The Guided Inquiry Framework of the Virtual Programming Lab (VPL) Micro learning-based for Improving Programming Algorithm

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Abstract

The implementation of learning at vocational colleges in the Covid-19 era, which is required to be carried out online, raises many obstacles, especially in practical learning, effective learning methods, and technical implementation problems. However, these obstacles can be overcome by implementing a virtual programming lab (VPL) based on micro-learning so that students can carry out online programming practices using mobile devices or smartphones. The Virtual Programming Lab (VPL) module in e-learning provides a programming environment consisting of an editor, compiler, assessment, and plagiarism checker. The micro learning-based VPL framework is conceptually designed with the guided inquiry method to increase students' self-study motivation, can be done anytime and anywhere, and can create collaborative learning because it is adapted to the interests and learning habits of Z-generation learners. The framework model is validated by e-learning experts, instructional experts, and programming algorithm experts. The results show that the developed framework model is valid. While the usability perception aspect of the subject of the Informatics Engineering Study Program, University of Technology Akba Makassar indicates that most students can accept the use of the VPL framework in e-learning

Keywords: *Virtual programming; Micro-learning; Framework; Algorithms programming.*

INTRODUCTION

Information and communication technology development impacts education, such as distance learning and increasing learning resources (G. Shivacheva et al, 2017). One of them is that the virtual programming lab (VPL) allows practical distance learning and offers several advantages over traditional teaching methods. The emergence of the corona virus (covid-19) requires all learning to be carried out online, so online interaction between students and lecturers is a must, especially in vocational higher education where students are directed to develop applied skills where the learning process is more practical that can be adapted in the work field (K.C. Dewi et al, 2019). Online learning makes students unable to do practical learning, which is usually only done offline. However, online practical learning requires an effective method and can overcome technical obstacles in its implementation. However, these obstacles can be overcome by implementing a virtual programming lab (VPL) based on micro learning. Students can carry out online programming practices from anywhere and anytime via mobile devices or smartphones (B Joyce et al, 2015). Students receive a virtual programming lab, making progress in collaborative learning (N Jensen et al, 2004)

University of Technology Akba Makassar has developed a lot of content for practical learning of algorithms and programming, which is available on the internet at: https://e-macca.akba.ac.id/ and https://e-lgoritma.id/. This makes the learning process easier for students. Another advantage is the

lessons can be repeated several times and at a convenient time and place for the student. In this case, the algorithm is practiced and studied individually. Through the application of the Virtual Programming Lab in teaching programming practices, students can be more motivated and improve students' cognitive abilities and algorithm problem-solving abilities (G. Shivacheva et al, 2016).

BACKGROUND

Virtual Programming Lab (VPL)

"Virtual Programming Lab" is a programming laboratory that interactively uses distance access to a real laboratory for experiments (M Cardoso et al, 2018). The implementation of VPL in a Learning Management System (LMS) is able to provide an online programming practice environment to solve programming algorithm cases. Language VPL also has automatic and semi-automatic assessors and plagiarism detection and offers features that can be configured according to the programming case given by the lecturer. (K Culligan et al, 2020). In this case, the lecturer can create their own assignment assessment rubric that will automatically assess student programming assignments. Thus, students will get feedback automatically when doing programming coding practice using VPL so that students can find out program errors that have been made.

The VPL architecture consists of three elements(M Cardoso et al, 2020). as follows: 1. Moodle module; This module functions as a Moodle plugin for use in Moodle LMS. The features of this module are assignment submission management, assessor, and plagiarism checker. 2. Program code editor that can be run in a browser. This element allows users to edit, run, and test programs that have been created without installing a compiler 3. A server provides an environment or container where programming tasks are executed and evaluated online and securely.

Micro learning

Micro learning focuses on the duration of learning (e.g., with mobile learning) with a short time (usually a few seconds) to 15 minutes (G Sun et al, 2015).. Micro learning is Web e-learning, referring to short-term learning activities in small learning units. In the contemporary mobile or web society, micro learning relates to a small share of knowledge from web resources (P Sani, 2020). With smartphone devices, students can complete learning missions in a short duration (J. Skalka, 2018). In establishing micro-learning content, there are several important things to note; learning content should focus more on what is put in the content, not on how long it takes to learn it. At least the micro learning content should be interesting for learners; it can increase knowledge for those who access it; gives important and clear points for the viewer, and help students transfer knowledge (M. Berkowitz et al, 2019).

Programming Algorithm Learning

An algorithm is a clear and structured instruction sequence to solve a computational problem to obtain an output from an input in a limited time (A.Levittin et al, 2020, and R Munir et al, 2016). The processor in the algorithm must: 1) understand each step in the algorithm; 2) carry out the operations in accordance with the steps (L Godschaler et al, 1987). Micro learning on programming algorithm learning is based on a regular rotation of micro-content and micro activities. The content is usually offered as short text, sometimes combined with images, tables, graphics, or programming source codes (J. Skalka et al, 2021). Learning algorithm programming is a series of activities that involve lecturers, students, and lessons to gain knowledge, understanding, attitudes and behavior, skills, and changes in the other aspects that exist in individual students (G Maulana et al, 2017).

The basic idea of the Framework

The implementation of the framework is conceptually and technologically focused, which will not be relevant without innovative content. The framework description is designed by following the student's psychology and the characteristics of Z- the generation. Two important technology concepts in learning programming algorithm courses based on micro learning are micro learning content and virtual programming lab (VPL). Source code in programming will be assessed automatically; micro learning in its current form is a relatively new learning concept developed with the smartphone. The guided inquiry teaching model in micro learning-based learning can foster the student's self-study motivation in exploring knowledge because the knowledge reconstruction process can occur according to the student's needs. Learning activities become interesting because they are designed and carried out independently according to the student's abilities and can train them in scientific investigations (E. Joyce et al, 2018).

MATERIALS AND METHODS

Step 1: Research and Data Collection

The steps in this research include the following activities: 1) problem analysis; 2) needs analysis based on the results of preliminary studies, learning motivation, characteristics of Z-generation learners, curriculum as well as theoretical and empirical studies related to the theory and the results of virtual programming lab of micro learning based research.

Step 2: Development and Implementation

Then the development and implementation steps are carried out to get a framework model and a micro learning-based tool framework for practical learning of programming algorithms. The development results are validated by Multimedia Learning experts, e-Learning experts, and field experts. A valid framework model was implemented and tested to determine the usability perception of 90 respondents from the Information Technology Department, University of Technology Akba Makassar. So that it can produce an inquiry learning framework model for the practice of micro learning-based programming algorithms that are valid and feasible to use.

RESULT AND DISCUSSION

The results of the development of the micro learning-based VPL framework and the implementation test results are in the form of student perceptions about the application of the micro learning-based VPL framework for practical learning of programming algorithms.

Conceptual Framework PVL Micro learning-Based

Figure 1 shows the framework model. The main actors are students, lecturers, and the learning environment. 1) Student actors carry out activities in the learning environment to complete the lesson's topic. Each lesson is designed to be micro-learning-based content. The duration of each content is no more than 15 minutes; 2) lecturer actor: developing content (lessons, videos, modules, quizzes/cases). Form small groups (consisting of a maximum of 5 people) for collaborative activity (discussion); 3) Learning environment: the set of tools (e-learning, app PVL)
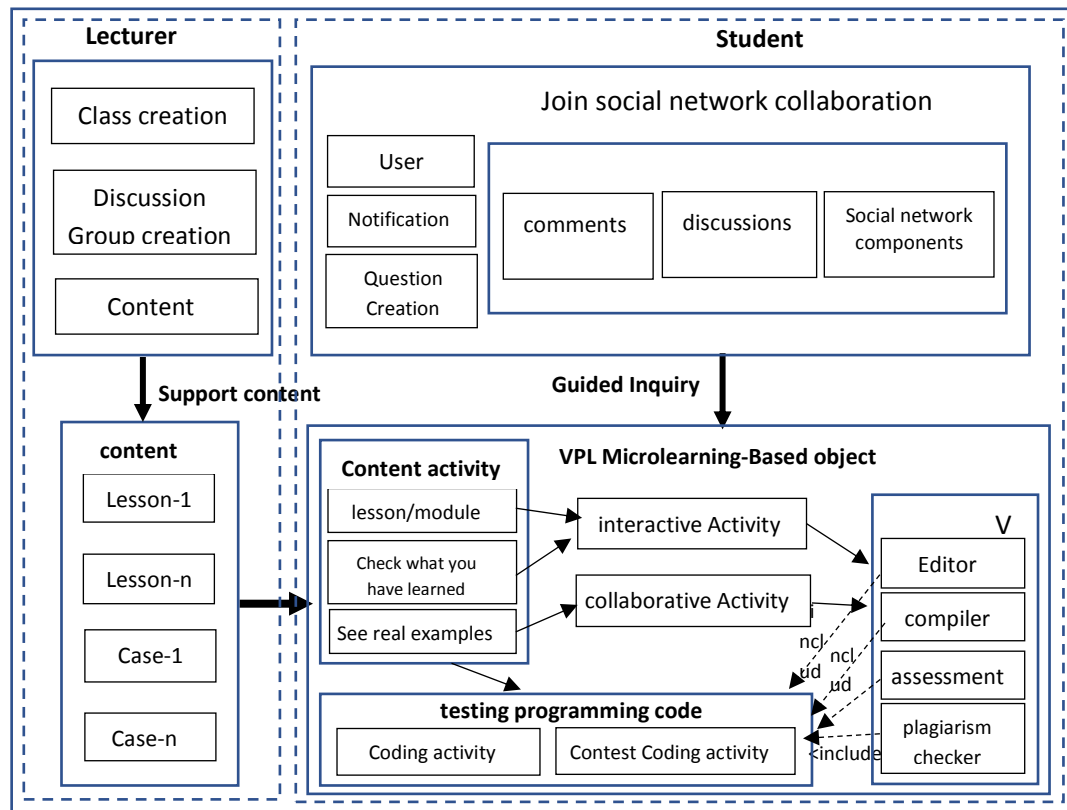
Figure 1. Conceptual Framework PVL Micro learning-Based

The more complex activities of the framework are as follows:

a. Content: The series of activity topics combine interactive materials and activities (lessons, cases, and program coding).

b. Collaborative activity: students carry out activities that discuss the program code with groups based on cases.

c. Interactive Activity: Containing questions or assignments which require the student's activities or reactions. This activity will also support offline mode.

d. Coding activity: The activity that sends programming code to the server and obtains its correctness evaluation. This activity requires guidance from the lecturer (guided inquiry)

e. Contest: a single task or sequence of code activities in which the correctness, speed, and effectiveness of written source code are assessed.

f. Testing programming code using PVL, including a code editor, compiling, assessment, and plagiarism checker

g. lessons: sequences of activities, combining learning content and interactive activities (problem cases, code activities),

h. Cases: the lecturer gives problem cases, then students do coding activities independently with a guided inquiry strategy.

i. Interactive activities with the content: Check what you have learned from the module. programming practice with examples

j. each activity is carried out by micro learning with a short duration (maximum 15 minutes) by using a mobile device

Syntax The framework Of The VPL Micro learning-Based:

Phase 1: Giving problems to the students

1. Via the practice module with the guided inquiry method, the lecturer gives problems to the students in the form of questions that must be answered through Practice.
2. Lecturers accompany the students either online in preparing practical processes, preliminary reports, or reports on analysis results to achieve the goals that have been set.

Phase 2: Data Collection through Theoretical Verification

1. Students compile algorithms and programs based on the theory studied according to the objectives that will be achieved.
2. Students collect analysis data programs that will be tested through theoretical verification.

Phase 3: Data Collection through Practice

1. Students test the programs that they have made through online applications (virtual programming lab)
2. Students practice obtaining the data needed to prove the allegations about coding programs they have made through an online task.

Phase 4: Presentation and Practical Data Analysis

1. Students classify the data based on the variables they investigate (input and output data)
2. Students present practical data in the form of analytical reports from the series that they are investigating.
3. Students compare practical data with the data from theoretical verification results.

Phase 5: Discussion and Conclusion

1. Students conduct discussions in the form of elaborating the data analysis results.
2. Students answer the questions given in the preliminary assignment based on the data analysis that is conducted.
3. Students conclude the practice results that are conducted.

The results of the validation of the micro learning-based VPL framework model

Expert judgment determines the micro learning-based PVL framework model for practical learning of programming algorithms with criteria of validity and practicality. Figure 2 presents the test results of the two indicators in a histogram.
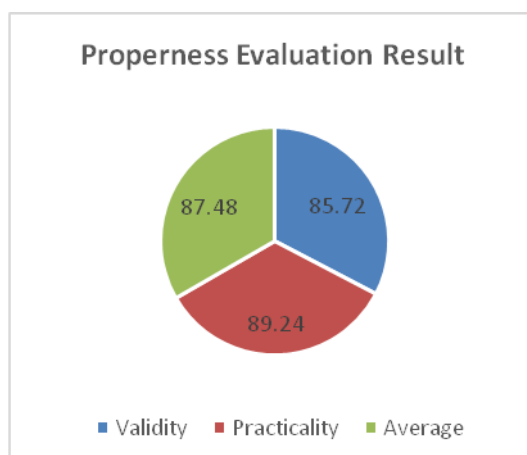

Figure 2. Properness Evaluation Result

Validity and practicality obtained an average of 87.48%, indicating that the micro learning-based framework model is feasible to be used as a micro learning-based framework model are feasible to be used as a micro learning-based VPL framework model for practical learning of programming algorithms.

Meanwhile, the evaluation of student perceptions is to determine the usefulness of the framework model with the criteria of usability, satisfaction, ease of use, and ease of learning. The distribution of questionnaires was carried out to determine respondents' perceptions of the developed learning media. The questionnaire has four indicators; (1) usefulness, (2) satisfaction, (3) Ease of use, and (4) ease of learning. Figure 3 shows the test.
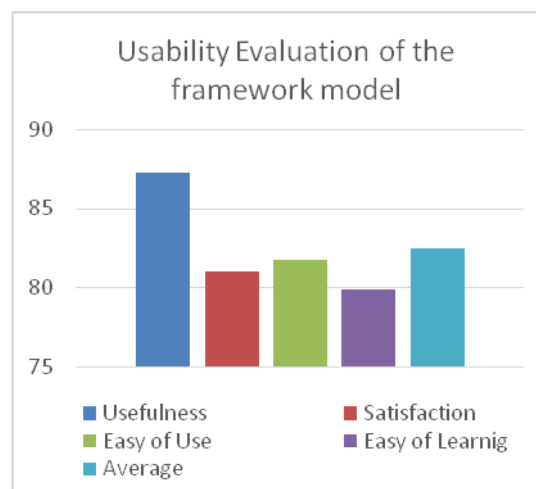
Figure 3. Usability evaluation results

Figure 3 shows the average score of 82.46%. Thus, the micro learning-based framework model for practically learning programming algorithms is categorized as useful.

CONCLUSION

The framework of Virtual Programming Lab (VPL) Micro learning-based for practical learning of programming algorithms is web e-learning in which learning activities are student-centered. The activity content is delivered in small, focused pieces, with a duration of fewer than 15 minutes, improving students' programming algorithm skills. The proposed application framework applies innovative methods so that learning can be carried out anytime and anywhere, creating collaborative learning. This innovation is in line with the learning habits of Z-Generation-Z. The results show the improvement of students' programming skills, the increase in self-study motivation, and maintaining students' interest in acquiring the necessary skills in programming algorithm subjects.

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