The Online Coding Learning Applications Development for Information Technology Students

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Abstract*—As many as 86.4% of the 81 students of the Information Technology Department had difficulty coding because they thought coding was a difficult thing. So that with this application students can be helped in overcoming difficulties in learning coding using peer tutoring methods. In the implementation, the application is built using the CodeIgniter 3 Framework with a MySQL database and applies the Waterfall Method. The stages that are passed in these methods are in the form of analysis, design, implementation, testing, and maintenance. This system was tested using Equivalence Partitioning and Usability Methods. With the Equivalence Partitioning Method, it was found that the features in this application already had the desired function, while in Usability, 27 student respondents proved that this application had fulfilled 5 aspects of usability with an average value above 59.99%. After testing, it was found that 94.1% of students considered that the material provided by the tutor was easy to reach so that students felt helped in overcoming coding difficulties. Based on these results, it can be concluded that this application can overcome student problems in coding difficulties by accessing existing features.

Keywords— online learning application, coding, peer tutoring

I. INTRODUCTION

Education is one of the important assets of a nation. Because the progress of the nation can be seen from the quality of education. As technology develops, the world of education is also growing from time to time. The Minister of Research and Technology (Menristek)/Head of the National Research and Innovation Agency (BRIN) in the Kemenristek/BRIN Press Release Number: 272/SP/HM/BKKP/XI/2019 said that one of the important elements in the digital era is computer programming, Indonesia needs to increase the number of experts in the field of coding where this field has a very vital role to develop the domestic industry [1].

Many high school students are now interested in joining the Information Technology Department, as shown by our study of 81 Information Technology Department students at a state polytechnic, 75.3 percent of whom were high school graduates. High school graduates are unfamiliar with coding, since there are no coding courses included in the school curriculum, despite the fact that coding is one of the most essential talents in the area of information technology. Students think that learning to code is less enjoyable and difficult. Additionally, students struggle to make appropriate companions with whom to discuss about coding. As a result, they are worried because they are unable to understand the information presented in programming class. Students often learn with friends, study and repeat the lesson given, and seek for references to help them overcome their lack of knowledge of coding. As a result, facilities are required to assist students in improving their coding skills.

We choose active students from the Information Technology Department who have good coding skills as teachers. The reason we choose students who are still active is because they have a lot of free time to do activities, and they still remember the lesson they are good at because they are still in the learning process. In addition, communication with peers also has an important role in fostering learning motivation which can increase the activeness and effectiveness of learning. Because in this process there is direct communication between students and teachers. Students can also conduct forum discussions, so that students can discuss their problems with other students so that they can help solve their difficulties.

II. LITERATURE REVIEW

Learning is a process of interaction between students and educators, with lesson materials, delivery methods, learning strategies, and learning resources in a learning environment [2]. The educational method has evolved throughout time. Initially, face-to-face learning was necessary. However, face-to-face learning is no longer a priority. Numerous learning apps have been developed to assist the online learning process, which is flexible and can be conducted anywhere and at any time, regardless of space or time constraints. This is acceptable if used in the context of a COVID-19 pandemic, which is presently spreading worldwide. In a pandemic situation, all outside activities are restricted and converted into activities at home through the online system [3].

Numerous studies have been conducted over the past decade on the use of online-based learning material, particularly website-based learning. Because the website has the capability to connect almost anybody on the internet. So that it may be utilized to optimize the educational activities. Online learning offers many possibilities for constructivist learning by facilitating and supporting resource-based, student-centered environments and by enabling learning to be contextualized and applied [4].

Programming is a fundamental subject in the Information Technology Department. The aim of the programming course is to develop and enhance students' coding abilities. Coding is

the process of translating a design into a language that can be understood by a computer [5]. Coding may also be defined as an activity that involves people writing commands for a computer. These commands are based on the syntax (writing rules) of a specific programming language, which is then translated into machine- or computer-readable codes.

According to the findings of our research, a website-based online coding learning platform is currently required. The objective is to provide assistance for programming classes. So that it may assist students in developing and honing their coding abilities. As a response, we developed a website for learning to code using the CodeIgniter 3 framework.

It is essential to conduct testing in order to get a suitable and effective learning website. As a result, we utilize two different test techniques to verify the website we build. The tests are partitioning equivalence and usability.

Equivalence Partitioning testing is a method for evaluating the quality of an application in which software testing documentation is generated for errors detected in each of the three error models, namely errors in functions, data structures, and interfaces [6]. The aim of this method is to identify the system's vulnerabilities in order to ensure that the data produced corresponds to the data input after the data is executed and to prevent inadequacies and errors in the application before being used by the user.

Usability is a qualitative analysis that determines how easy it is for users to use the interface of an application. An application is called usable if the functions in it can be run effectively, efficiently, and satisfactorily [7]. Based on this definition, it also explains that usability is measured by components:

a) Learnability, is defined how fast users are proficient in using the system and the ease of use in carrying out a function and what users want they can get.

b) Efficiency, is defined as the resources expended to achieve the accuracy and completeness of the objectives.

c) Memorability, is defined how the user's ability to retain knowledge after a certain period of time, the ability to remember is obtained from a menu position that is always fixed.

d) Errors, is defined how many errors the user makes, the errors made by the user include the discrepancy of what the user thinks with what is actually presented by the system.

e) Satisfaction, is defined as freedom from discomfort, and a positive attitude towards the use of the product or subjective measure of how users feel about using the system.

III. METHODOLOGY

The research methodology explains the steps and methods used in the application development process. This approach uses the Waterfall Method, which consists of five phases, start with requirements analysis and completing with application testing. Waterfall technique is a sequential linear process in which each step begins only after the preceding stage has been finished. Each step has its own set of deliverables [8].

The research methodology can be seen in Figure 1.

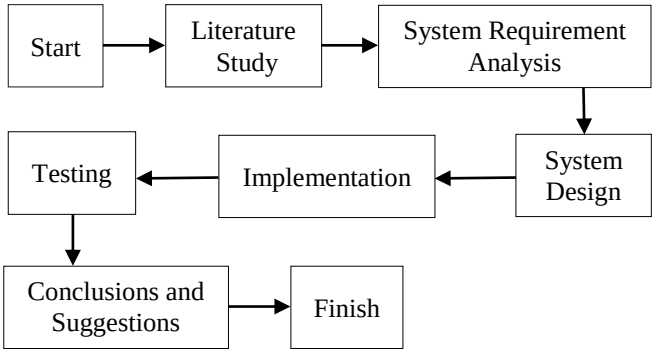

Fig1. Research Methodology

The following is an explanation of the steps in Figure 1.

1. Literature Study—The theoretical basis is built on references to books, journals, articles, and research with similar themes. The purpose of the literature study is to obtain information from existing references in order to assist in conducting needs analysis, design, implementation to system testing.
2. System Requirements Analysis—System requirements analysis aims to obtain the necessary requirements of a system to be built. Dissemination of questionnaires is one of the methods chosen in determining system requirements.
3. System Design—System design aims to provide convenience in implementing the system. The system design used used the Unified Modeling Language (UML) modeling language and resulted in a system design in the form of use case diagrams, activity diagrams, Entity Relationship Diagrams (ERD), and interfaces. In making the database this application uses MySQL which is a Database Management System (DBMS) software that can manage databases quickly and accommodate large amounts of data.
4. Implementation—Implementation is an activity to translate the design into a programming language. The programming language used is the PHP (Hypertext Preprocessor) programming language with the CodeIgniter 3 Framework.
5. System Testing—System testing aims to determine the suitability of the application with its design. Testing on this application focuses on functional testing using a Black box testing system with Equivalence Partitioning technique and ease of interface using usability testing with a questionnaire method in the form of Google Forms to Information Technology Department Students measured using a Likert Scale.
6. Conclusion and Suggestions—Conclusions are made after all stages from literature study to system testing have been carried out. Conclusions can be obtained based on the results obtained at the functional and interface testing stages. So from these conclusions it can be answered the formulation of the problem that has been formulated. The last stage is writing suggestions. Suggestions aim to do the system development functionally and interface.

IV. RESULT AND DISCUSSION

4.1 System Requirements Analysis

At the stage of needs analysis based on the distribution of questionnaires through the Google Form media which was distributed to 81 students of the Information Technology Department at the State Polytechnic of Malang, it was found that 75.3% were high school graduates. In high school there is no special curriculum on coding. So that students feel unfamiliar with the term coding and 86.4% of students feel that coding is a difficult thing.

Of the 81 students who filled out the questionnaire, they wanted 3 main features needed to overcome their coding difficulties by only accessing this application, namely structured material, private chat between students and tutors, and forums. The data needed in the construction of this system are student data in the form of ID, name, gender, study program, and year of entry.

4.2 System Design

The step taken after analyzing the system requirements is to make a design. This stage will be a reference in building a software in accordance with the results of the needs analysis. The software design stage that is made is use case diagrams, database design, and interface design.

a) Use Case Diagram

Use case diagram is a description of scenarios and interactions between users (actors) and every activity or behavior that can be carried out in the system or application that is built. Table I below describes the actors and their access on the application.

Table I. Detail of Use Case Diagram

No	Use Case Name	Actor
1	Manage Forum	Admin
2	Manage Data of Students	Admin
3	Manage Data of Tutor	Admin
4	Manage Data of Course Category	Admin
5	Manage Data of Criticism and Suggestions	Admin
6	Change Password	Admin
7	Verify Tutor Candidate	Admin
8	Register	Tutor Candidate
9	Check Registration Status	Tutor Candidate
10	Revise Assignments	Tutor
11	Manage Course	Tutor
12	Manage Content	Tutor
13	Private Chat	Tutor, Students
14	Send Criticism and Suggestions	Tutor, Students
15	Answer Forum	Tutor, Students
16	Manage Profile	Tutor, Students
17	Verify Assignments	Tutor
18	Ask to the Forum	Students
19	Access the Course and Content	Students
20	Access the List of Tutor	Students
21	Submit Assignments	Students

Based on Tabel I this application has 4 actors, namely admin, students, tutors, and tutor candidate. The four actors have different access rights which have been indicated by each use case.

b) Database Design

After the needs analysis process is carried out for all features, 12 entities are needed. database design described in the ERD with the following details:

1) Mahasiswa Table

This table is use for save data of Informatics Technology Students in State Polytechnic of Malang. The attributes in this table are id_mahasiswa, nim, password, nama, jenis_kelamin, jurusan, prodi, kelas, tahun_masuk, github, foto.

2) Tutor Table

This table is use for save tutor data. The attributes in this table are id_tutor, id_mahasiswa, id_kategori_matei, surat_pernyataan, status.

3) Kategori_materi Table

This table is use for save category of material to be provided. The attributes in this table are id_kategori_materi, nama_kategori.

3) Materi Table

This table is use for save the material according to the category. The attributes in this table are id_materi, id_tutor, id_kategori_materi, nama_materi, deskripsi, requirement, cover.

4) Konten Table

This table is use for save the course according to the selected material. The attributes in this table are id_konten, id_materi, judul, video, soal, file_pendukung.

5) Tugas Table

This table is use for task of students in every course. The attributes in this table are id_tugas, id_mahasiswa, id_konten, tugas, status, revisi.

6) Admin Table

This table is use for save the admin data of this application. The attributes in this table are id_admin, nama, username, password.

7) Forum Table

This table is use for save topics of forum discussion. The attributes in this table are id_forum, id_mahasiswa, id_kategori_materi, topic, pertanyaan, created_at.

8) Chat_forum Table

This table is use for save all of answers based on topics. The attributes in this table are id_chat_forum, id_forum, id_user, chat, send_time, status.

9) Private_chat Table

This table is use for save the private chat from students and tutor. The attributes in this table are id_pesan, to, from, message, created_at, status_chat.

10) Session_mahasiswa_tutor Table

This table is use for save the history of login and logout from student and tutor. The attributes in this table are id_hitung, id_mahasiswa, id_tutor, log_in_time, log_out_time.

11) Kritik_saran Tutor

This table is use for save the criticism and suggestion from students dan tutor. The attributes in this table are id_kritiksaran, id_user, subject, kritik_saran.

c) Interface Design

Interface design is a visual image that becomes a relation between the system so that it can interact with users. The following is the design of the 3 main features in the application.

1) Design of Course Page

This page displays all the course according to the selected category on the main page. What is displayed is the cover image of course and the name of the tutor. In addition, there is a search button to perform a search according to the name of the material to be searched.

2) Design of Private Chat Page

The private chat page display consists of the name of the recipient of the message, the contents of the message, fields for replying, and buttons for sending messages.

3) Design of Forum Page

Displayed on the forum page, among others, the forum topics submitted, forum creator name, forum creation date, answers, fields for reply to the discussion, and the submit button to slice the forum discussion answers.

4.3 Implementation

System implementation is an activity to translate the design into a programming language.

a) Database Implementation

On this step, the implementation is based on the database design in the previous step. Figure 2 is a database implementation using MySQL with 12 entities and the relationships between entities.

b) Interface Implementation

The implementation of the interface is the result of making an interface design for the user or often referred to as the user interface in accordance with the design that has been made in the previous chapter. The following is the result of implementing 3 main features in the application.

1) Implementation of Course Page

According at the design, the course page in Figure 3 displays all the material according to the category chosen by the student along with the material data search form.

2) Implementation of Private Chat Page

By design, the private chat page in Figure 4 displays a chat column as a place to send and receive messages between tutors and students along with a column for writing text and a send button.

3) Implementation of Forum Page

By design, the forum page in Figure 5 displays a chat column as a place to send and receive messages between users and the send button.

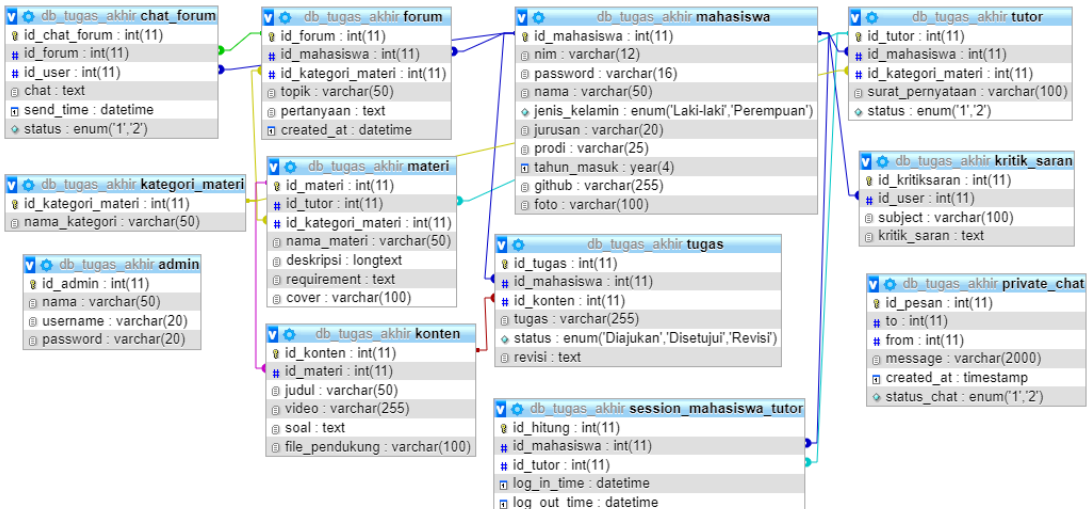

Fig 2. Database Implementation

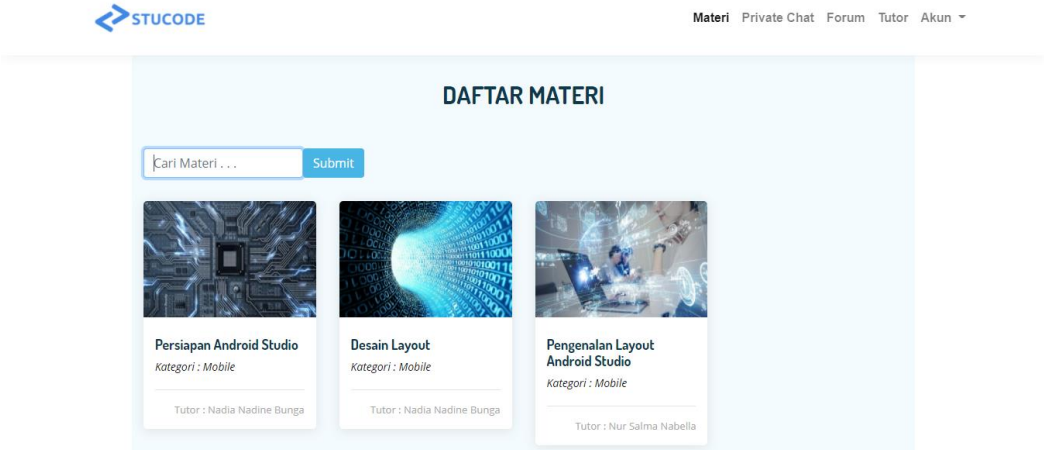

Fig 3. Implementation of Course Page

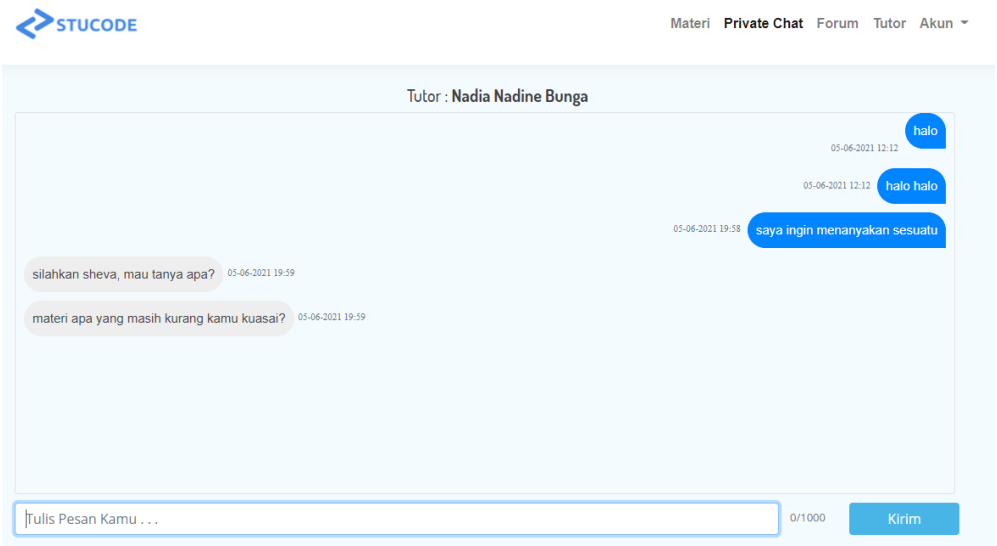

Fig 4. Implementation of Private Chat Page

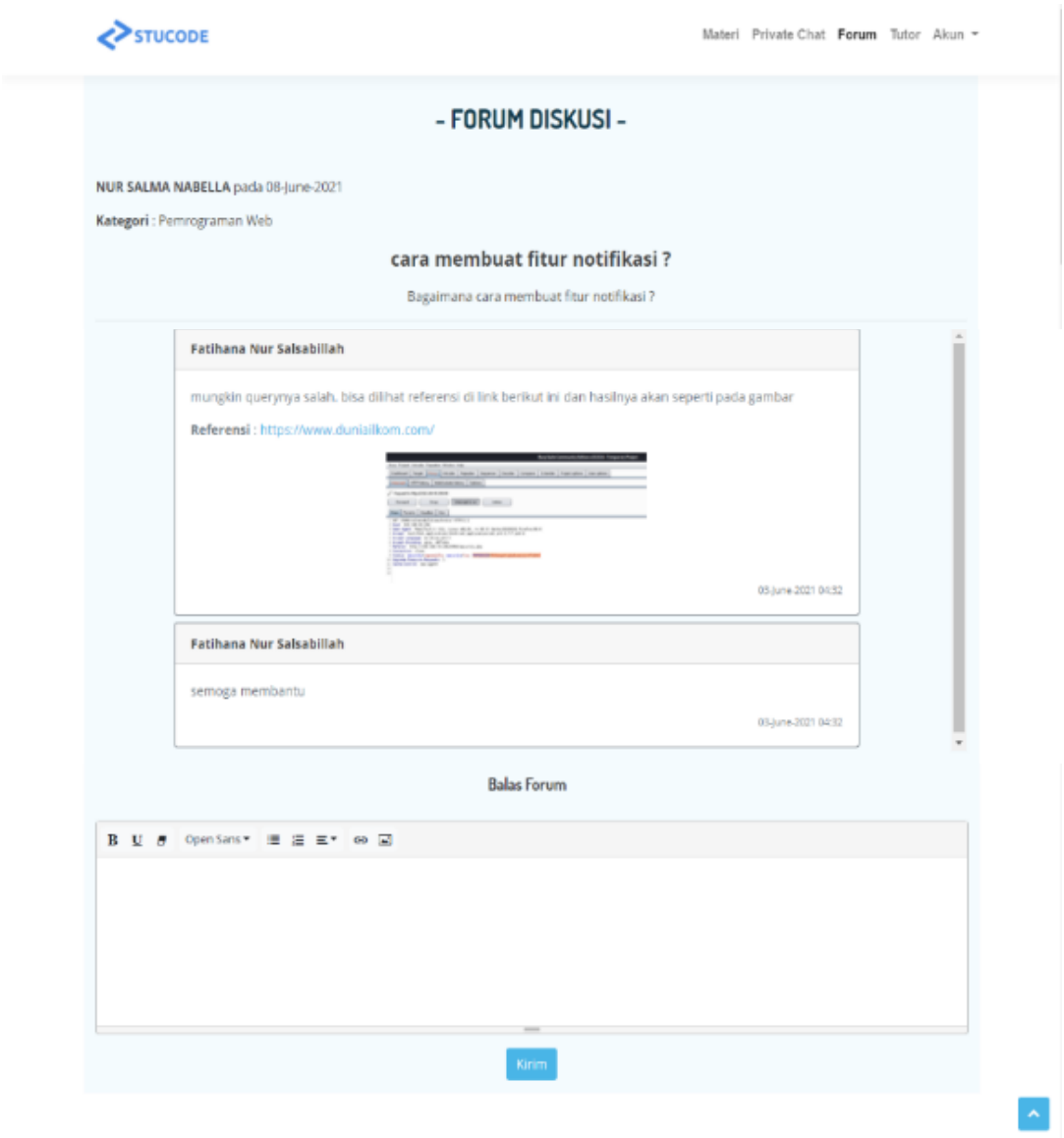

Fig 5. Implementation of Forum Page

V. TESTING

This application will be tested using 2 methods, namely testing with Equivalence Partitioning techniques and Usability testing.

5.1 Equivalence Partitioning Testing

This test will be carried out by one of the students of the Department of Information Technology at the State Polytechnic of Malang who will test all the features in each actor. The following are the results and discussion of the Equivalence Partitioning test.

a) Case and Test Data of Add Student Data (Valid)

Table II. Valid Test Case

Input Data	Valid Class	Observation	Conclusion
Example input of NIM field: 1831710001	[0-9] 1-10 Integer	NIM data can be accepted if the input data is a number, not more than 10 characters	Success

b) Case and Test Data of Add Student Data (Invalid)

Table III. Invalid Test Case

Input Data	Valid Class	Observation	Conclusion
Example input of NIM field: 1831710001	[0-9] 1-10 Integer	NIM data can be accepted if the input data is a number, not more than 10 characters	Success

The results obtained in the Equivalence Partitioning test such as Table I and Table II explain that the results of the tasks tested have run according to the design in the test cases that have been made. So with this test will minimize software functional errors.

5.2 Usability Testing

Usability is a qualitative analysis that determines how easy it is for users to use the interface of an application. The steps taken in usability testing are by distributing questionnaires using Google Forms media to 27 respondents of Informatics Technology Students. The answers from these respondents will be calculated in the form of a Likert Scale, namely 1 - 5 with the following assessment.

Table IV. Interval of Likert Scale

Value	Interval	Description
1	0% - 19.99%	Very Hard
2	20% - 39.99%	Hard
3	40% - 59.99%	Neutral
4	60% - 79.99%	Easy
5	80% - 100%	Very Easy

Based on Table IV, the greater the weight value given by the respondent, the more this application will be considered to have a usable interface. After all respondents have given an assessment, it can be calculated with the total being added up and divided based on the number of respondents. The following are the results of the analysis of respondents' test results on the application.

Table V. Analysis of Usability Test Results

No	Question	Value
System Aspect		
1	Is the appearance of the application easy to recognize?	87%
2	Is the application easy to operate?	89.4%
3	Is the color display on the application comfortable to see?	87%
User Aspect		
4	Is the menu display on the application easy to recognize?	87%
5	Is the information in the application easy to find?	84.7%
6	Is the text on the application easy to read?	89.4%
7	Is the application easy to access?	91.7%
8	Are the symbols and icons in the application easy to understand?	84.7%
Interaction Aspect		
9	Is it easy to access the information offered	82.3%
10	Do the functions offered match the purpose of the application?	87%
11	Is the available material easily accessible?	84.7%
12	Is security guaranteed?	76.4%
13	Is the menu of the application easy to remember?	87%

The results of usability testing in Table V show that the coding learning application has an interval above the middle interval of 59.99% so that the coding learning application has fulfilled the five usability components, namely learnability, efficiency, memorability, errors, satisfaction.

VI. CONCLUSIONS AND SUGGESTIONS

6.1 Conclusions

From the research that has been carried out up to the testing stage, it can be concluded that this research was successful in building a Coding Learning Application for Website-Based Information Technology Department Students with Case Studies at the State Polytechnic of Malang which can provide convenience for students majoring in information technology in learning coding with providing material in the form of learning videos, private chat, and forums for discussion.

After testing using two methods, namely Equivalence Partitioning and Usability, this system results that this

application already has functions that are in line with expectations so as to minimize application functional errors. This application was also successfully built by fulfilling 5 usability aspects with an average value above 59.99% making the application fall into the very good category.

6.2 Suggestions

The author has suggestions for further development, which is expected in coding learning applications can be developed by providing rewards for students who are willing to become tutors such as giving certificates or others. And can also be applied to the development of mobile-based applications to be more flexible in its use.

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