

Development of Practical Guidance based on Research to Improve Science Process Skills and Learning Outcome in Biology Education Students

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Article History

Received : 01-11-2021 Revised : 03-03-2021 Accepted : 15-04-2021

Keywords: Practical Guidance, Science Process Skills, Learning Outcomes, Development

Article link



Efforts to improve students' understanding of science process skills in learning the Animal Development Structure subject are developing a research-based Practicum Manual for the Structure of Animal Development course. The purpose of this research is to develop a researchbased Practicum Manual Structure of Animal Development courses that are suitable for use as a learning resource and experiment in the Structure of Animal Development course. The development of laboratory engineering modules uses the ADDIE development model (Analyze, Design, Development, Implementation, Evaluation). This research is a development research and uses questionnaire and test instruments. The data were analyzed descriptively qualitatively and the results were analyzed using the Gain normality test. Experts in developing teaching materials and materials assess that the lecture modules developed are of good qualifications and are suitable for use. The trial results on a limited scale as well as the lecture module field tests are in good qualifications.

Abstract

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Introduction

The Natural Sciences cluster is a science that develops from observing natural phenomena and the interactions that occur therein, including Biology. Natural Science is essentially built on the basis of scientific products, scientific processes and scientific attitudes. In addition, natural science is seen as a process, as a product, and as a procedure (Trianto, 2010). Science plays a role in increasing people's knowledge about the use of natural resources or increasing people's understanding of natural phenomena in their daily lives. As a process, Natural Science is a process used to study objects of study, find and develop scientific products and as an application, Natural Science theories will give birth to technology that can make life easier (Mardiani, 2015).

Biology, as a branch of Natural Sciences is a science that is learned based on process skills, where learners are educated to discover and develop their own facts and concepts (Yuniastuti, 2013). Science process skills themselves are very likely to be obtained from natural phenomena that are around them which include the stages of observing, clarifying, communicating, measuring, predicting and concluding. These science process skills are the basis for the development of scientific attitudes in students that can be implemented in lectures.

Some research results indicate that the use of modules designed with a research approach will improve science process skills in students (students and students). Research conducted by Rosa (2015), shows that there is an increase in learning outcomes and an increase in students' science process skills on the subject of Pressure. The module with the research approach developed by Wenno (2010) is effective for developing science process skills of students in the science learning process.

Methods

The stages in this research follow ADDIE instructional design development. These stages have covered the entire research starting from preparation, implementation, to the final stage of the research. This research is a development research with the ADDIE model implemented with a quasi experimental method. The design used the pretest-posttest nonequivalent control group design that is integrated with the ADDIE development stages (Arikunto, 2010). In the experimental group, there were two groups of students, namely the experimental group and the control group. For the experimental group, the Structure of Animal Development practicum lecture was carried out by using the development results practicum manual. Whereas in the control class used learning resources and lecture methods according to the RPS.

The data in this study and the collection techniques are as follows:

- 1. Data on science process skills were obtained using essay test instruments and observation sheets at the beginning of the study (analysis stage) and at the end of the study (evaluation stage), one test each.
- Data on the development of the practicum manual were obtained using several instruments, including:

 Questionnaire student responses to find out the readability of the practicum manual developed, which was filled in by students at the Development stage.
 - b. Validation sheet to find out the results of the validator's assessment (expert lecturer in teaching material development) related to the structure of the practicum manual developed. On the validation sheet there are items that must be assessed and a suggestion column for revision of the practicum manual. The validation sheet is filled out by the validator at the development stage.

Data processing techniques are distinguished for data in the form of science processing skills, and data in the form of notes on the development of practicum manuals that have been carried out.

1. Science Process Skills Data

Data obtained from the pre-test and post-test prior knowledge of science process skills and observation sheets. This is done to find out that there is a significant difference between the science process skills of students who learn using a practical manual based on science process skills and without a practical manual based on science process skills in Structure of Animal Development lectures. Analysis of the value of Science Process Skills using the N-Gain scale.

2. Data Development of practical guidance based on Animal Development Structure lectures science process skills.

Data regarding the development of the practical guidance will be analyzed using descriptive analysis, both qualitatively and quantitatively. Qualitative descriptive analysis was carried out to process data from expert reviews. Data processing is done by grouping qualitative data information in the form of responses and suggestions for improvement from expert validators of teaching material development. Meanwhile, quantitative descriptive analysis was carried out to process the score data from the validation sheet. After the validation sheet is collected, the percentage of each question item will be calculated on the validation sheet with the following equation:

$$P = \frac{\sum x}{\sum xi} \ge 100\%$$

Results and Discussion

Researchers collected preliminary data about research subjects in the form of science process skills and student learning outcomes obtained from the pre-test in both the control class and the treatment class. The results of the initial data on science process skills and student learning outcomes are used for the development of teaching materials in the form of practical manuals. The pre-test results of the control class and the experimental class were not too different. The value taken is the cognitive value and science process skills of students. This initial data collection is important to map and design the practical manual to suit the needs of students.

At this stage, researchers designed a practical manual for the Structure of Animal Development course based on the Biology Education study program curriculum, Semester Learning Plans for Animal Development Structure (practice) course, and the results of preliminary data on student science process skills. At this stage, an outline of the contents of the practical manual on the Structure of Animal Development is also made. The compiled practicum book contains the basic theory of practicum material, practicum methods carried out by students, and evaluation questions to measure cognitive aspects and science process skills. The practicum materials prepared are: introduction to animal tissue and microtechnics, reproductive organs and gametogenesis in mice, fertilization and implantation, frog embryo development, organogenesis in chickens, and metamorphosis. The selection of this material is based on the

semester learning plan that applies to the study program. In addition, this material is material that allows students to practice.

The process of developing a practicum book starts from lowering the teaching materials that will be practiced. Develop an appropriate practical theoretical basis, design practicum activities, explain what data students must collect in observation sheets, and evaluation questions to measure cognitive aspects and science process skills. After the module is developed, the module will be validated by material experts, and media development expert and the readability of the module will be tested by 10 biology education study program students. Based on the validation results and limited legibility tests, the module will be revised and improved.



Figure 1. Comparison validation score on material and media aspect

Score of validation results by material experts is 149 out of a maximum total score of 165. The items that are scored are the aspects of the feasibility of the content, the feasibility of language and the feasibility of presenting the material. Suggestions from the validator regarding the practical manual before use in learning are the addition of motivational sentences at the beginning/end of practicum activities and pictures to complement the material or theoretical basis in each practicum activity. For the validation score obtained from media development experts is 53 out of a maximum score of 70. There are 3 aspects of the assessment, namely the size of the book, the design of the book cover and the design of the book content which includes 14 indicators. Based on the score obtained regarding the quality of the practicum manual, it can be used with a few revisions before being applied to learning. Suggestions and input from media development experts are that the uniformity of fonts is made of only 1 type or a maximum of 2 types of fonts for harmonious book design, adjustment of margins for the proportion of paper sizes, as well as adding schemes / images related to practicum material / theme.

In addition to being assessed by the validator, the readability of the practicum book draft was also assessed by students on a small scale. For limited readability results or limited testing of practicum books, 10 students showed that 3 out of 10 students gave suggestions about the layout of images or schemes in the practicum book. Eight out of 10 students are satisfied with the content of the material, the design of practicum activities and the use of language that is easy to understand in the practicum manual.

Practicum Handbooks that have gone through validation tests, legibility tests and have been revised then implemented / applied to treatment classes. At this stage, the control class is given the freedom to access Structure of Animal Development material from source books obtained in libraries and from internet sources, while in the experimental class students are given Practical Handbooks to use as materials or learning resources. The post-test was carried out after students from both the control class and the experimental class had studied their respective learning resources.

Researchers assessed the effectiveness of the Structure of Animal Development Handbook seen from the increase in the value of science process skills and student learning outcomes (post test results) in the control class and treatment class. The results of the effectiveness test can be seen in table 1.

No	Evaluation Score	Control Class		Experiment Class	
		Pre-test	Post-test	Pre-test	Post-test
1	Cognitive score	70	73	72,6	85,8
2	Science process skills score	73	79	75	89
2	Science process skills score	73	79	75	89

Table 1. Results of the effectiveness test

Based on the results of book development according to ADDIE Instructional, the Practical Guidance Structure of Animal Development was successfully developed and passed the feasibility test based on the validation results of material experts and media experts and the results of usage tests to students. The development an Structure of Animal Development Practical Guidance is very helpful in providing an overview of practical activities and materials as well as a description of what the actual stages of the stages occur when an animal develops or experiences a developmental process from zygote to individual.

The results of the development of the practicum guide that have been compiled can be seen in Figure 2. This is the final practicum guidebook resulting from development, validation and revision and is ready to be used in learning.



Figure 2. Display of the Structure of Animal Development practicum manual

In addition, practicum instructions interspersed with related material provide an overview of the animal development process so as to increase student understanding and science process skills of students. In controll class, get 0,25 for N-Gain score and 0,83 for experiment class. The results showed that the Animal Development Structure Practicum Manual could improve students' science process skills, especially in the Animal Development Structure Practicum course, which was marked by an increase in the post-test score after learning using the module compared to the pre-test score.

Conclusions and Recommendations

The Science Process Skills of Tidar University Biology Education Students increase along with the implementation of the Practical Manual of Animal Development Structure in the learning / practicum process. Development of Animal Development Structure Practicum Manuals can improve students' science process skills and student learning outcomes (cognitive).

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