

CHAPTER 8

SYSTEM TESTING AND EVALUATION

8.0 Introduction

Testing is a process of executing a program with the intent of finding an error. Once source code has been generated, software must be tested to uncover as many errors as possible before being delivered to user. There are several techniques that are suggested in software testing strategy, such as unit test, integration test, validation test and system test. Besides, user acceptance testing is also conducted to verify whether LOOOP system meet the essential user requirements.

8.1 Software Testing Strategy

A strategy for software testing using on this project consisted of four types of testing, such as unit testing, integration test, validation test and system testing. Unit testing is a testing of an individual program or module. Integration test is a testing that test two or more programs that depend on each other. Validation testing is a testing that validated all the software requirements with the system developed. System test is a test involving the entire system.

8.1.1 Unit Testing

Unit testing concentrated on each unit of the software as implemented in source code. This test purposes to identify and eliminate execution errors that could cause the program to terminate abnormally, and logic errors that could be missed. In this project, unit

testing are performed once a new block of source code was written. Debugger or language compiler is used in this testing. The compiler detected all the syntax errors that is found in the source code. Besides, input data also have been tested in this stage. The data tested included was the test on login textbox field, register user textbox field and others.

8.1.1.1 Login Page

Login page is the place where user registered to the system and the place for the system recognized the existing users. This page has only two functions, including log in user and register user.

8.1.1.1.1 Login user

This function is tested with a valid password and invalid password. First, a valid password is entered to the password field and the login button is clicked. The system loads the learning contents page when it is successfully login. Second, an invalid password is entered and the login button is clicked. A message box appears to let user know about the password is incorrect.

Table 8.1 Unit test for Login user

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	10	8	2
Total		10	8	2

8.1.1.1.2 Register user

This function is tested with an Internet connection and without Internet connection. A new user name is entered with the password. If the user name was not found in the list of login form username combobox, the system loads the sharable learning contents list page to let the user selects the contents needed to add into his or her personal learning contents. After selecting the contents, the learning contents page is loaded. An error will be raised if

the connection to the database is terminated during the half way of the process. This error will caused the user name was saved but could not be used in future time.

Table 8.2 Unit test for Register user

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	31	27	4
2.	If/ Else/ Then	8	6	2
Total		39	33	6

8.1.1.2 Learning Contents Page

Learning contents page is the place for registered user to manage the personal learning contents. This page provides several functions that is used to manage the contents.

8.1.1.2.1 Send contents by email

This is a simple test. First, the send contents by email button is clicked. This process will load the client mailing system such as Microsoft Outlook. The content of the current page is checked and attached to compose email page as attachment file. The failure of the test is caused by the setting of the email system on the client machine which was not set up.

Table 8.3 Unit test for Send contents by email

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	35	30	5
Total		35	30	5

8.1.1.2.2 New page

First, the new page buttons is clicked. An add content page is loaded for user to add a new content to his or her personal learning contents. This function is considered successful when the database successfully creates a record for the new content. Besides, the content title is also tested to have defferene within the existing learning contents topic title. A same content title will make the system confused and caused an error.

Table 8.4 Unit test for New page

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	9	8	1
Total		9	8	1

8.1.1.2.3 Open file

Some different format of files is used to test for this function. An error is caused when tested with the web page file. The system cannot load the page well when the page contains some unexpected error or an error occur during data transfer or database records missing.

Table 8.5 Unit test for Open file

No	Control Structure	Total Test	Total Success	Total Failure
1.	Select case	9	8	1
2.	If/ Then	33	27	6
Total		42	35	7

8.1.1.2.4 Save to database

This function is considered successful when the contents is successfully saved to the database. Incomplete data transfers cause the failure from client machine to server machine.

Table 8.6 Unit test for Save to database – Learning content page

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	38	29	9
Total		38	29	9

8.1.1.2.5 Save as LOOOP file

After the button is clicked, the file is checked to be successfully created on the client machine. Besides, the file is opened with system to ensure the file can be loaded.

Table 8.7 Unit test for Save as LOOOP file

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	15	14	1
Total		15	14	1

8.1.1.2.6 Save as XML file

After the button is clicked, the file is checked to be successfully created on the client machine. Besides, the file is opened with system to ensure the file can be loaded. The unknown or confused html tag caused the failure.

Table 8.8 Unit test for Save as XML file

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	39	28	11
Total		39	28	11

8.1.1.2.7 Save as sharable learning contents

After the button is clicked, the content is ensured to be included to the sharable learning contents. If the content is not found in the sharable learning contents, the function is considered not successful.

Table 8.9 Unit test for Save as sharable learning contents

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	35	29	6
Total		35	29	6

8.1.1.2.8 Delete contents

After the button is clicked, the content is ensured already deleted from the personal learning contents. The failed caused by in-completed SQL statements or data transfer problems.

Table 8.10 Unit test for Delete contents

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	18	14	4
Total		18	14	4

8.1.1.2.9 Print content

The print out copy is ensured same with the content viewed in learning contents page.

Table 8.11 Unit test for Print content

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Else/ Then	37	28	9
2.	If/ Then	32	26	6
Total		69	54	15

8.1.1.2.10 Navigation buttons

These functions included first page, previous page, next page function and last page function. These functions are used for navigating personal learning contents. When the first page button is clicked, the browser will open the first page of personal learning contents. When the previous button is clicked, the browser will open the page before the currently viewed page. The test on this function is tested for the correctness of content opening and ensured no error will occur when there are end of file or before of file.

Table 8.12 Unit test for Navigation buttons

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	24	22	2
Total		24	22	2

8.1.1.2.11 Editing tools

The test for editing tools is tested for the functions such like bold, underline, italic, redo, undo and other tools provided.

Table 8.13 Unit test for Editing tools

No	Control Structure	Total Test	Total Success	Total Failure
1.	-	0	0	0
Total		0	0	0

8.1.1.2.12 Internet search

This test is performed by selecting a word or a phrase and clicking the Internet search button. The word or the phrase will appear on the keyword field and the Internet searching is executed. The failures are caused by no Internet connection or result not found from Google.com. Result not found from Google.com will cause the function unable to retrieve the results.

Table 8.14 Unit test for Internet search

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	42	37	5
Total		42	37	5

8.1.1.2.13 Reader agent

After the button is clicked, the system will read the entire text found in the current content or selected text. There is an error to this function. The agent is only operated in operating system that supported the agent.

Table 8.15 Unit test for Reader agent

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	28	23	5
2.	If/ Else/ Then	23	20	3
Total		51	43	8

8.1.1.2.14 Highlight text and clear highlighted text

For this test, a clear text is selected for highlighting text test. After the highlight text button is clicked, the background of the selected text is ensured and has already been highlighted. For clear highlighted test, there is a problem that still cannot be solved. The problem is when the highlighted text was highlighted a couple of time, user needs to click the clear highlighted text button couple of time to clear the highlighted color.

Table 8.16 Unit test for Highlight text and clear highlighted text

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	32	30	2
2.	If/ Else/ Then	27	22	5
Total		59	52	7

8.1.1.2.15 Play board file

In this test, the browser is ensured could open the selected file.

Table 8.17 Unit test for Play board file

No	Control Structure	Total Test	Total Success	Total Failure
1.	-	0	0	0
Total		0	0	0

8.1.1.3 Search Information Page

Search information page is the place for user searching the keyword from the Internet or sharable learning contents. The result page found can also be a source for user to add it as learning contents.

8.1.1.3.1 Search from Internet or contents

First, a word or a phrase is entered to the keyword field. The search from Internet checkbox and search from contents checkbox are checked. Then only the search button is clicked. The results listed out are ensured and could link to the related page.

Table 8.18 Unit test for Search from Internet or contents

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	46	32	14
Total		46	32	14

8.1.1.3.2 Save to contents

First, the save button is clicked. Then, a topic title is selected and the ok button was clicked. The problem that still occurred to this function were the images on a web page is not fully saved to the database. Besides, some of the files could not be saved properly.

Table 8.19 Unit test for Save to contents

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	53	39	14
2.	For/ Next	48	41	7
Total		101	80	21

8.1.1.3.3 Save as board file

First, the save button is clicked. Then, a content title is selected to add the selected file as board file. The problem that still occurs is some of the links on the web page are shown in the file selection box and cause the system cannot be found the file at the specific link.

Table 8.20 Unit test for Save as board file

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	45	34	11
2.	For/ Next	32	24	8
Total		77	58	19

8.1.1.4 View file Page

View file page is the place for user to view and manage the board file, which is the file that is associated with the personal learning contents.

8.1.1.4.1 Save to database

This function is considered successful when the contents is successfully saved to the database.

Table 8.21 Unit test for Save to database – view file page

No	Control Structure	Total Test	Total Success	Total Failure
1.	-	0	0	0
Total		0	0	0

8.1.1.4.2 Save as external file

After the button is clicked, the file is ensured to create in the original file format.

Table 8.22 Unit test for Save as external file

No	Control Structure	Total Test	Total Success	Total Failure
1.	-	0	0	0
Total		0	0	0

8.1.1.4.3 Delete file

After the button is clicked, the record is ensured and already deleted from the personal learning contents.

Table 8.23 Unit test for Delete file

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	12	11	1
Total		12	11	1

8.1.1.5 Forum Window

Forum window is the place for registered user to communicate with another online LOOOP registered user.

8.1.1.5.1 Send file

First, a file is selected and the send file button is clicked. The function is considered a success when the recipient receives the file successfully and the file can be opened.

Table 8.24 Unit test for Send file

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Then	31	28	3
2.	For/ Next	27	24	3
Total		58	52	6

8.1.1.5.2 Send message

First, a message is typed in the message box. Then the send message button is clicked. This function is considered a success when the recipient receives the message send to them.

Table 8.25 Unit test for Send message

No	Control Structure	Total Test	Total Success	Total Failure
1.	If/ Else/ Then	43	31	12
Total		43	31	12

8.1.2 Integration Testing

Integration test focused on design and the construction of the system architecture. This test purposed to take unit test components and built a program structure that had dictated during system design. During this testing, LOOOP server-side application, LOOOP Socket is tested with the LOOOP client-side application. LOOOP socket, which is a data processing system, sent the data to client-side application when requested. The data that is in LOOOP language is the input data on client-side application and executed. The

valid characters for data record replaced the invalid characters or spaces and the replacement process is called again when user retrieved the specific data. Besides, LOOOP ActiveX control merged several of COM components in the system. Integration testing is not only tested for the data passing within LOOOP ActiveX control and the COM components, but also with database. Some integration test done within system and database are user verification, registered user, retrieved learning contents, save learning contents and others. SQL statement is used in this integration test by retrieving the data from the database.

8.1.3 Validation Testing

Validation test is achieved through a series of black box tests that demonstrate conformity with requirements. Black box testing also called as behavioral test focused on the functional requirements on the software. During this testing, the functionality and features built are checked whether they met the functional and non-functional requirements of this project. Those features are information searching, highlight text tool, reader agent, play multimedia file, user registration, user verification, add new learning contents, modify, delete learning contents and others. The test is checked for the availability of features, the accessibility and the functionality. Validation test is also tested for the reusability, durability, accessibility and interoperability. For example, a highlight text feature is planned to include in this system. The highlight text tool is built and its function had been tested that it can highlight the text on learning contents and clear the highlighted text. The verification and validation are very important because these ensure the system is built in the right way and correct.

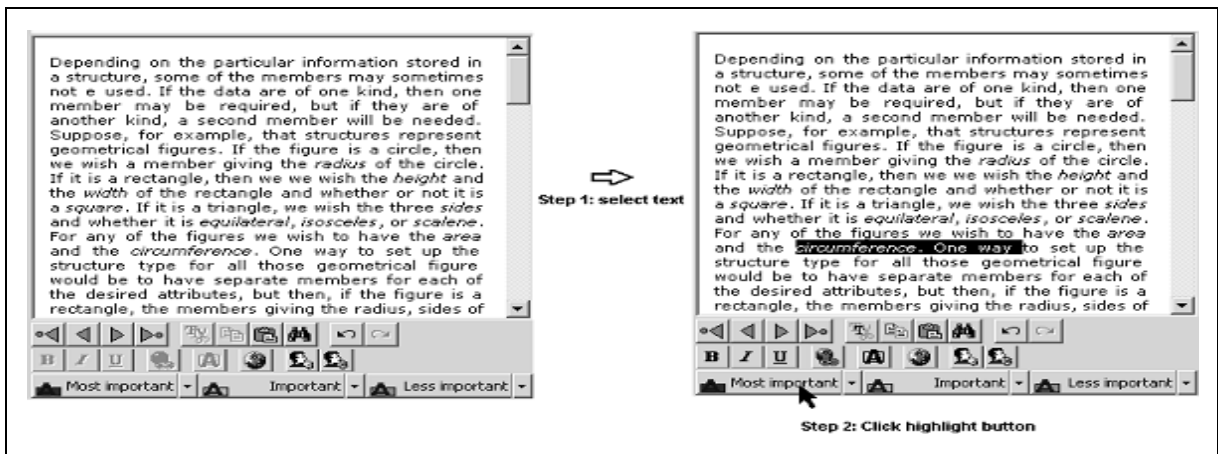


Figure 8.1 Validation test for highlight text

8.1.4 System Testing

System testing is actually a series of different tests where primary purpose is to fully exercise the system. Although each test has a different purpose, all work to verify that system elements had been properly integrated and performed allocated functions. The testing included recovery testing that run though LOOOP system with some different value input and try to find out some unexpected errors. Besides, the security testing also had been tested for the security of user log in to the system and ensured there was no duplicated user name in database. Furthermore, a stress testing and performance test is also tested in this stage. For example, a new user wanted to use LOOOP. First, the user needs to register to the system. After a few seconds, system displayed the sharable learning contents for user to select to add in the personal learning contents. At the same time, the system performs a number of SQL query with the database, such as recording user name, creating table, copy learning contents and others. After the registration is completed, user may perform highlight text, information searching, text reading and play media file. Lastly, user terminates the system. System test is considered completed and successful if the system did not raise with any error from loading to termination.

8.2 A Survey On User Acceptance Testing

Below is the analysis of survey based on the results gathered from questionnaire done.

8.2.1 Justification of the survey

User Acceptance Testing (UAT) is used to verify whether a new application meet the essential user requirements. UAT enabled captured user requirements in a directly verifiable way and measured the level of the system that meets those requirements. Besides, UAT also expose problems that cannot be found during unit tests and provides a ready-made definition on the completion of the system. In this project, a survey is conducted for UAT purposed. This survey consisted of a questionnaire that requires respondents to fill it after they had tested the system.

8.2.2 Survey method

Thirteen people are involved in the survey. The respondents are from both IT and non-IT fields. They are in age's ranging from twenty-two to twenty-six and moderates used with the computer. The questionnaire used is a closed-ended type of question. Closed-ended question is used to limit or restrict the responses.

8.2.3 UAT results

The questionnaire contained two parts. Part one regarding the respondent's information and part two regarding to respondent's satisfaction to the system.

8.2.3.1 Respondent information

Five respondents were from ages ranging twenty-two to twenty-four and seven were from ages ranging twenty-four to twenty-six. Eight of them were male and five of them were female. Figure 8.2 illustrated the column chart for the ages range and figure 8.3 illustrated the pie chart for the gender.

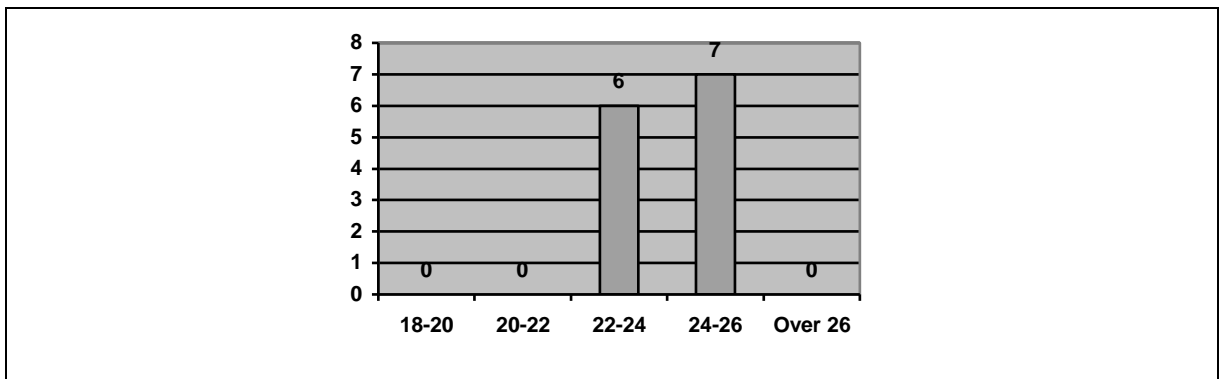


Figure 8.2 User acceptance testing respondents ages range

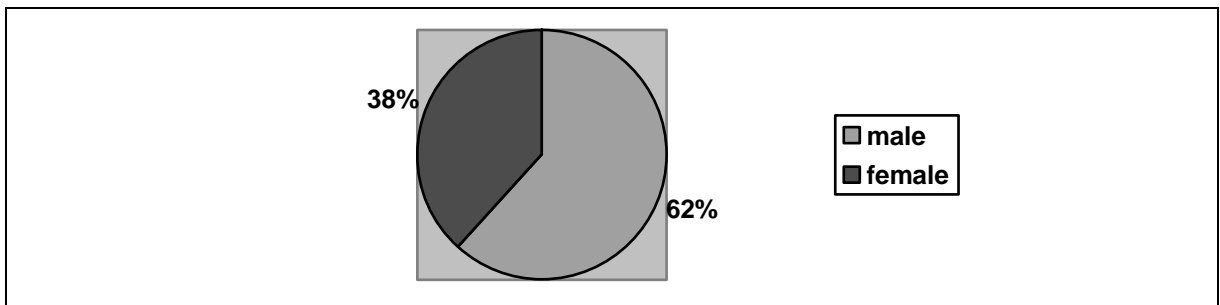


Figure 8.3 User acceptance testing respondents gender

8.2.3.2 Graphical user interface

Section B was the questionnaire asked for the user feedback after user had tested the system. Eleven respondents liked the system GUI design and two respondents disliked with the LOOOP system interface design because of the toolbars location. The width of the toolbars was fixed and some buttons were hidden when the width of screen was smaller than the width of the toolbars. Ten respondents agreed with the GUI design compatible to

the use of system. Figure 8.4 illustrated the column chart for user likeliness to the system GUI and figure 8.5 illustrated the column chart for the compatible of design.

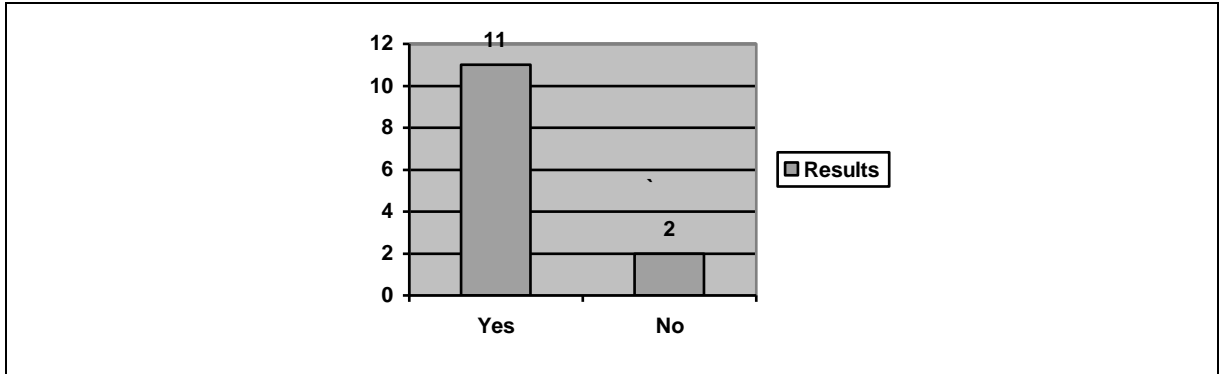


Figure 8.4 User likeliness on system GUI

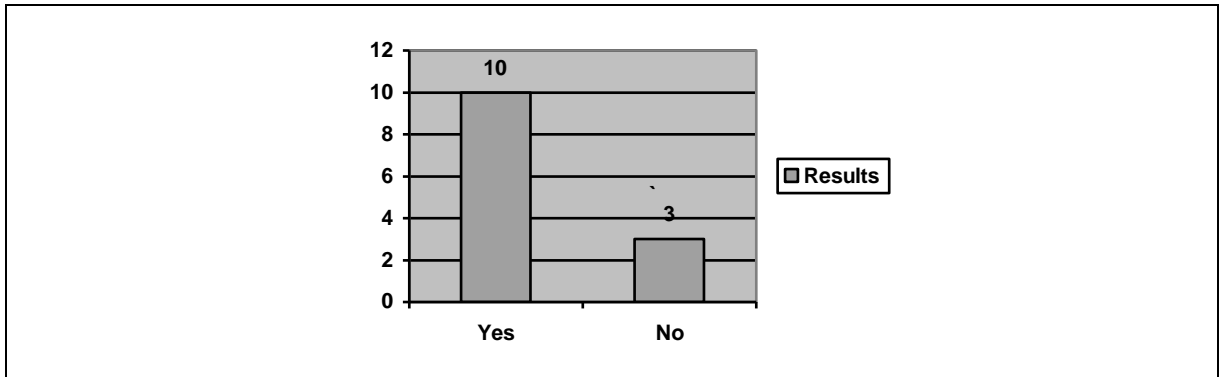


Figure 8.5 Compatible of GUI design to the system

8.2.3.3 Functionality

Eleven respondents are satisfied that the system had the features and capabilities needed and another two respondents needed more editing tools for editing the learning contents. Twelve respondents thought the system was easy to use and one found the system lack of tooltips on the features provided. Nine respondents were satisfied with the information provided in the sharable learning contents and four needed more sharable learning contents. Figure 8.6 illustrated the column chat for features and capabilities satisfaction and figure 8.7 illustrated the column chart for the satisfaction of easy use. Figure 8.8 illustrated the column chart for the satisfaction of providing information.

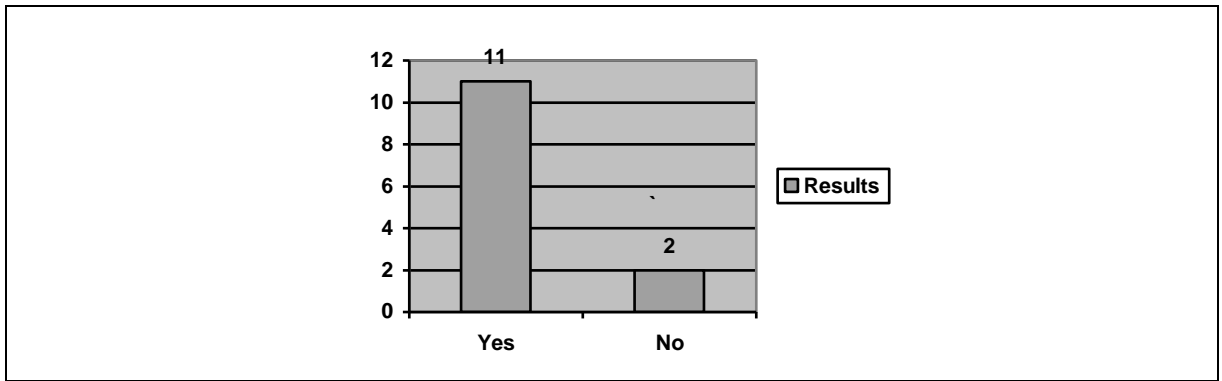


Figure 8.6 Features and capabilities satisfaction

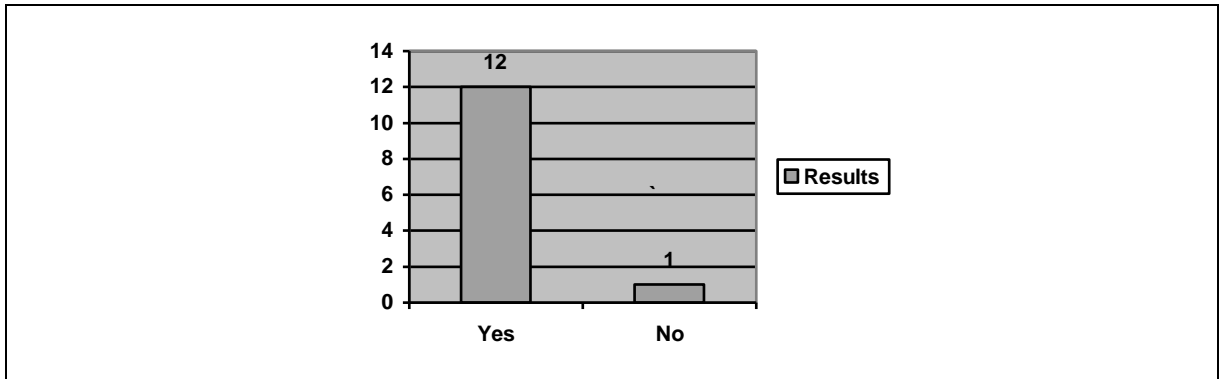


Figure 8.7 Satisfaction of easy use

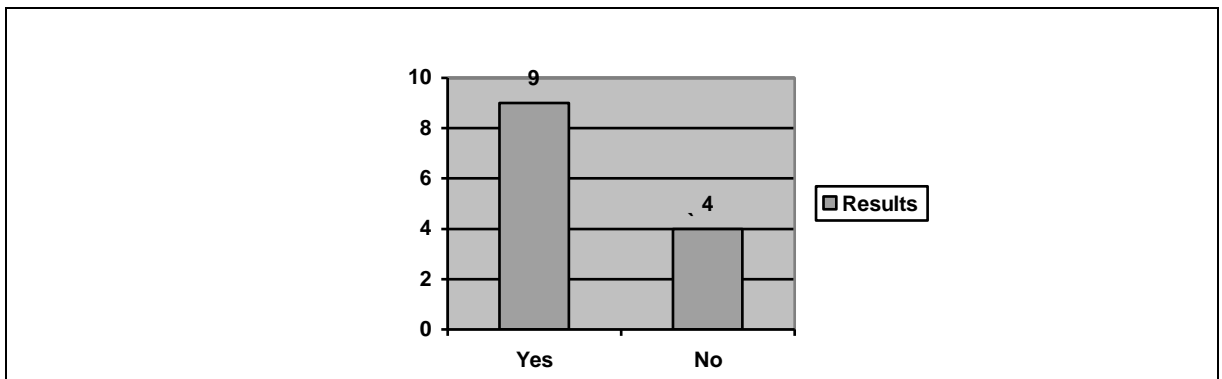


Figure 8.8 Satisfaction of provided information

8.2.3.4 Learnability

All respondents were able to use the system without any learning even with the lack of the tooltips provided. Eight respondents understood with the information provided. The information was the content of sharable learning contents. Five respondents suggested more details on the contents provided. Eleven respondents felt comfortable using the system. Two respondents were not because of the design of system GUI design. Eight respondents

were satisfied with the alert messages or pop-up message boxes provided and five suggested more alert messages and provided a status bar on the client-side application to show out the status of sending and retrieving data from LOOOP server-side application. Figure 8.9 illustrated the column chart for easier learning on how to use the system. Figure 8.10 illustrated the column chart for understanding on information provided and figure 8.11 illustrated the column chart for comfortable use with the system. Figure 8.12 illustrated the column chart for the alert messages provided.

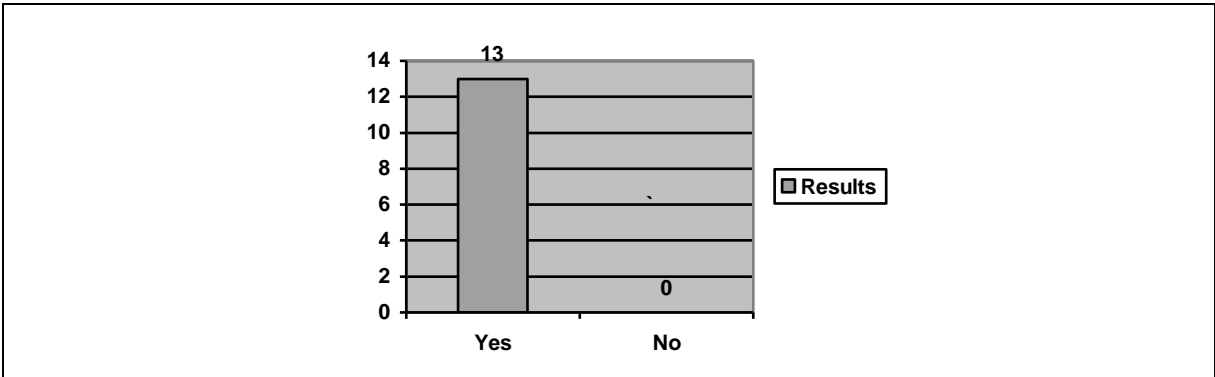


Figure 8.9 Easy to learn how to use the system

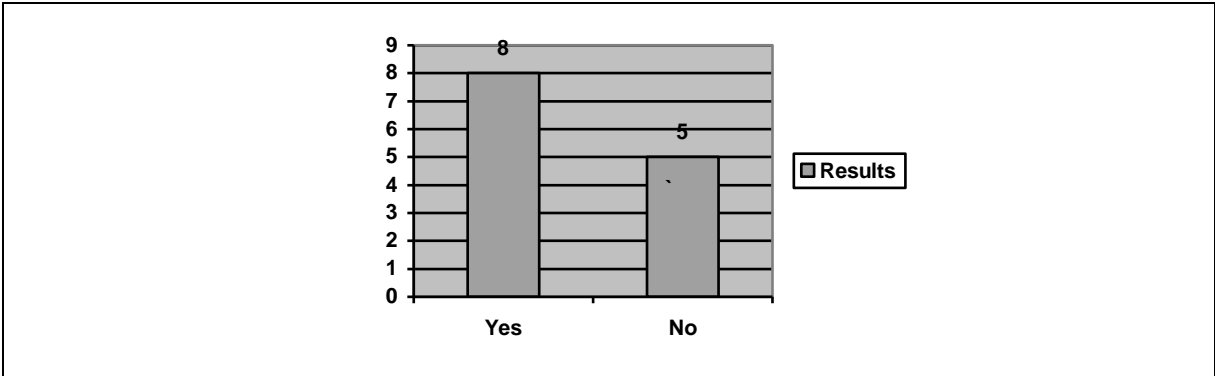


Figure 8.10 Not really understand the information provided

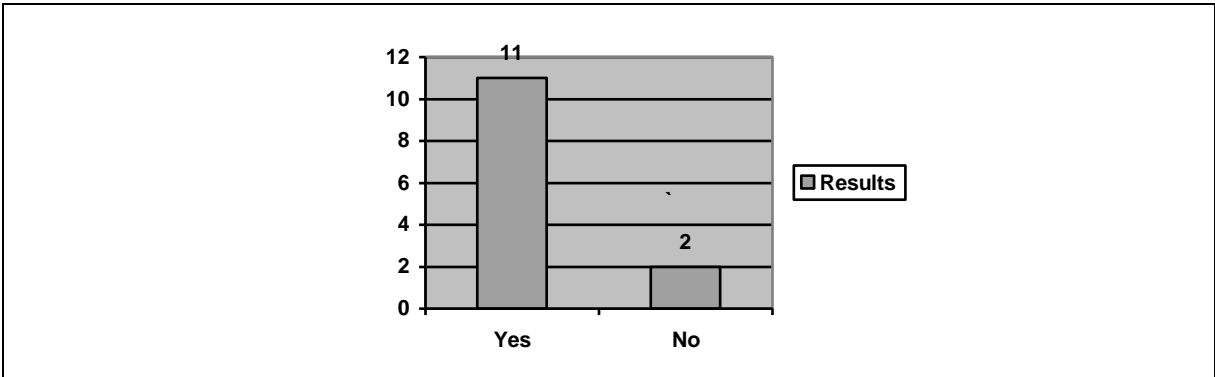


Figure 8.11 Comfortable use with the system

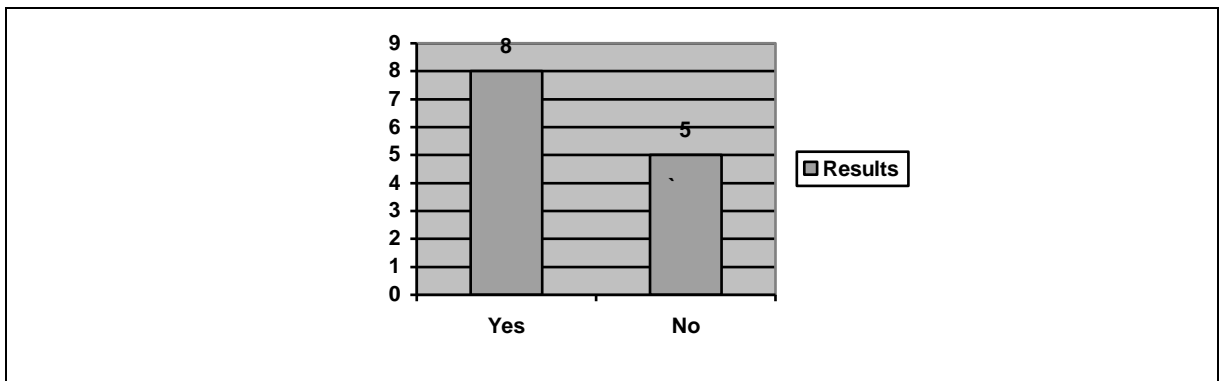


Figure 8.12 Alert messages provided

8.2.3.5 Satisfaction

Twelve respondents were satisfied with the system and the another one respondent suggested that more features need to be included in the system. Figure 8.13 illustrated the satisfaction to the system.

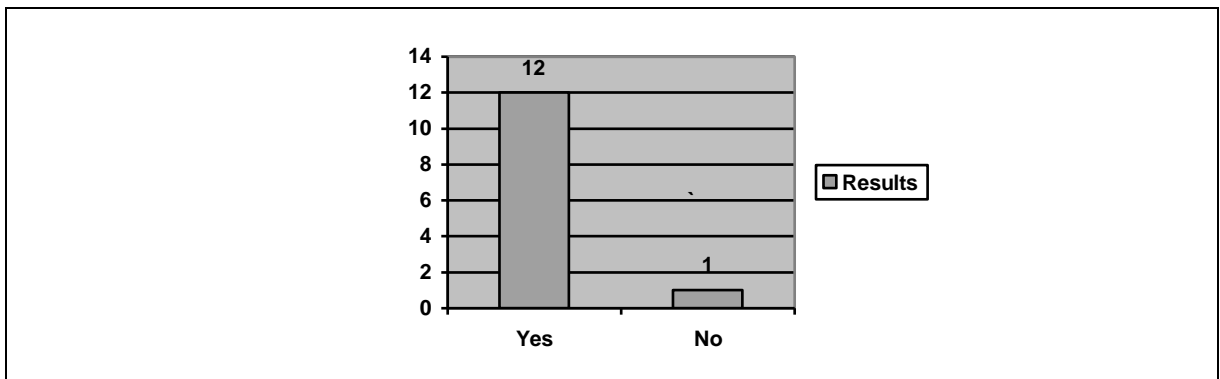


Figure 8.13 Satisfaction to the system

8.2.4 Survey conclusion

In a conclusion, many features need to be added to the system to make the system more functionality such as the learning contents editing tools. Besides, more system information is needed to add to the system, such as the tooltips, message box and status bar. Finally, most of the respondents are satisfied with the system and only one suggested more features to be provided on the system

8.3 Comparison Between LOOOP System Architecture to DSpace System Architecture

Architecture

DSpace is an open source that is designed run on UNIX platform and programming in JAVA programming languages. DSpace consists a three layers architecture including storage, business logic and service layer. Storage layer is a layer consisting of a relational database for saving metadata and 'bitstream' module for saving content data. Business logic layer is a layer that contains the modules to perform business logic of the system where all of the require functions such as search function, browse function, content management API and administration toolkit are located in this layer. Service layer is the layer that contains web user interface. Each of the layers links with API (Application Program Interface) interface. For storage layer and business logic layer, the API interface is called storage interface. For business logic layer and service layer, the API interface is called Dspace in-proces application interface (Michael, 2002). Figure 8.14 illustrates the DSpace system architecture.

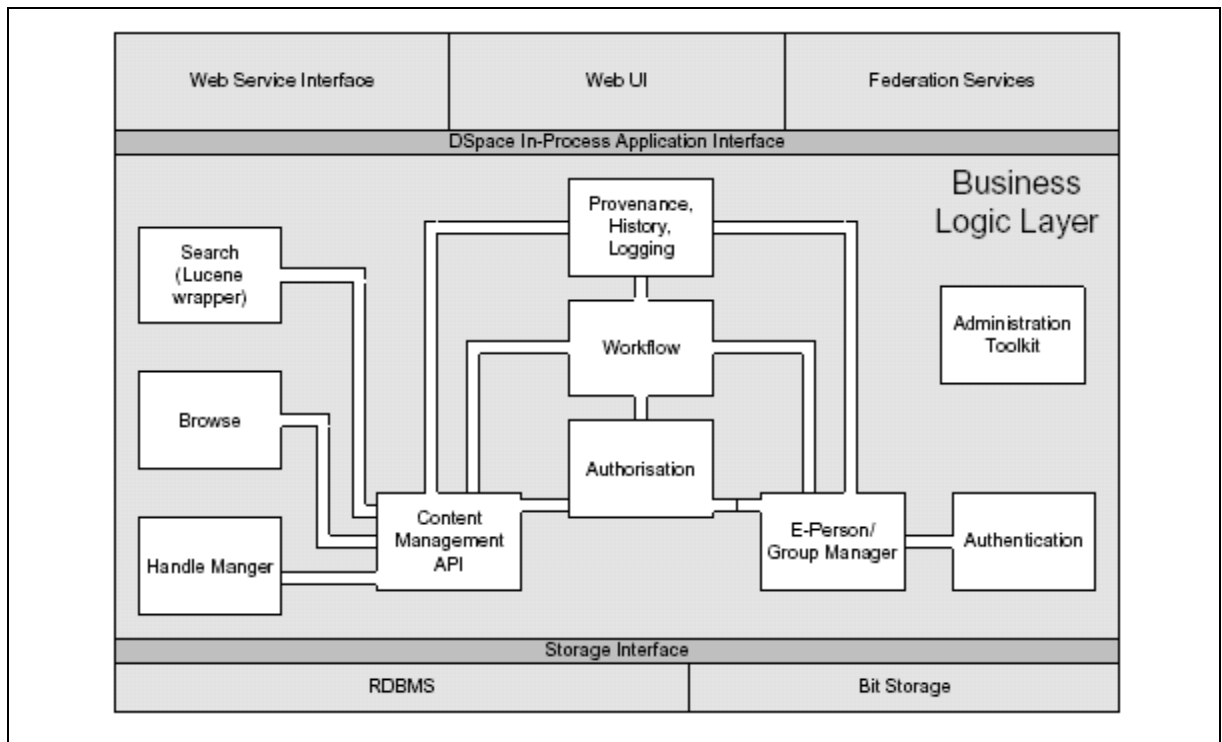


Figure 8.14 DSpace system architecture

The system architecture of LOOOP is designed based on the SCORM standard. There are only two part in LOOOP system architecture including client-side and server-side. Client-side is the part that contains all the function needed to communicate with Learning Objects including search function, browsing function and information searching. Server-side is the part for storing Learning Objects in a relational database. As a comparison, the client-side of LOOOP is similar as a combination of business logic and service layer for DSpace. The server-side of LOOOP is similar to the storage layer for DSpace. Besides, Dspace consists of a relational database for storing metadata and 'bitstream' module to save contents data while LOOOP consists of a relational database to save Learning Objects and the field name for the table is the metadata for Learning Objects. Thus, Dspace used JAVA programming language that is one of the object-oriented programming languages in its implementation and LOOOP used Visual Basic programming language in its implementation. The system architecture that designed based on SCORM standard is selected to be use in this system because SCORM standard is simple to construct a new system architecture and the way of to deal with Learning Objects is more direct than DSpace system architecture. Besides, LOOOP uses a relational database as Learning Objects repository that contains all created Learning Objects and its metadata while Dspace uses a relationship database for storing metadata and 'bitstream' to store contents data. These are the reasons explains why LOOOP used the architecture based on SCORM standard in implementation. Table 8.26 shows the comparison within LOOOP system architecture and DSpace system architecture.

Table 8.26 Comparison withing LOOOP system architecture and Dspace system architecture

	LOOOP	DSpace
Layer/ Parts	Client-side and server-side	Storage layer, business logic layer and service layer.
Repository and metadata	-Data store at server-side and store at client-side for offline version. -Table field name as metadata, record as Learning Objects	- data store at storage layer - Metadata store in database and content data store in 'bitstream'
Programming languages	JAVA - Object-Oriented Programming	Visual Basic - Event-driven and Object-oriented programming

8.4 Summary

Coming to the system testing, the software development life cycle has almost reached the final step. The system is performed with a list of testing method such as unit test, integration test, validation test and system test. Unit test is tested for every block of code written and every single component or functions built. Integration test is tested for interaction between two or more components. Validation test is tested for ensuring the entire features and requirements stated had been included in the system and functioning well. System test is tested for whole system, from system loading to system termination. Finally, a survey that performs as user acceptance test was conducted to know the user satisfaction to the system.