

Development of Green Chemistry Practicum Guidelines Based on Discovery Learning

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ABSTRACT

This study aims to analysis the practicum guide of the school under study, to find out the feasibility of the chemistry practicum guide based on Discovery Learning in class eleven second semester which was developed based on the results of standardization and expert validator opinions, and to determine student motivation and learning outcomes of students taught using Green Learning chemistry laboratory guides based on Discovery Learning. This type of research uses the Development Research method that uses the ADDIE development model (Analysis, Design, Development, Implementation and Evaluations). The results showed that: The feasibility level of the second semester in class eleven chemistry laboratory guide published by several publishers has a fairly decent category, The results of the validation of teachers and lecturers towards four components of the feasibility test for environmentally friendly chemistry laboratory guides based on Discovery Learning Senior High School grade eleven second semester have an average value of 4.33 so that they can be categorized as very feasible, there is an increase in student learning outcomes taught using the chemistry practicum guide based on Discovery Learning with what is taught using books used by students, with the value of student learning outcomes ($\text{Sig} < \alpha$) and ($t_{\text{count}} > t_{\text{table}}$) namely ($0.00 < 0.05$) and ($3.288 > 2,000$), there is a significant increase in students' learning motivation that is taught using green chemistry practicum guides based on Discovery Learning with those who are taught using books used by students.

Keywords: Chemistry practicum guide, green chemistry, Discovery Learning, Keyword student motivation, learning outcomes.

1. INTRODUCTION

Chemistry is a branch of natural science based on experimental science, which means that the concepts contained in chemical materials can be proven through practicum activities. BNSP (2006: 177) states that in chemistry there are two things that are closely related and cannot be separated, namely chemistry as a product (chemical knowledge in the form of facts, concepts, theories, and principles) and process (scientific work). Both of these things can be achieved by students, one of which is through practicum activities. The success and effectiveness of practicum activities is supported by several factors, one of which is the eelevenstence of a practicum guide book. The practicum guidebook is one of the learning media which contains the implementation of practicum activities containing practicum procedures so that it can help teachers and students in the smooth process of practicum activities (Imalia et al, 2013). With practicum activities, abstract and micro chemical concepts will appear more concrete

and easier for students to understand. (Ayas, 2013). In addition, other research also reveals that practicum experiences in laboratories have been recognized as a way to achieve learning goals that can increase students' understanding of concepts in science and the application of scientific skills, problem solving abilities and scientific thinking habits. (Hofstein et al., 2007 and Siregar et al. 2020). In the Discovery Learning Learning method, teaching materials are not presented in the final form, students are required to carry out various activities to collect information, compare, categorize, analyze, integrate, reorganize materials and make conclusions. To see an increase in student learning outcomes using a practicum guide that had been developed, a trial was conducted at the Smart Pure Private High School.

2. LITERATURE REVIEW

Literature review is the basis of argumentation in assessing problems in order to obtain reliable answers. In the literature review will illustrate the flow of the

author's thoughts that have been summarized. Through literature review it is hoped that scientific truth, studies that have been done previously related to relevant topics and look for solutions that solve the proposed problem and enrich researchers in concepts, arguments and knowledge correct (Situmorang, 2010 and Panggabean et al., 2020).

2.1 Research And Development

Research and development is a process used to develop and produce products, designs and processes. Products resulting from development must be validated, (Borg and Gall, 1989). The results of development research are not only to develop an eelevensting product but also to find knowledge or answers to practical problems. Research and development methods are also defined as a research method used to produce certain products (Sugiyono, 2010).

2.2 Research And Development Steps

Broadly speaking, the ADDIE model development research procedure consists of:

- Conduct research and information gathering by observing or studying literature.
- Designing development research by formulating objectives and establishing learning sequences.
- Perform initial product development.
- Conduct limited trials of initial products that have been developed in the field. Trial data collection can be done through interview methods, observation to questionnaires, so that the initial product weaknesses are found.
- Make improvements and revisions to the initial product in order to obtain improvements in the educational product
- Conducting trials (evaluations) to measure the achievement of the results of the products being developed.

2.3 Green Chemistry

From the results of research and developing technology, chemistry plays an important role for the convenience of human life, but on the other hand, the progress and development of the chemical industry has a harmful impact on humans and the environment.

Anastas, PT, (2000) introduced the program and design of Green Chemistry products and processes that developed as a general research program, resulting from the interdisciplinary collaboration of university teams, research academics, industry, independent research groups, the scientific community and government

agencies, and each has its own program, connected with the twelve principles of Green Chemistry as a new approach to the application of processes and produce chemical products that are not dangerous, so that continuous development is carried out in the chemical science, technology, chemical industry, which minimizes the harm to human health (Wardenci , 2004; Arrends, 2008).

2.4 Discovery Learning

Discovery is a mental process in which students are able to assimilate a concept or principle. The mental processes in question include: observing, digesting, understanding, classifying, making assumptions, explaining, measuring, making conclusions and so on. With this technique students are left to discover on their own or experience their own mental processes, the teacher only guides and provides instructions. Thus discovery learning is a learning that involves students in the process of mental activities through exchange of opinions, by discussing, reading on their own and trying on their own, so that children can learn on their own.

Discovery learning method is a teaching method that focuses on student activities in learning.

The three main characteristics of Discovery's learner strategy are: (1) exploring and solving problems to create, combine and generalize knowledge; (2) student-centered; (3) activities to combine new knowledge and eelevensting knowledge.

Blake et al. discusses the philosophy of discovery published by Whewell. Whewell proposed a model of discovery with three stages, namely: (1) clarifying; (2) draw conclusions by induction; (3) proof of truth (verification).

3. METHOD

This research includes development research (research and development) and is modified with the model of Analysis, Design, Development or Production, Implementation and Evaluation. The steps or stages of research in the development of a practicum guide implementing the Analysis, Design, Development or Production, Implementation and Evaluation model are as follows:

3.1 Analisis Phase

Activities carried out at this stage as initial data are analyzing the eelevenstence, usability and completeness of chemical laboratory infrastructure for private and public high school schools. From this preliminary data, it can be concluded that a practicum guide is needed that can contribute to answering eelevensting problems. Then analyze the 2013 curriculum-based chemistry practicum guidebook that has been circulating.

3.2 Design Phase

Product design activities start from the main components systematically contained in the 2013 curriculum, starting from determining basic competencies, learning objectives, designing scenarios or teaching and learning activities, designing learning tools, and evaluation tools for learning outcomes and activities along with their rubrics as a basis for assessing activities (performance). In the design stage, the researcher prepares the initial product (prototype) or product design. It is a systematic process. The initial design of the product is conceptual and serves as a basic design for development.

3.3 Development Phase

The development carried out in the ADDIE model (Analysis, Design, Development or Production, Implementation and Evaluation) is a product design realization activity. At this stage, the conceptual framework is realized into a product that is ready to be implemented. The development steps taken are: (1) Designing the appearance of the practical guidebook; (2) Developing product designs (practicum material) required for development; (3) making instruments to measure the performance of practicum guides, in the form of motivation and learning outcomes; (4) based on results, at this stage the products are made according to the Discovery Learning model.

3.4 Implementation Phase

This is the stage of using the design of a new practicum guide that has been developed and applied in the classroom. In actual conditions. Prior to the implementation of the practicum, students were given a preliminary test on chemistry lessons. Then the Green Chemistry chemistry practicum activity was carried out based on Discovery Learning learning. At this implementation stage, student activity data were collected in applying the practicum guide that had been developed by the researcher. At this stage, it aims to see the shortcomings and strengths of the practicum guide that has been developed, as feedback from the evaluation process.

3.5 Evaluation Phase

Evaluation aims to measure the final competency of the practicum guide delivered, the learning objectives to be achieved and as feedback to the researcher. Based on the results of the evaluation and the sections that have not been covered in the new practical manual, revisions will be made. Evaluation is carried out by giving questions and motivation questionnaires to determine the learning outcomes obtained after participating in learning and the level of student motivation.

4. RESULT AND DISCUSSION

After conducting the prerequisite test, namely the normality test and the homogeneity test of the data, it was obtained that the data were normally distributed and homogeneous, so a hypothesis test could be carried out using the SPSS 21.0 For Windows program. So based on hypothesis testing with SPSS 21.0 For Windows, it is found that there is a difference in the improvement of student learning outcomes carried out by the One Sample T-test which was taught using discovery learning-based chemistry lab guides for chemistry lab guides for the experimental class and the control class. The results of hypothesis testing can be seen in Table I.

Table 1. hypothesis test results

Class	hypothesis test	
	Sig	α
Ekperimen	0,000	0,05
Kontrol	0,000	0,05

Based on Table 1 above, it can be seen that the significance value is 0.00. H_a is accepted if the value is $\text{sig.} < \alpha$ (0.05) and simultaneously rejects H_0 . Based on the data calculation, the sig value is obtained. $(0.00) < \alpha$ (0.05) which means that H_a is accepted, so it can be concluded that there is a difference in the improvement of student learning outcomes using discovery learning-based green chemistry lab guides with students' handheld chemistry lab guides for the experimental class and the control class.

Based on the data obtained, there was an increase in student learning outcomes who were taught using a chemistry lab guide green chemistry based on Discovery Learning with those taught using books used by students, with student learning outcomes scores ($\text{Sig} < \alpha$) and ($t_{\text{count}} > t_{\text{table}}$), namely $(0,00 < 0.05)$ and $(3,288 > 2,000)$. There is a significant increase in the learning motivation of students who are taught using the green chemistry lab guide based on Discovery Learning with those taught using books used by students.

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