



# Programming Learning Strategy Using Virtual Lab

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**Abstract.** This study brings virtual technology into the experimental class to monitor student activities in learning programming. The problem that has occurred so far is the difficulty of monitoring student activities it has an impact on student motivation and learning outcomes. This study describes a modern teaching strategy that outlines the basic principles of teaching programming in the classroom. The recommended method for implementing teaching is designed according to MOOCs (Massive Open Online Courses). The teaching strategy explores the design concepts and implementation details of virtual laboratories by integrating teaching strategies through inquiry and collaboration. The virtual platform encourages the development of student's abilities to be active, reflective, thinking, and creative in the 16 designed lecture meetings.

**Keywords:** Virtual Lab · Programming Class · Inquiry · and Collaboration

## 1 Introduction

The era of digital technology has enabled every student to develop their talents and potential through knowledge supported by technology [1]. Creating a new learning environment in the 21st century is done to prepare students to become graduates who have ICT-driven knowledge and skills. ICT-based learning can use learning media such as videos, presentations, interactive multimedia, simulations, media games, and vlogs. Apart from that, creating virtual learning can also use augmented reality, virtual reality, the use of robotics, and online learning such as e-learning, blended learning, MOOC, and distance learning [2]. So that various breakthroughs are made so that the strategies and teaching methods are by the objectives, especially strategies in practicum learning for programming [3].

The teaching strategy for practicum in a programming learning environment includes learning theory as a basic element in the form of programming algorithms with mastery of skills in a modern environmental approach [4, 5]. Research [6] said the failure of learning programming 33% was caused by ineffective problem-solving strategy skills, 26% of programming was difficult, 11% inability to solve problems, 7% by learning style and motivation, 7% did not apply the correct algorithm, 6% wrong perspective about computers, 6% lecturer-centered learning and 4% lack of human interaction.

Various programming learning strategies are offered by several researchers. Among them is a web-based learning approach by applying the Collaborative Project-Based Learning (CPjBL) model using the Moodle application [6]. Moodle is a software application used for e-learning activities [7]. This learning strategy constructs knowledge by giving assignments in the form of projects. In research [8] a comparison of learning programming with three different learning strategies is carried out. Results The results of the t-test with the post-test t-test showed a very significant difference in student final results. Where inquiry-based learning strategies have higher cognitive value than traditional and problem-based strategies.

Programming learning strategies introduce and promote inquiry-based learning (IBL) [9]. However, this strategy has not been able to solve complex problems so that students have the attitude and motivation needed in designing activities related to social development and knowledge [10, 11]. Next [12] states creativity and teamwork are necessary for innovating and generating knowledge. So a problem-solving strategy involving lots of logic programming activities was also proposed by [13].

Designing activities that incorporate collaborative learning and inquiry into virtual labs is one of the most challenging and exciting endeavors currently in schools [14]. Virtual Labs (VL) are the most popular alternative to traditional labs [15]. Preparing a virtual laboratory requires two main parts, namely a theoretical part and a practical part that will be used for computer applications [16]. In this study, experiments were carried out in small groups for programming learning strategies with VL. Programming learning strategies were applied to 16 lecture meetings with 7 syntax steps [17].

## 2 Programming Learning Strategy

Researchers from the literature review researched strategies to help students learn computer programming to improve their understanding and programming skills. The strategy in the VL learning environment is designed to make it easier to monitor student activity during practicum [18]. Computer laboratory design for lecturers and students can be seen in Fig. 1

In Fig. 1 the client computer, namely students as users connected to the lecturer's computer. Figure 2 is that lecturers can monitor student computers and manage the learning process.

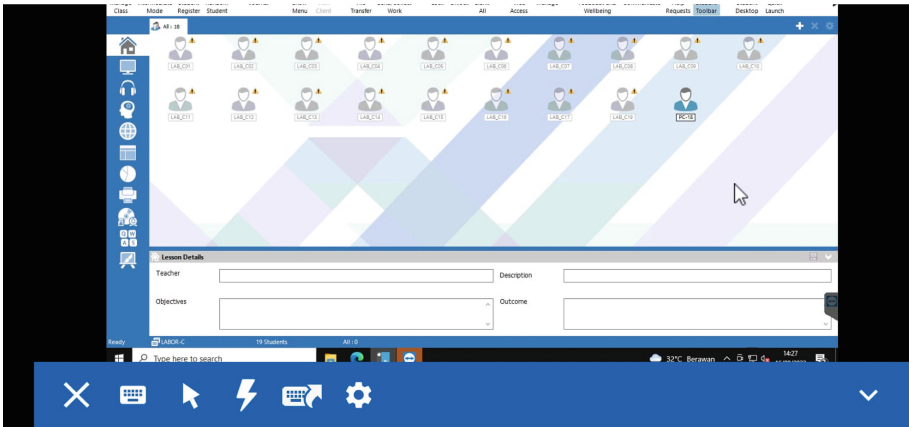


Fig. 1. Users in a Virtual Laboratory

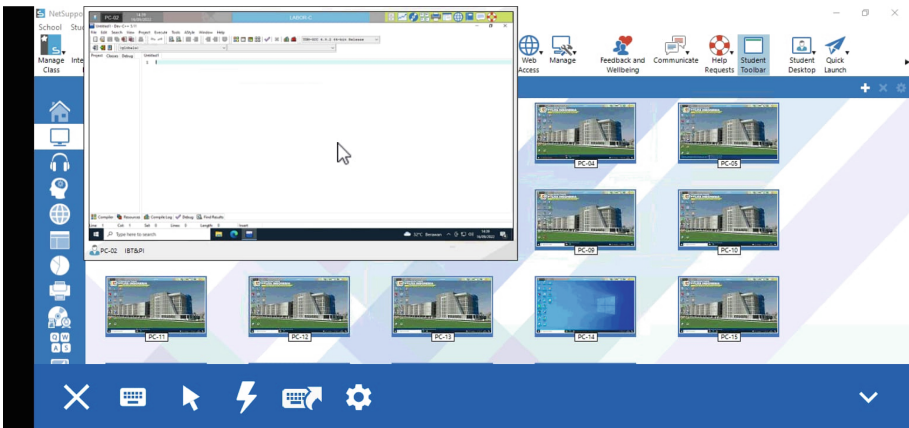


Fig. 2. Learning activities on the VL platform

### 3 Stages of Learning Strategies

The programming learning activities at 16 meetings with collaborative inquiry strategies on the VL platform are described in Table 1.

**Table 1.** Programming Learning Activities

<b>Sunday</b>	<b>Goals</b>	<b>Activity</b>
1–3	Goals and Motivation	Provide goals and motivation so that there is an interest in participating in learning.
	Presenting Information	Explanation of concepts to see the flow of student thinking.
	Identification of problems	Identify problems in everyday life
	Forming Online Discussion Groups	Grouping heterogeneously
	Proses Inquiry	Emphasize maximum student activity to seek and find knowledge. Lecturer as a facilitator and motivator
	Applying New Knowledge	Showing performance as a skills value use programming language
4–7	Goals and Motivation	Provide goals and motivation so that there is an interest in participating in learning.
	Presenting Information	Explanation of concepts to see the flow of student thinking.
	Identification of problems	Identify problems in everyday life
	Forming Online Discussion Groups	heterogeneity grouping
	Inquiry Process	Emphasize maximum student activity to seek and find knowledge. Lecturer as a facilitator and motivator
	Applying New Knowledge	Performing a skill value using a programming language
8	Evaluation	The lecturer gives an initial evaluation/midterm exam
9–12	Goals and Motivation	Provide goals and motivation so that there is an interest in participating in learning.
	Presenting Information	Explanation of concepts to see the flow of student thinking.
	Identification of problems	Identify problems in everyday life
	Forming Online Discussion Groups	Grouping heterogeneously
	Inquiry Process	Emphasize maximum student activity to seek and find knowledge. Lecturer as a facilitator and motivator
	Applying New Knowledge	Performing a skill value using a programming language
13–15	Goals and Motivation	Provide goals and motivation so that there is an interest in participating in learning.

*(continued)*

**Table 1.** (continued)

Sunday	Goals	Activity
	Presenting Information	Explanation of concepts to see the flow of student thinking.
	Identification of problems	Identify problems in everyday life
	Forming Online Discussion Groups	Grouping heterogeneously
	Inquiry Process	Emphasize maximum student activity to seek and find knowledge. Lecturer as a facilitator and motivator
	Applying New Knowledge	Performing a skill value using a programming language
16	Evaluation	Provide a final evaluation/end-of-semester exam in the form of a post-test to measure cognitive, affective, and psychomotor

## 4 Conclusion

Virtual Laboratory (VL) is an architectural framework designed to implement the concept of MOOCs (Massive Open Online Courses). The learning design is designed based on seven stages of learning based on the stages of inquiry and collaboration. Programming learning strategies are organized into 16 lecture meetings. The seven stages of the learning strategy are (1) goals and motivation (2) presenting information (3) problem identification (4) forming online discussion groups (5) inquiry process (6) applying knowledge and (7) evaluating. So that learning activities for programming practicum become active, reflective, thinking, and creative.

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