The application of online practicum in assisting learning process of database courses using Waterfall method

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Abstract: The Open University is a State University prioritizing independent learning. Independent learning would certainly succeed if the students owned a strong determination in effectively and efficiently manage their time. In the Information Systems Study Program curriculum, there are several practical courses that must be conducted offline. In 2019 however, the phenomenon of the COVID-19 pandemic outbreak requiring all educational units to carry out learning from home had impacted on the learning process, especially the implementation of practicum at the Open University. The implementation of practicum activities usually held in collaboration with several institutions has become constrained. This triggered the possibility of not achieving student learning outcomes related to learning materials learned through practicum. Therefore, as an alternative solution, an application is required that could assist the students in carrying out practicum learning activities independently which is adapted to each teaching material. This practical application would be developed in a study using the Waterfall method consisting of analysis, design, implementation, testing and maintenance. From the results of test using the System Usability Scale (SUS), the score obtained is 64.44 (margin low). This means that the application online practicum can be used but does not meet the requirements to be implemented into existing learning systems until it gets a score of more than 80 (Acceptable).

Keywords: *Online Practicum, Waterfall, Application*

INTRODUCTION

The Open University is a State University putting forward independent learning (Open, 2021). The independent learning certainly pans out if the students have a strong earnestness to manage time effectively and efficiently. To assist the students in the independent study, the Open University provides several learning aids, like Offline Tutorials, Online Tutorials, Webinar Tutorials, and tutorials through radio and television.

In accordance with the Study Program curriculum, there are several practical courses. Practice is an activity requiring the students to apply concepts, principles, procedures, and skills in real or artificial situations in a programmed and guided or unchaperoned. While practicum is an activity of observing, experimenting, or examining a concept or principle of subject conducted inside or outside the laboratory. The implementation of practicum is performed through the coordination between the Study Program and the Distance Learning Program Unit. The implementation of practicum is generally executed by the collaboration with schools, other relevant institutions or elsewhere corresponding to the course characteristics. The objective is to enable students' assistance of independent learning process.

The emergence of the Covid-19 pandemic outbreak in 2019 enforced the Ministry of Education and Culture to issue two circulars, Circular No. 2 of 2020 concerning Prevention and Handling of COVID-19 at the Ministry of Education and Culture (Kemendikbud RI, 2020) and Circular No. 3 of 2020. 2020 concerning Prevention of the COVID-19 Outbreak in Education Units throughout Indonesia (Kemdikbud, n.d.-b) is a guide in dealing with the disease at the education unit level. However, the next circular letter no 4 of 2020 (Kemdikbud, n.d.-a) was released demanding all educational institutions to conduct learning from home. This impacted on learning process, especially the practical learning process at the Open University. Practicums that were previously held in collaboration with several institutions were constrained. Owing to this situation, students experienced difficulty in the comprehension of practical learning.

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Thus, as a solution in a form of an application is required. This application was expected to be able to assist students in understanding the process of independent practical learning activities that are adapted to each teaching material. In printed teaching material of MSIM4206 Database for instance, practical activities are integrated into modules 3, 6, and 9 requiring a coding application media to comply students' understanding of doing practicum.

LITERATURE REVIEW

Teaching materials

Teaching materials are learning tools functioning to support the students to achieve the competencies that have been determined in the curriculum (Nurdyansyah & Mutala'liah, 2015). Several functions of teaching materials are mentioned as follows (Education et al., 2019):

a. For students, it improves their motivation to learn
b. For teachers, it eases their control over learning process so that it becomes more effective and efficient
c. For researchers, it can be used as reference material.

In the learning system at the Open University, teaching materials are main learning resources for students. Teaching materials are specially designed so as to students can study independently. There are several types of teaching materials, they are main and supporting teaching materials. Main teaching materials are in the form of Basic Material Books (BMP), BMP Plus (BMP integrated with audio/video/graphics) and guidance in the form of audio CDs, audio graphic CDs, video CDs, interactive CDs, computer-assisted BA, and online-based enrichment materials (MPBO). In addition to printed and non-printed teaching materials, the Open University also provides practical KIT for practical courses. Teaching material used is the MSIM4206 Database teaching material. In these teaching materials, practical material would be made into an application. Practical material in MSIM4206 is found in modules 3, 6, and 9.

Practicum at the Open University

Several offered courses in certain study programs oblige practicum. Practical is an activity demanding the students to apply concepts, principles, procedures, and skills in real or artificial situations in a programmed and guided or unassisted. Meanwhile, practicum is an activity of observing, experimenting, or examining a concept or principle of subject matter performed inside or outside the laboratory. The competence of conducting practicum is unique. It is something that would only be mastered by students who have real or artificial experience through the accomplishment of exercises or practical assignment. Practical activities or practicum are carried out under the guidance of the instructor, supervisor or advisor. Students can independently practice by using standard practice procedures especially for the FST Agribusiness Study Program. The guidance can be seen on the https://fst.ut.ac.id/index.php/agribusiness-s1/ page. For the Biology and Food Technology undergraduate and postgraduate study programs, practicum is enforced with in associate laboratories. However, the process of practicum activities currently cannot be conducted due to the COVID-19 pandemic.

Method of Waterfall Software Development

The waterfall model is applied in the development of this online practicum application. The waterfall model is a traditional software development process commonly used in most software development projects (A. Suryadi et al., 2019). This is a sequential model, so the completion of one set of activities leads to the start of the next activity. The following is the figure of the Waterfall model according to Pressman (Pressmann, 2010):
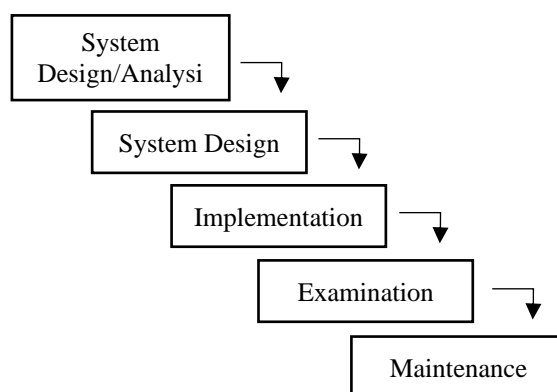

Image. 1 Waterfall Pressman Method

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a. System Design/Analysis
The first stage of the waterfall method of the software development takes place in the system design or analysis. At this stage, a search for information related to the system would be carried out. This information search includes services, objectives, scopes and users which would then be translated in detail to produce a system specification (Informatics & Dharma, 2004). This system specification will be used as a reference to the next stage named system design.

b. System Design
Subsequent to the completion of system analysis stage and producing system specifications, the next state is the system design stage. At this stage, system design would be undertaken in the form of data flow design (DFD), database design, and display design (Andri Suryadi, 2020).

c. Implementation
The implementation stage is to create the application using a programming language that has been determined based on the analysis result in the first stage. The reference at this stage is the result of the previous design stage (Wahyudi et al., 2019). The results of this implementation stage are applications that have been completed and would be tested for applications in the next stage.

d. Testing
The succeeding stage is the application testing stage of the previous stage result. The effectiveness would be tested in order to recognize the shortcomings or weaknesses (Atmini, 2019). Testing is done by using black box testing. This blax box test is a test that creates a test case scenario based on the application function. (Andri Suryadi, 2019)

e. Maintenance
The last stage is the maintenance stage. This stage is to run and to maintain the application. In this maintenance stage, contrivance of undetected errors in the previous stage is also conducted. (Ian Sommerville, 2011).

METHOD

Research Stages

Research stages in the establishing online *praton* to assist learning process at the Open University could be seen in Figure 2
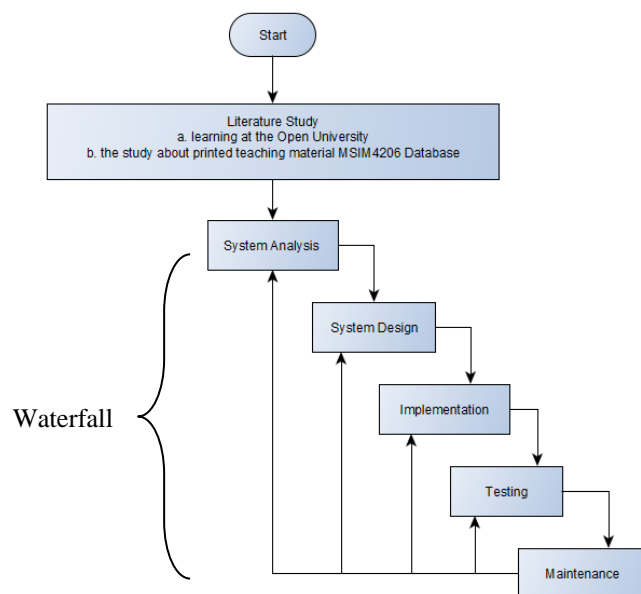

Figure. 2 Research Stages

The research stages described in Figure 2 are elaborated below:
1. Literature Study
   The first stage is literature study. There are two stages in literature study, they are the study of practicum learning at the Open University and the study about printed teaching material MSIM4206 Database. From the printed teaching materials, the researcher took the required practicum materials into software as system requirements.
2. The Establishment of Waterfall Method Software
   a. System Analysis

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The analysis system is the first step in the waterfall method. This stage is performed by compiling the information related to MSIM4206 printed teaching materials, objectives, scope and solutions going to be made in the form of practical applications.

b. System Design

A system design using structured modeling is made in this stage. The modeling is undertaken using DFD (Data Flow Diagram). This stage also explains the expectant database design and the display design of the application.

c. Implementation

Further stage is implementation or coding. At this stage, the results from the previous stage would be implemented in the form of a system design into a web-based programming language. The applied programming language is PHP while the database applied the MySQL/MariaDB

d. Testing

The application is furthermore tested in this stage using *blackbox* testing. In this *blackbox* test, the application function is examined. The design function and performance would be tested for its suitability and sustainability.

e. Maintenance

Maintenance is the last stage. This stage is to run the application and recheck in case deficiencies in making the application occur.

RESULT

Literature Study

Literature study is the first step done prior to developing the software. The literature study phase would discuss about two topics; they are (1) how to learn practicum at the Open University and (2) how to print teaching materials MSIM4206 Database.

Analysis

The entire system analysis is the application requirements or commonly referred to as system requirements. The system requirements in this application are divided into two requirements, they are; functional and non-functional. Here are the required system requirements:

a. Functional requirements
1) Every user of the application of online practicum can login.
2) The front page beside login, the users can register and reset password of forgotten password.
3) The registration is used by student users who would use this application.
4) If login is successful, the users are directed to the dashboard page.
5) On the dashboard page, the vision, mission, goals of the study program are displayed
6) The user menu is a page to manipulate the user data. The user menu can manipulate the menu on any other users.
7) Practicum menu is a place to choose practicum based on level.
8) The evaluation menu is the place to evaluate and to display the evaluation results.
9) The report menu is a report view from the users who have carried out evaluations. The result of the evaluation is the largest value of values having been obtained by the user.
10) Menu 'menu' is to manipulate menus.
11) Profile menu is to manipulate user's profile data and here, the users can change password.

b. Non-functional requirements
1) Application of online practicum is a web-based application.
2) Application of online practicum can be accessed through a web browser.
3) The database used is MariaDB
4) The programming language applied is the Code Igniter framework

Design

The application design consists of four types of designs, they are; Data Flow Diagrams (DFD), database designs, display designs, and site map designs. The explanation of each design stage could be seen below.

a. Data Flow Diagram

Data Flow Diagram (DFD) is the representation of an application that is described based on data flow. DFD level 0, commonly called a context diagram, is an explanation of the system in general. The appearance of the data flow at level 0 DFD would be explained on the following figure:
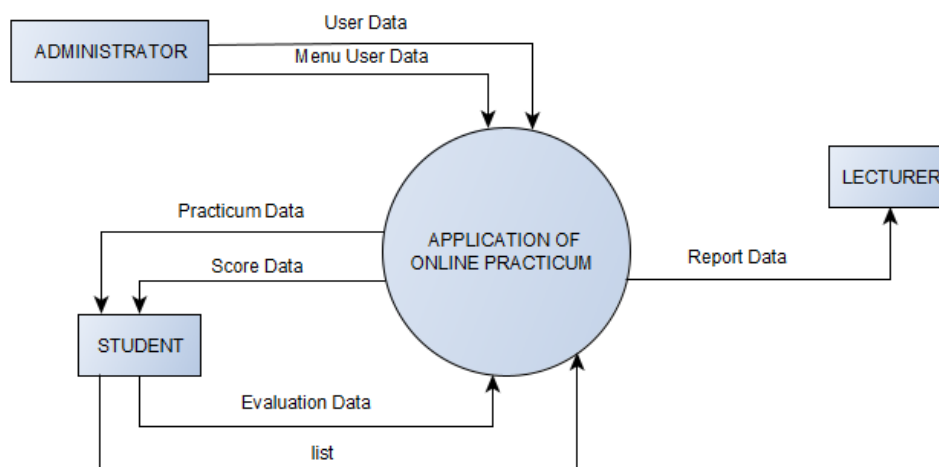
*name of corresponding author

Figure. 3 DFD Level 0

Based on Figure 3, there are three users who interact with application of online practicum system. They are admins, lecturers, and students. In admin, the data flow sent to application of online practicum system is user's data and user's menu data. Meanwhile, for students, the data sent to the system are the evaluation data and list data. On the other hand, the data received by students from the system are practicum data and score data. Lastly, lecturers only receive report data from this application of online practicum system .

b. Database Design

Database is a place to store data connected to each other. In this practical system, there are four entities, they are; user, user menu, menu, and answer. Figure 4 below is the design of this application database.
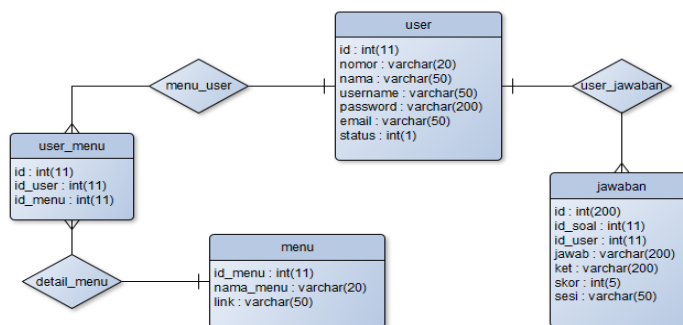

Figure. 4 *Entity Relationship Diagram* (ERD)

Figure 4 showed clearly that the Entity Relationship Diagram (ERD) design consists of four entities or tables. The user table consists of seven attributes, the user menu table consists of three attributes, the menu table consists of three attributes, and the answer table consists of seven attributes. This ERD is the basis for the storage area that would be used in application of online practicum system.

b. Sitemap

The sitemap is a map of running the application. The sitemap of prakton application can be seen in the following figure.
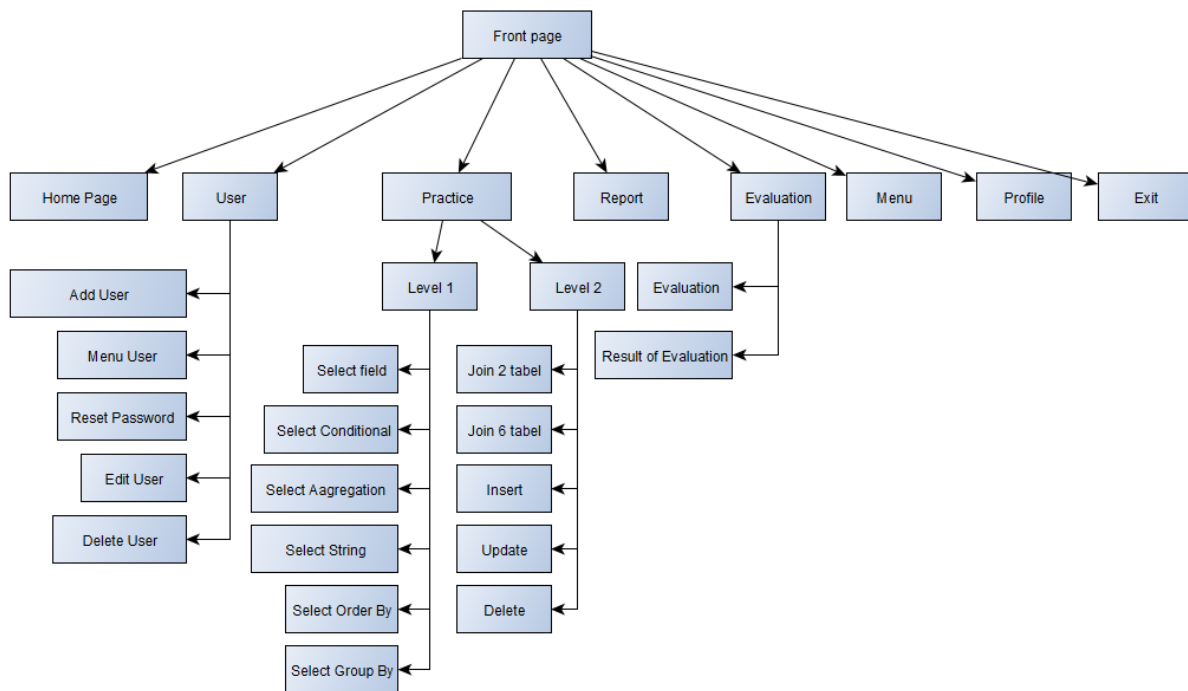
*name of corresponding author

Figure. 5 Prakton application site map

If the user has logged in, there are eight menus as seen in Figure 5 on the user menu. In the practicum and evaluation menu, there are clickable sub menus. Then at practicum levels 1 and 2, there are sub menus again as part of the practicum learning.

Implementation

Subsequent to the design phase completion, the next stage is the implementation phase. This stage is executed using several tools including using *xampp* as a server, *mariadb* as a database, and a combination of html, php, javascript, and bootstrap to create a view. The applied programming language used several tools such as *html* and *css* (bootstrap) to design the front end. Then *php* and *javascript* are used as a code generation in the back end. Here's the view of the combined coding implementation between the front end and back end:

Figure. 6 Front page view

Figure 6 is the front page view. In this page, the user enters the registered username and password. This link is also facilitated with a list menu link, forgot password, and chat to admin in case that users are in need of contacting the admin. In this evaluation process, students are given unlimited opportunities to evaluate, but the history of this evaluation can be viewed and downloaded as shown in Figure 7.

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Figure.7 Evaluation print page view

This printout was uloaded by the students to the elearning page in the practicum session.

Testing

To test the online practicum application, questionnaires are distributed and applied SUS (System Usability Scale) method (Abiwardani et al., 2020). The questionnaire was distributed to the students who studied database courses. The results of the distribution of the questionnaire can be seen in the table below.

Table. 1 The Result of Application test questionnaire

Respondent	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Score
1	4	3	4	4	5	2	4	2	4	5	62,5
2	3	4	3	3	3	3	3	3	3	4	45
3	4	4	4	3	4	5	5	2	4	2	62,5
4	5	4	5	4	5	3	4	2	5	4	67,5
5	5	1	5	3	4	2	5	1	4	3	82,5
6	4	4	4	4	4	4	4	4	4	4	50
7	2	4	3	2	4	3	4	3	2	2	52,5
8	4	4	5	2	3	3	3	2	4	3	62,5
9	4	3	4	4	4	3	4	3	4	4	57,5
10	5	1	5	1	5	1	5	1	5	1	100
11	5	2	5	4	5	2	2	2	5	4	70
12	5	2	5	2	5	2	4	2	5	2	85
13	5	2	5	2	5	2	5	3	5	5	77,5
14	2	3	3	4	2	4	4	2	4	5	42,5
15	1	2	5	2	5	2	3	2	2	5	57,5
16	5	2	5	2	4	2	4	2	4	4	75
17	3	4	3	4	4	3	4	3	4	5	47,5
18	4	2	4	2	4	3	4	3	3	4	62,5
											64,44

The table showed the results of the questionnaire. The SUS score was 64.44. From these values, a mapping is carried out to the SUS scale so as to produce the following positions:

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Scale	10	20	30	40	50	60-69	70-79	80	90	100
Description	Not Acceptable					Margin low	Margin high	Acceptable		

Score of Application Online Practicum

Not acceptable = Application is not acceptable
Margin low = Application occupies low margin
Margin high = Application occupies high margin
Acceptable = Application is acceptable
With score 64.44, this application can be said to have a low margin of test results with the System Usability Scale (SUS) (Brooke, 2006). This means that application of online practicum can be used but does not meet the requirements to be implemented into existing learning systems until it gets a score of more than 80 (Acceptable).

DISCUSSIONS

Using System Usability Scale (SUS) method, this online practicum application got a score of 64.44 (low margin). From these results, this practical application cannot be implemented further. Therefore, this online practicum application must be reviewed and redeveloped in order to get a decent score to be implemented (acceptable).

CONCLUSION

This study resulted in a practicum application that is established based on the waterfall method starting from analysis, design, implementation, testing, and maintenance. Testing stage applied System Usability Scale (SUS) method with score 64.44 (low Margin). This means that the application can be used but it has a very high risk for further implementation. The application still needs improvements to get a better score (Acceptable).

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