Preliminary study on development of practicum module for algorithms and computer programming course

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Abstract. Physics is part of Natural Sciences. Studying physics is inseparable from the existence of quantities. Quantities itself are anything that can be measured and expressed in numbers. These numbers then give birth to an empirical formula and a model that represents physical phenomena in nature. Physics students are expected to master, understand, and be able to apply physics knowledge to find solutions to physical problems. Lately, the use of computers has been integrated in almost all aspects of science, including physics. Based on these conditions, a computer-assisted calculation method known as a computational method has developed which is very precise and can involve large amounts of empirical data. On this basis, the Algorithm and Computer Programming Course was born, which focuses on providing programming skills to physics students so that they are able to use computers to calculate existing empirical physics formulas and mathematical models and for this purpose, critical and creative thinking skills are needed. The research carried out is a type of research and development (R&D) using the 4-D Model. This paper presents the results of research that has been carried out and shows the need for a needs analysis and the urgency of changing the use of a new programming language for students to better understand algorithms and coding. Data were collected by distributing questionnaires and analyzing literature.

1. Introduction

Physics is part of Natural Sciences. Studying physics is inseparable from the existence of quantities. Magnitude itself is anything that can be measured and expressed in numbers [1]. These numbers then give birth to an empirical formula and a mathematical model that represents physical phenomena in nature. Physics students are expected to master, understand, and be able to apply physics knowledge to find solutions to physical problems [2]. To find such a solution, the ability to analyze conditions and make an inventory of the available parameters is needed. In addition, the ability to think critically and creatively is also needed to support the achievement of the expected results. With this condition, ideally, physics students can be formed who are able to analyze physical problems using analytical methods.

Along with the times, the use of computers has been integrated in almost all aspects of science, including physics. Based on this condition, computer assisted calculation method known as computation method developed. The advantage of computational methods is that calculations can be performed very precisely / accurately and can involve large amounts of empirical data, which analytical methods have limitations for this. On this basis, the Algorithm and Computer Programming
Course was born, which focuses on providing programming skills to physics students so that they are able to use computers to calculate empirical formulas of physics and existing mathematical models. This course gives students the ability to compile algorithms to solve physical problems. After the algorithm is obtained, it is followed by making a series of computer commands with a specific programming language. To be able to do this, critical and creative thinking skills are needed [3]. Students are expected to be critical in analyzing problems and creatively in designing appropriate, practical and efficient algorithms [4] [5]. To be able to do this, students are given theoretical concepts in class and programmed practicum activities so that students are expected to be able to apply them actually.

This research focuses on student practicum activities and there are several current conditions that need to be considered. First, the strategy currently being implemented has actually been able to build students' critical and creative thinking skills, but in recent years it has started to diminish. This is thought to be due to a change in the mindset of students, especially in the era of the Industrial Revolution 4.0 so that it is necessary to apply a new approach so as to be able to provide better algorithm design and programming skills than before. The approach that the researcher will try to apply is Cognitive Conflict which is considered capable of developing students' critical and creative thinking skills [6]. Second, the programming language used today is the Pascal Programming Language. This programming language is good for building student mindset, but the problem now is its compatibility and application. Turbo Pascal software is compatible with the Windows XP Operating System, Windows Vista and some versions of Windows 7, but not compatible with the Operating System for some versions of Windows 7, Windows 8 and Windows 10. In addition to the operating systems commonly used today are dominated by Windows 8 and Windows 10, exe files generated from Pascal programming also cannot be run because of the incompatibilities of the Turbo Pascal software itself, which causes it to be less applicable. Researchers assess the Matlab programming language as more compatible and applicable than the Pascal programming language. Moving on from this condition, researchers feel the need to develop a practicum module that applies cognitive conflict strategies and converts the use of the Pascal programming language to the Matlab programming language.

2. Research Methods
This research is a Research and Development (R&D) research. This method is used to produce certain products and test the effectiveness of these products. The type of R&D research model used is the 4-D model which includes Define, Design, Develop and Disseminate. However, in the implementation of this research it is only limited to Develop, while for Disseminate it is planned for further research in the following year. The data presented in this paper are data obtained at the Define stage. Data collection was carried out through distributing questionnaires to students who took Algorithm and Computer Programming courses in the 2019/2020 academic year.
3. Result and Discussion
At this stage, the researcher collected data in the form of distributing questionnaires to students of the Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang who had and are currently taking Algorithm and Computer Programming courses while there are 4 main points that form the basis for developing this module, including the following

3.1. The need for updating the practicum module used by students today

![Figure 2. The need to update the practicum module]

The development of computer technology today has an effect on the development and changes in the mindset and learning orientation of students. The change in student's mindset can indirectly result in no longer suitable way of delivering the material presented in the practicum module that has been used so far. Based on these considerations, there is a need to update the practicum modules used in algorithmic and computer programming courses. For this reason, questionnaires were filled out for a number of students who were taking algorithm and computer programming courses to find out whether or not an update was needed on the existing practicum module. This preliminary study shows a high level of need from students for updates to the practicum module. It can be seen that seventy-two percent (72%) of students want an update from the practicum module that has been used so far.
3.2. The need for the introduction of a new programming language that follows current technology developments

![Figure 3. The need to use a new programming language](image)

The current development of computer technology has indirectly resulted in the development of the programming language used, which is simpler and easier to use and easy to learn. On the basis of these considerations, this study considers the need to renew the use of the programming language used in the practicum module to a newer programming language that is also compatible with existing computer operating systems.

The preliminary studies that have been carried out indicate a need for students to be introduced to new programming languages which are of course adapted to the times and technological developments. Eighty percent (80%) of students expressed a response to an update on the programming language used in algorithms and computer programming courses. This data then becomes the basis for researchers to offer new programming languages for students who are deemed able to bridge the needs of these students with technological developments.

3.3. The need to use a different and new approach in delivering lecture material

![Figure 4. The need to use a new learning approach](image)

The preliminary studies that have been conducted also indicate the need for a new approach in presenting practicum activities in the practicum module for students. Sixty-five percent (65%) of students stated the need for a different approach or a new approach in delivering practicum activities in the practicum modules used by students. These results then become the basis for the application of the cognitive conflict approach in the practicum module that the researcher will develop.
3.4. The need to facilitate the pattern of lecture activities by looking at student learning patterns at this time

![Figure 5](image)

Figure 5. The need to facilitate the pattern of lecture activities needed by students

The preliminary study shows the initial data on the lecture pattern desired by students. Of course, these results cannot fully be used as a basis in determining what methods will be used in the delivery of practicum material in the practicum module that the researcher has developed. This is because these results are relatively subjective from the student's point of view where they do not fully understand the constructivist learning patterns. Even so, this data is still needed as a consideration in choosing the approach to be used in the practicum module to be developed.

4. Conclusion

The results of the preliminary study show that it is very necessary to renew the structure of Algorithm and Computer Programming lectures, both in terms of explanation of material in class and in terms of practicum in the laboratory.

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