Chapter 3

Research Methodology

3.1 Research Design

This study was designed to develop a web-based e-learning information system for a university as a source of learning materials for Higher Education via electronic devices. This study is designed to produce a web application which will be used by a university to publish their course materials. The stages of this research are designing and making an information system that manages the planning, implementation and evaluation processes. This research uses Rapid Application Development model. Rapid application development is a form of Agile software development methodology (Abrahamsson, Salo, Ronkainen, & Warsta, 2017). There are six stages in the Rapid application development model which are requirement planning, analysis, design, implementation testing integration, and maintenance or release the product (Martin & Finkelstein, 1989).

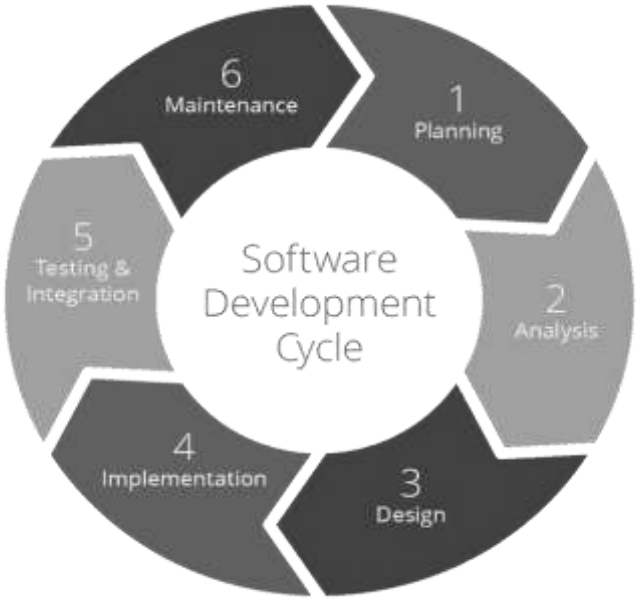

Figure 3.1: Software Development Cycle

Based on the above scheme, it is explained that the development of the e-learning OpenCourseWare system is done in six stages:

3.1.1 Planning

A perfect plan for developing OpenCourseWare for Universitas Pendidikan Indonesia develop in this step, calculating the strengths and weaknesses of OpenCourseWare (Berchet & Habchi, 2005).

3.1.2 Analysis

This step aims to analyze the performance of the software at different stages and to make notes on additional needs (Grant, 2016). The analysis is very important for the next step.

3.1.3 Design

Once the analysis has been finished, the design step, which essentially builds the project architecture, is taken over. This step helps to eliminate possible defects by setting a standard and trying to abide by it.

3.1.4 Implementation & Development

The actual task of software development starts here with data recording in the background (Mesaros et al., 2017). Once the software is developed, the implementation stage leads to a pilot study of the product to see if it works properly (Kupiainen, Mäntylä, & Itkonen, 2015).

3.1.5 Testing and Integration

The test stage evaluates the software for errors and bugs in documents and fixing them (Chopra, 2018)(Hua, Zhang, Wang, & Khurshid, 2018).

3.1.6 Release and Maintenance

Once the software passes all the steps without any problems, it conducts a maintenance process in which it is maintained and upgraded from time to time to

adapt to changes and release the software to the customer (Martin & Finkelstein, 1989).

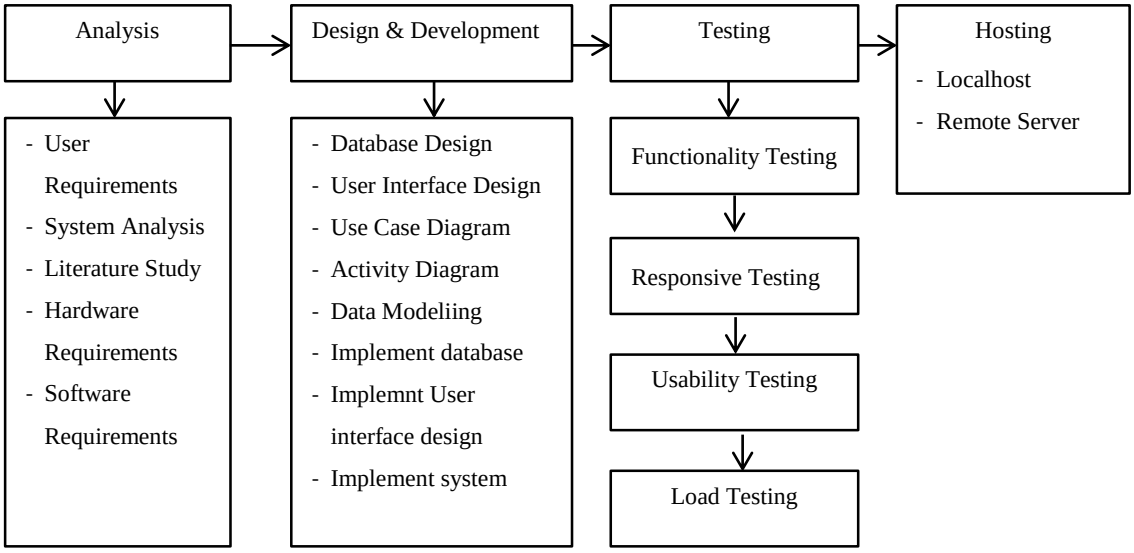

Figure 3.2 The flow of OpenCourseWare development.

3.2 Research Participants

The Students and teachers from Universitas Pendidikan Indonesia in Bandung City participated in this study. The sample of this study is based on the data source and is divided into two parts. In the first part, there are 6 software engineer were participated in a responsive and functionality test of the system where 4 software engineer participated in responsive test and rest of the 2 software engineer participated in functionality test of the system. There were given the link of the system and a questionnaire form which was sent via Gmail. In a free structured interview, there were two students from the first semester of Mechanical Engineering Education Department, two teachers also from the same department participated in this study. The head of the SPOT e-learning system of UPI also participated in an interview.

Quantitative research requires at least 20 (twenty) respondents to achieve substantial statistical value (Wimmer & Dominick, 2013). In the second part, this

study collects data from 25 respondents' bachelor students who had taken Applied Physics (Fisika Teknik) in their first semester, the students are from the Department of Mechanical Engineering Education at Universitas Pendidikan Indonesia, Bandung City. The URL of the system has been sent to the students and there were asked to use the system after they used the system, there were asked to fulfil an online questionnaire which was developed by Google forms and sent to them via Whatsapp group.

3.3 Research Instrument

The research data were obtained from several data collection techniques which follow: a) literature study, b) interviews, and c) questionnaires.

Table 3.1: Research Instrument

Data	Method	Respondent	Analysis
OpenCourseWare related information	Literature Study	-	-
User Requirments	Interviews	5 Respondents (3 Students and 2 Teachers)	Description analysis
Functionality Test	Questionnaire	4 Respondents	Description analysis
Responsive Test	Questionnaire	2 Respondents	Description analysis
Usability	Questionnaire	25 Respondents	Alpha Cronchbach's

3.3.1 Literature Study

Literature Study is conducted to collect research and information related to product open e-learning information development. This research studies the steps in web development, and the popular OpenCourseWare system.

3.3.2 Interviews

Interviews technique used in this study is an unstructured (free) interview technique. Interviews were conducted on students and teachers of Universitas Pendidikan Indonesia. This technique is used to determine user requirements regarding the development of the OpenCourseWare system.

3.3.3 Questionnaire

Questionnaire data collection techniques in this study were used to collect data related to web-based software quality testing. The instrument used in this study consisted of instruments for aspects of functionality, usability, and website responsive testing.

3.3.4 Functionality Test Instruments

Functionality test is used to check if the product is as per the specifications has been intended for it as well as the functional requirements (Montgomery, 2017) (Dick, Hull, & Jackson, 2017) (Abrahamsson et al., 2017). Functionality research instrument in the form of a checklist of the list of website functions that have been developed. Checklist of functions used for testing functionality aspects is shown in Table 3.2.

Table 3.2: Functionality Test Instrument

No.	Functions	Result	
		Works (Yes)	Failed (No)
Administrator Panel			
1	Login		
2	Navigation Bar		
3	User menu		
4	Change password		
5	Setting		

No.	Functions	Result	
		Works (Yes)	Failed (No)
6	Logout		
7	Setting page		
8	Department (create, update, search, delete and sort)		
9	Instructors (create, update, search, delete, and sort)		
10	Course category (create, update, delete, and sort)		
11	Course level (create, update, delete, and sort)		
12	Materials Types (create, update, delete, and sort)		
13	Grid View of Course		
14	List View of Course		
15	Searching course by keywords and filters		
16	Create a course from the homepage with validation		
17	View course details		
18	About course Tag 'Save Changes' button		
19	Change Banner		
20	Syllabus Tag and Save changes		
21	Lecture Videos Tag		
22	Upload Video with validation		
23	Play Video		
24	Change video and video update information		
25	Delete a video		
26	Lecture Video pop up and download materials		
27	Reference Book Tag		
28	Reference Book popup the details		
29	Update reference book information		
30	Delete reference book		
31	Materials Tag		

No.	Functions	Result	
		Works (Yes)	Failed (No)
32	Search materials by keywords and filters		
33	View and download materials		
34	Upload Materials and validation		
35	Change information about materials and it's the attachment		
36	Delete a material file		
37	Course button on the navigation bar		
38	Lecture Button on the navigation bar		
39	Lectures search by keywords and filters		
40	Upload video and validation		
41	Play video		
42	Sort videos by 'Lecture title'		
43	Change video information and delete a video		
44	View video details and download a material file.		
45	The Book button on the Navigation Bar		
46	Upload, Change and Delete a book		
47	Search for a book by using keywords and filters		
48	Sort books by 'book title'		
49	Book details in pop up		
50	Materials button on the Navigation Bar		
51	Upload a material and its validation		
52	Search materials by keywords and filters		
53	Sort, change and delete a material		
54	Users button Navigation Bar		
55	Create, update, view and delete a user		
Student Panel			
1	Login		

No.	Functions	Result	
		Works (Yes)	Failed (No)
2	Navigation bar		
3	Breadcrumbs		
4	User menu		
5	Change password		
6	Logout		
7	Home page searching course by keywords and filters		
8	View course details		
9	About course Tag		
10	Syllabus Tag		
11	Lecture Videos Tag		
12	Play Video		
13	Lecture Video pop up and download materials		
14	Reference Book Tag		
15	Reference Book pops up details		
16	Materials Tag		
17	Search materials by keywords and filters		
18	View and download materials		
19	Sort materials by Title		

3.3.5 Usability Testing Instrument

The instrument for usability testing uses an evaluation sheet in the form of a questionnaire which is USE Questionnaire (Ivory & Hearst, 2001). USE Questionnaire consists of four quality components (Delone & McLean, 2003), they are usefulness, satisfaction, ease of use and ease of learning. The scale used in the usability questionnaire is a Likert scale consisting of five points to get ordinal data. The scale includes Strongly Agree (SA), Agree (A), Neutral (N),

Disagree (DA), Strongly Disagree (SDA) (Yu, Keown, & Jacobs, 1993). Instruments for conducting usability tests are shown in Table 3.3.

Table 3.3: Usability Test Instrument

No.	Questions	Strongly Agree (SA)	Agree (A)	Neutral (N)	Disagree (DA)	Strongly Disagree (SDA)
Usefulness						
1	I think this portal helps me to be more effective in accessing university course materials.					
2	I think I would like to use this portal frequently.					
3	I think this portal help me to understand my lecture easily					
4	I think this portal is beneficial for higher education institute's students					
Ease of Use						
5	I think the portal was easy to use.					
6	I think the terminology used in this portal is clear					
7	I found the various functions in this portal were well integrated.					
Ease of Learning						
8	I would imagine that most student would learn to use this portal very quickly					
9	I found the portal is very difficult to use.					
Satisfaction						

No.	Questions	Strongly Agree (SA)	Agree (A)	Neutral (N)	Disagree (DA)	Strongly Disagree (SDA)
10	I feel very confident using the portal.					
11	I feel comfortable using this portal.					
12	I am satisfied with this portal.					

3.3.6 Responsive Website Testing

A responsive test is used to check if the product can be browsed from various devices or not. The Google Chrome Developer Tool will be used for responsive testing. The portal will be accessed using the latest Google Chrome browser then all the will be checked from the various device to see the content is responsive to device or not. This test has been done by a software engineer who is an expert on quality assurance and testing. The software engineer will check all the page list on the table below and fulfil the form based on the test result. The responsive testing instrument in the form of a checklist of the list of website pages that have been developed. Checklist of page used for responsive testing aspects is shown in Table 3.4.

Table 3.4: Responsive Test Instrument

No.	Page	Galaxy S5		iPhone 6/7/8 Plus		iPad		iPad Pro	
		Works (Yes)	Failed (No)	Works (Yes)	Failed (No)	Works (Yes)	Failed (No)	Works (Yes)	Failed (No)
Administrator / Teacher Panel									
1	Login								
2	Home								
3	Course								
4	Lectures								
5	Materials								
6	Users								
7	Setting								
Student Panel									
No.	Page	Galaxy S5		iPhone 6/7/8 Plus		iPad		iPad Pro	

		Works (Yes)	Failed (No)	Works (Yes)	Failed (No)	Works (Yes)	Failed (No)	Works (Yes)	Failed (No)
1	Login								
2	Home								
3	Course Detail								

3.3.7 Website Load Testing

Load testing is a type of performance testing that determines the performance of a system under conditions of real-life load. This test helps to determine how the application acts when accessing it simultaneously by multiple users. In this research to know the performance of the system. We have used an online load testing web portal www.loadimpact.com. On before running the test, the system has hosted on a server which can be accessed via the Internet. Then visit the sites of Loadimpact and put the URL of the test to test the system.

3.4 Research Procedure

a. Analysis of the application requirements: Identification of problems, analysis the functionality of the application, user interface design, application and hardware requirements to be able to develop and OpenCourseWare applications in the form of a web application. The method of data collection was carried out in this study by conducting literature studies, observations, and questionnaires.
b. Application design: Based on the analysis of needs that have been carried out, the next is the system design stage which is an illustration of the user requirements.

c. Application implementation: Implementation is the process of translating application design into real products. At this stage, the application starts to be developed based on the design that has been made.
d. Testing / Test application: Testing is performed to minimize the number of errors occur and also to test the quality of the OpenCourseWare web applications that have been made. Application testing consists of application function testing and application quality testing.

3.5 Data Analysis

3.5.1 Aspect Functionality

Data analysis of testing aspects of functionality is performed using descriptive analysis techniques (Delone & McLean, 2003), which is analyzing the per centage of test results for each function of the web application which is done by a web developer. The scale used in this functionality data analysis is the Guttman scale which consists of two value which is "yes" or "no" (Guttman, 1944). In the same time to determine the level of the feasibility of a web application in terms of functionality is used the interpretation of standards set by ISO 9126 (Ríos, Ordóñez, Tapia, & Moreno, 2016).

3.5.2 Aspect Usability

Based on the results obtained from the questionnaire, then we calculated the usability per centage of usability instruments by testing the usability consistency value using the Alpha Cronbach method. Calculation of *Alpha Cronbach's* value using SPSS software with the interpretation of Cronbach Alpha reliability values (Cronbach, 1951)(Ivory & Hearst, 2001).

3.5.3 Aspect Responsive

Data analysis of testing aspects responsive will be performed using descriptive analysis techniques (Delone & McLean, 2003), which is analyzing the per centage

of test results for each web page. The scale used in this data analysis is the Guttman scale which consists of two points "yes" or "no" (Guttman, 1944).