3 \leq Va < 4$	Fairly valid
$4 \leq Va < 5$	valid
$Va = 5$	Very Valid

The next stage is a practical analysis for testing students' science process skills. Analysis of the practicality of the lab work module using a questionnaire instrument given to students. Next, the responses from students were analyzed using the formula for calculating the average percentage of each statement component contained in the response questionnaire which was then converted into practicality categorization according to [17] which is contained in Table 2:

Table 2. Categorization of practicality

Score	*Category*
$80\% < \bar{R} < 100\%$	Very practical
$60\% < \bar{R} < 80\%$	Practical

40% <$\bar{R}$< 60%	Quite Practical
20% <$\bar{R}$< 40%	Less Practical
0% <$\bar{R}$< 20%	Not Practical

The final stage in this development research is the effectiveness test. This test is carried out based on the results of student observations and lab work reports. Next, the lab work results are processed into final grades to determine the completeness of student's learning outcomes. The learning mastery obtained by students is based on the qualifications of learning success in taking courses that have been determined by the college. Students pass the course program if they get a minimum grade of C or the equivalent of a quality grade of 2.00 – 2.75.

RESULTS AND DISCUSSION

The development of the module created in this research was based on an analysis of the situation. The analysis used observation instruments on chemistry and chemistry education students and the laboratory regarding tools, materials, and infrastructure as supporting laboratory activities. Observation results show that the availability of tools and chemical substances is not complete yet for lab work activities according to the existing lab work modules, so it must be updated. The needs analysis stage is also carried out by analyzing learning documents such as the curriculum, syllabus documents, and learning outcomes. The lab work module is developed based on Learning Outcomes. The results show that chemistry graduate students must have analytical skills in the laboratory, so lab work activities are needed to equip students with laboratory skills. On the other hand, it is necessary to be equipped with science process skills which students can get from lab work activities.

Next, plans and designs are made for the lab work modules that will be created. The content is suitable to the syllabus. Flowcharts were created to make module development easier. Next, a questionnaire instrument was created which will be used for media expert validation tests and material expert validation test questionnaires. The aim is to evaluate whether the module developed is suitable for use in lab work activities or not. A practical questionnaire instrument was also created for students. The aim is to prove the practical and effectiveness of the lab work module.

The development of the lab work module is designed by updating existing lab work modules. The newest module is a module whose contents have been adapted to real conditions based on the results of initial observations in the laboratory. The content of the lab work module uses daily life material for lab work activities. The next step is to carry out validation tests on the module that has been developed. Validation was carried out using a questionnaire instrument for 2 (two) media experts and material experts each. This test aims to test the feasibility of the module created. Revisions are made if there is a request for revision either from material experts or from media experts. The feasibility test for the practical module being developed is listed in Figure 1 below:

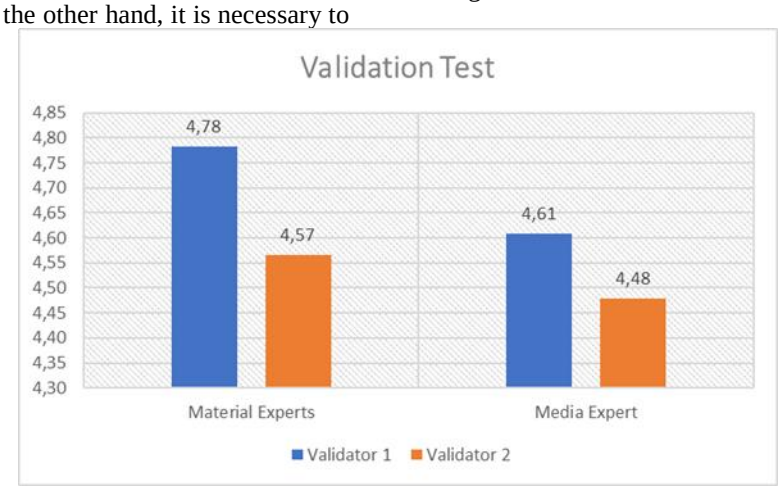

Figure 1. Product feasibility test results

Validation is to measure whether the module created is feasible and valid in terms of content accuracy, concepts, completeness, and accuracy of the material or not, and also to assess whether the material in the module allows it to be used in lab work activities or not. Based on the results of the material expert validation test, scores obtained for material experts 1 and 2 were 4.78 and 4.57 respectively with an average value of 4.67. Furthermore, the validation results from media experts 1 and 2 respectively received scores of 4.61 and 4.48 with the average score for media experts being 4.54. The conclusion is that the basic chemistry lab work module 1 has been successfully developed and is valid for use as a learning resource.

Implementation is carried out by carrying out lab work activities using a developed module. The trial was carried out on students taking the Basic Chemistry Lab Work 1 course. There are 19 students or respondents. Evaluation based on the results of trials on respondents using posttest, pretest, final semester scores, and questionnaires. Evaluation

determines the practicality and effectiveness and whether the module developed can be accepted by students or not. Module effectiveness data can be seen from student learning scores at the end of the semester. Students pass the course if they get score minimum C according to university standards. From the results of the final semester exam scores, the student's graduation rate are 100%. The student learning results show that the basic Chemistry 1 lab work module is effective to be used as teaching material for lab work activities.

The data was also collected regarding improvements in student learning outcomes based on pretest and posttest scores. Increasing student abilities is obtained from gain scores by normalizing the difference between pretest and posttest scores (N-Gain). From the calculation results, an N-Gain value was obtained of 0.71, which is included in the high category [18]. The result shows that the student's abilities have increased.

Finally, the analysis of the module practicality is based on student responses using a questionnaire instrument. The results of the questionnaire showed that the average value obtained was 89.47%. These results indicate that the student's needs and expectations have been obtained. It can be concluded that the module is considered practical.

This research is in line with research conducted by Rukmana, et. al. in 2024 regarding the development of a constructivism-based General Biology E-Module which obtained an N-Gain value of 0.71. This shows that the module developed is effective. The student graduation rate was 100% and the student practical response based on the questionnaire instrument was 86.67%. The conclusion is that the product made is good and practical [19].

CONCLUSION

Based on research, the development of a basic chemistry 1 lab work module based on daily life has been successfully created. Based on the data analysis, it can be concluded that: (1) the module developed is valid with the validity values of materials and media respectively are 4.67 and 4.54, (2) the module is effectively proved by the student learning graduated 100% and an N-Gain value of 0.71, and (3) the module is practical that is proved by the practical questionnaire instrument, and got a score of 89.47%.

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