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# Online Learning Innovation in the Era and Post Covid-19 Pandemic

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**ABSTRACT**
In the 21st century educators use technology not only to develop knowledge but also soft skills to improve competencies that are in line with the requirements of the world of work. The emergence of new technology in education changes the paradigm of educators in the learning process. We take a research approach on how to use technology to support computer programming learning. Various approaches are carried out by analyzing a collaborative environment that runs online. Collaboration doesn't happen naturally in a group. This study aims to construct student knowledge during and after the COVID-19 pandemic. The results showed that student learning achievement, especially computer programming skills in an online collaborative environment increased compared to conventional collaborative classes. In addition, it was found that students who studied with the proposed approach improved their cognitive learning outcomes.

***Keywords:*** *Collaborative Online, Computer Programming, Soft skill*

## 1. INTRODUCTION

The outbreak of the Covid-19 pandemic has resulted in all learning being applied online, including in universities. Online learning started two semesters ago, namely from the even semester of 2019/2020 and the odd semester of 2020/2021. Since the Indonesian government declared March 1, 2020 that Covid 19 is a pandemic disease that is contagious and enters through breathing, social distancing and physical distancing policies have begun to be implemented. The learning process was initially conventionally, lecturers and students met face-to-face and immediately turned into online/online learning. The online learning model requires educators and students to have creativity and skills in using technology [1]

In addition to the efforts of the universities to be able to meet the criteria for success in education, skills are needed in dealing with the 21st century learning process. Education experts formulate various academic achievements or skills needed by 21st century students, including: 1) having character as a thinker, proficient in innovative creative thinking which is characterized by high adaptability, able to solve complex problems, strong self-control and can self-directed. 2) Productive and have high work motivation. 3) Having the ability to set priorities, develop plans, and map the results achieved 4) Proficient in communication which is characterized by the ability to work in varied teams, collaborate, and develop interpersonal relationships [2].

The development of an inquiry-based online collaborative learning model in the field of Informatics Engineering expertise needs to be developed, this is due to changes in knowledge in the 21st century that require learning to be integrated with technology [3]. This change affects the delivery process in education, including the teaching and learning process. Lecturers are already required to utilize emerging technologies to develop graduate knowledge as well as soft skills to improve student competence in meeting employer requirements [4][5].

Learning in the 21st century prepares generations and enables them to develop the skills and abilities

to master information and communication technologies to meet the challenges of future globalization. The teaching framework in the 21st century proposed by [6] explains that the need for skills learned in this globalization era is future-oriented which is increasingly challenging and can be successful with 4C Standards: critical thinking and problem solving, communication , collaboration, creativity and innovation [7]. Advances in internet technology have opened up new opportunities for the development and application of software education methods for computer-supported collaborative learning [8].

The online collaboration model is a learning model that is built and implemented based on workflows and standards developed in conjunction with the STAD type collaborative learning model. Collaboration does not only involve students in a team or study group, but lecturers are also involved in the group members as learning facilitators [9].

Online collaborative model is defined as a procedure or step those researchers need to take to help students learn in groups, participate, interact, and jointly complete a task in algorithms and programming courses. The online collaboration model provides students with opportunities to develop critical thinking skills, create frameworks, and work together to complete assignments[10]. Algorithm and Programming learning outcomes produce competencies in the cognitive, psychomotor and affective domains. The behavior of the cognitive domain of students is behavior that is the result of thinking. Psychomotor behavior related to learning output includes skillful engineering involving muscles and physical strength. Affective behavior is student behavior in making decisions in integrating with the environment in the form of feelings, attitudes, interests, emotions and values [11].

Algorithm and Programming is the first programming course given to students. This course discusses how to overcome existing problems by creating programming algorithms and implementing them into programming languages. One of the competencies of this course is being able to apply logical, critical, systematic and innovative thinking in the context of developing or implementing science and technology that respects and applies humanities values in accordance with their field of expertise. For this reason, students must have computer programming skills which are basic skills that every computer science student must learn using a programming language [12]. This course requires a set of cognitive processes that naturally develop through practice and writing algorithmic solutions [13]. Program learning is needed to improve problem solving skills so that students have basic skills in the field of computer science[14].

Failures that occur in learning programming students find it difficult to understand basic programming concepts, skilled in solving problems, namely in terms of identification, algorithms developed into program code and low student learning outcomes due to interest and ineffectiveness in learning [15][16]. [17] in a study stated that the programming pass rate after 12 years only increased by 5 percent, not surprising, because learning to program can be a difficult task, until the failure rate phase in programming classes is almost the same [12]. This is due to ineffective problem solving strategies [18]. Meanwhile, to be able to compete, students must have cognitive skills, the ability to solve complex problems, have attitudes and motivation [18]. According to [19] incorporating mastery of knowledge and technology into solutions in the face of century trends..

An online collaborative learning environment with inquiry-based practice strategies is proposed to increase social interaction among students to be involved in finding concepts and understanding complex problems [20]. Programming training in algorithms and programming courses must be learned through an observation process, then observations or experiments must be carried out to explain or test the truth of the concept, so that students can feel the concept in context [21]. Previously it was suggested to study outside the classroom to provide direct experience of the learning process, therefore the curriculum developed should teach students to identify and classify phenomena, processes, skills, and concepts learned in a certain way.

Investigating the effectiveness of the proposed approach during the learning activities, team members identified problems from the assignments given by the lecturer and started posing problems collaboratively to design new programming assignments. They then collaborate to complete the task. Students in the team carry out a search process to find a solution to the problem in the form of a flowchart. Lecturers check the results and provide feedback. After that, the task is implemented with a programming language to prove the concepts obtained. That is, each team tries to complete the task proposed by the lecturer. The final result of learning is given an evaluation to see students' cognitive in learning.

## 2. METHOD

This research is experimental research. The research design used is a classical experimental design. The population in this study were 31 students of the Informatics Engineering Study Program who took the Algorithm and Programming course for the 2020/2021 academic year. Students were divided into two groups, the experimental group was 15 people, the control group was 16 people. The Inquiry-Based Collaborative Model is a development model that includes 7 steps with the STAD Type Collaborative by (Slavin 2015) as shown in Figure 1.

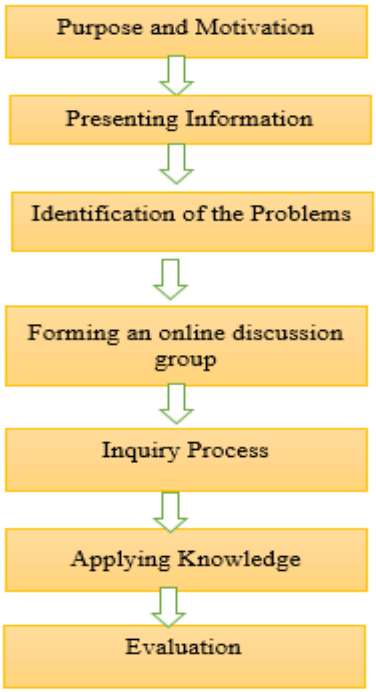


**Figure 1.** Steps for developing an inquiry-based online collaborative learning model

The steps of the Inquiry-based Online Collaborative model can be described as follows:

**Phase 1:** Introductory activities and basic questions. Activities carried out by lecturers are: Lecturers motivate students in carrying out learning activities so that students are interested in participating in learning. The process of implementing learning in the preliminary activities (fundamental questions) is greeting and checking student attendance. Asking algorithm students in everyday life to see students' basic logic This fundamental question is to see students' initial abilities in logical thinking skills. Determine the learning objectives according to the learning outcomes of the course. Provides guidance for access to E-Learning

**Phase 2:** Explain the basic concepts of algorithms and programming. Explain the programming language used to prove the student's line of thinking. Provide case examples and case studies to see students' thinking flow.

**Phase 3:** Perform problem identification. At this stage the lecturer asks each student to identify and formulate problems in everyday life. Ask students to complete the identification of the problem.

**Phase 4**: Dividing heterogeneous study groups provide facilities for online discussions Grow awareness of social interaction through online applications. Provide opportunities for students to actively participate in the learning process. Observe each discussion in groups.

**Phase 5:** Emphasizes student activities maximally to seek and find knowledge. Lecturers as facilitators and motivators.

**Phase 6**: Lecturers provide opportunities to prove new knowledge by testing using programming languages.

**Phase 7**: Evaluation, Measuring the final ability of students to gain knowledge and skills of students.

## 3. RESULT AND DISCUSSION

The preliminary student learning activity is the initial stage of the lecture, the lecturer provides learning objectives and motivation to attract students' interest in learning and self-reflection. Provide information related to lecture material and ask students to identify problems related to the given case. They are guided by lecturers to discuss in online groups to discuss solving problems. Furthermore, students explore knowledge by looking for sources from outside or in the e-learning that has been provided. The final results of students are asked to make presentations and testing in the form of programs using the C++ programming language. After the learning activities, pretest and posttest were carried out. Figure 4 shows the activities carried out during the learning process.

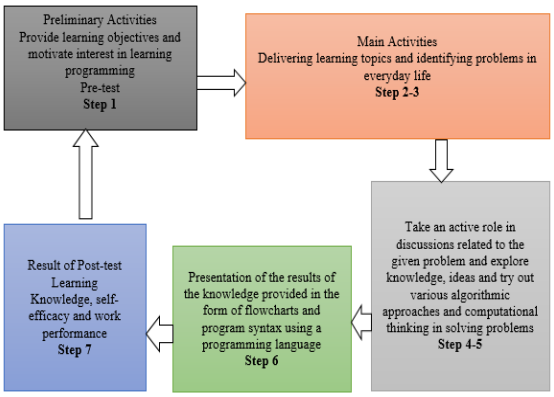


**Figure 2.** Inquiry-based online collaborative learning activities

The display of online student discussions can be seen in Figure 3.

**Figure 3.** Online collaborative activities display of program implementation in e-learning

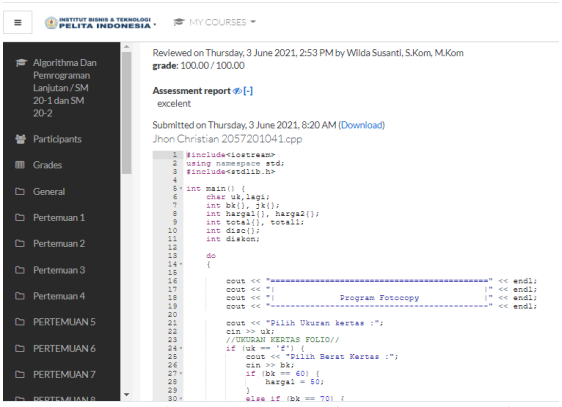


**Figure 4.** Program implementation

The needs analysis questionnaire was analyzed using descriptive techniques. The purpose of this questionnaire is to see if there are gaps that have occurred so far in learning before the new model is implemented. The needs analysis will see how much the need for new learning models can be applied in learning in Algorithm and Programming courses.

The needs analysis instrument aims to try to fix problems in learning in the Algorithm and Programming course by knowing the causes, so that what is expected from the learning objectives in this course can be achieved. This instrument is distributed to students before the teaching activity takes place. The needs analysis instrument can be seen in Table 1.

**Table 1.** Needs analysis instrument

| No | Indicator | Total |
|---|---|---|
| 1 | Student Perception | 5 |
| 2 | Learning Experience | 10 |
| 3 | Model Development Needs | 8 |

The questions given to the students above were assessed based on a Likert Scale with five weighting criteria, namely: strongly agree (SS) with a weight of 5, agree (S) with a weight of 4, doubtful (RR) with a weight of 3, disagree (KS) with a weight of 2, and disagree (TS) with a weight of 1.

The results of the needs analysis according to student perceptions during lectures with an inquiry-based online collaborative model such as motivation in learning, interest in learning, learning difficulties and interest in the model to be developed. The results obtained can be seen in Figure 5 below:

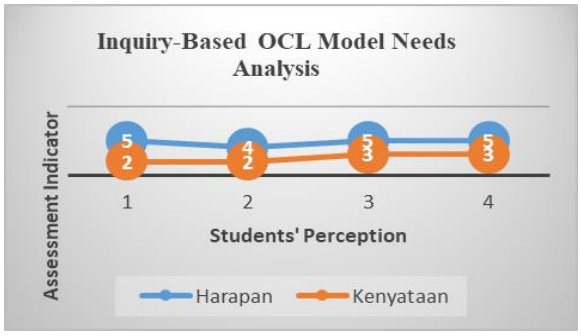


**Figure 5.** Students' perceptions of the need for an inquiry-based online collaborative learning model

Needs analysis based on student experience in learning the use of methods/models/media, facilities in learning, experience in learning while the results are presented in Figure 6 below:

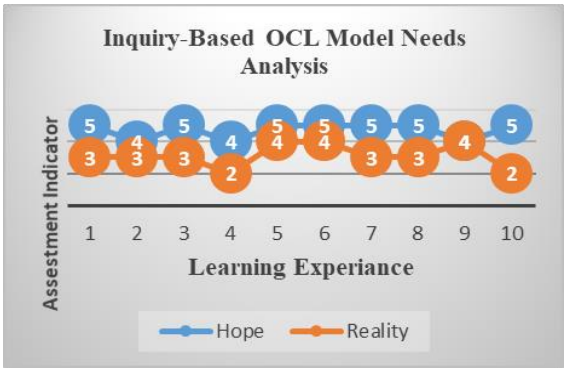


**Figure 6.** Results of inquiry-based ocbl model needs analysis based on student learning experiences

The results of the needs analysis based on the needs of developing an Inquiry-Based OCL model in the Algorithm and Programming course are presented in Figure 7 below:

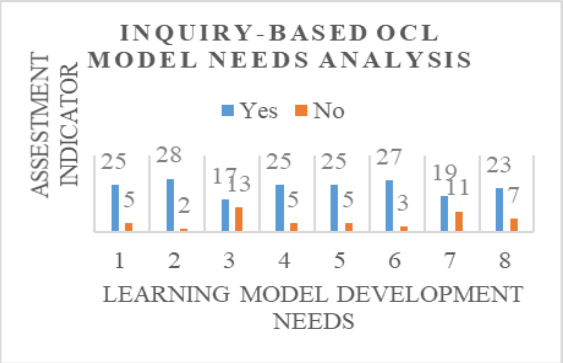


**Figure 7.** Results of the needs analysis of the development of an inquiry-based online collaborative model based on student needs

### *3.1. Cognitive Aspects of Pre-test and Post-test Results*

From the cognitive aspect, the effectiveness measure is used to measure the extent to which student learning outcomes are improved based on the tests or tasks given, especially in analyzing a solution algorithm in the Algorithm and Programming course and also in the form of other practice questions.

Before the questions are tested, the questions that are designed must also take into account the level of difficulty of the questions. The difficulty level of the questions describes the difficulty or ease of the questions to be tested.

The degree of difficulty of the questions can be classified as follows:

**Table 2.** Category of question difficulty degree

| Number | Interval | Category |
|---|---|---|
| 1 | 0,00 < 0,30 | Difficult |
| 2 | 0,30 < 0,70 | Medium |
| 3 | 0,70 < 1,00 | Easy |

Pretest is given before starting the learning material. Pretest aims to determine the initial cognitive abilities of students whether the test subjects have the same abilities and come from the same sample. The results of students' cognitive tests in both classes to assess students' initial abilities can be seen in.

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**Table 3.** Results of cognitive aspects of pretest and posttest

| Class | N | Mean Pretest | Mean Postest |
|---|---|---|---|
| Experiment | 15 | 21,83 | 81,13 |
| Control | 16 | 21,03 | 71,30 |

From the test results, there was an increase in students' knowledge of the pretest and posttest tests.

## 4. CONCLUSION

The inquiry-based online collaborative learning model is learning that is done online. The inquiry-based online collaborative learning model here can create flexible learning, can be done at any time, and in various places, there are interaction and activity facilities in it. The syntax contained in the inquiry-based online collaborative learning model is the existence of Sharing Instructional content online where the proportion in online learning will explain its function as a supplement, complement in learning, make an appropriate schedule and approach through synchronous and asynchronous methods.

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