UTM Computing Proceedings
Innovations in Computing Technology and Applications
Volume: 5 | Year: 2022 | eISSN No. : 2976-2278

Digitization of Academic Staff Performance Assessment

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***Abstract*—Assessing academic staff is a challenging task especially for Higher Education (HE) institution. Each HE institution has a unique method with different requirements. In addition to that, the results of assessment data on the academic staff effectiveness such as teaching performance, competencies and professional experiences must be reported accurately and timely. The statistic report are critically beneficials not only to the evaluated staff, but also to the related various stakeholders namely the departmental and administrators to fine-tune current organization practice. At the same note, the leverage of specific education data namely the students rating on teaching effectiveness should be harvested to empower professional development and encourage to higher standard achievement. Nevertheless, this project aims to explore the digitization of education data, as a strategic asset combined with the cloud technology and the potential of intelligence capabilities to develop intelligent analytic dashboard, to improve teaching approach and learning outcome across HE institution. This paper aims to present the requirements and analysis of proposed analytic dashboard to digitize the academic staff performance assessment. As a summary, the result of this study shows by design and develop teacher assessment tool that include three important key features: (1) allow customized or pre-defined evaluation form and rubrics, (2) self-evaluation for teaching approach reflection, (3) interactive and real-time analytic dashboard and report generation.**

Keywords -- Education data; Academic staff assessment; Analytic dashboard; Teaching Evaluation; Kano Model

I INTRODUCTION

Most academic staff in university consists of lecturer and researcher. Usually, their work performance will be evaluated by their supervisor or students. Right now, all High Education (HE) institution facing many challenges when assessing their work performance through academic staff performance assessment. It must be unique and have different requirements for each HE institution. One of the challenges that we are facing right now is the equity of the assessment. [1] stated that each level of education should have different indicators and measurement tools. This context can be applied where the rubrics for each academic staff assessment should be based on the course itself. The assessment for academic staff usually includes teaching performance, competencies and experiences that will critically benefit for academic staffs to improve their work performance, especially in teaching. Furthermore, those assessments also can improve the standard of HE teaches quality so that we can produce more quality learning outcome for every course. A comprehensive, fair, research-based, and well-implemented academic staff assessment framework will enhance the academic staff workforce while also improving student outcomes [1]. We also can improve the outcome of the assessment by integrating the assessment result with an intelligent analytical report and visualize it using an analytics dashboard where it will summarize the result from the assessment. An analytical report is a form of business report that analyses and evaluates a business plan or method using qualitative and quantitative company data while encouraging workers to make data-driven decisions based on facts and analytics [2]. This type of report can help academic staffs to decide based on the result in the reports. For those reasons, this study will show a system designed as an effective and accurate academic assessment tool with three important key features:

1) Allow customized or pre-defined evaluation form and rubrics.
2) Self-evaluation for teaching approach reflection.

3) Interactive and real-time analytic dashboard and report generation.

The main aim of this paper is to study the essential requirements and analysis of the proposed analytic dashboard in digitizing the academic staff performance assessment. The overall structure of this paper is as follows. Related works and discussion of previous studies are presented in literature review. Next method section presents the process as well as the outcomes for requirements and analysis activities, followed by the preliminary findings of related stakeholders' opinions in data analysis section. Finally, the summary and plan for this study is concluded at the end of the paper.

II LITERATURE REVIEW

This section will examine and analyse comparisons between existing systems. Compare the compromises made between system features and functionalities. Knowing the strengths and shortcomings of the current system will help to improve the recommendation system, which is the goal of this analysis. The literature review covers the issues and research that will help the system develop into what it is today—the Teacher Evaluation System. Examining and understanding all works that are pertinent to this topic, as well as the materials employed in earlier considerations, is the goal of the literature review. The chapter will aid in developing a deeper grasp of the current system because it explores parallels within it.

A Rediker Teacher Evaluator

The Teacher Evaluator from Rediker Software is a stand-alone classroom observation program that works with any web browser and is optimized for the iPad®. Teacher Evaluator gives the resources that need to simply perform evaluations and boost teacher effectiveness, regardless of which student information system used or whether students are a private school, public school, district, or diocese [3]. Most of the function such as dashboard and custom form has been made as guidance for UTM Digital Teaching Evaluation (UTM DTE) application development.

B Standard for Success Teacher Evaluation Software

Throughout the assessment process, Standard for Success provides a single platform for recording, documenting, and gathering observations. Standard For Success provides administrators and teachers with a web-based platform that is simple to use, collaborative, and adaptable to the needs of any school. The application also has self-evaluation capabilities that can be use as guidance for implement it into UTM DTE application.

Rediker Teacher Evaluator and Standard for Success Teacher Evaluation Software are compared in Table I. Their strengths and weaknesses are analysed and applied to the UTM DTE application as unique features that meet the needs of the stakeholders.

The comparison is based on major features that plan to be implemented into UTM DTE application especially dashboard and custom form with rubric function. Also, there is also comparison on how the result generate in the system. As stated before, all system in the comparison can generate the data get from the evaluation, but each system has its own process to on how to view and access the data.

TABLE I. COMPARISON OF EXISTING AND SIMILAR SYSTEMS

Features	**Rediker Teacher Evaluator**	**Standard for Success Teacher Evaluation Software**
Dashboard	Analytical and Summaries	Real-Time analytics
Custom rubric	Include in form builder	Implement own locally created rubric, or to make modifications to existing widely accepted rubrics.
Form creation	Edit a pre-existing form with the built-in form builder	Fully customizable to own metrics
Evaluation	Ability to evaluate teacher	Ability to evaluate teacher, principal, superintendent, and more, all in one system
Self-evaluation	View dashboard for summary Can view evaluation result individually	Drill-down capabilities for in-depth data analysis
Result Data	Use the Excel™ wizard to export data for state reporting.	Generate performance analytics and report.

III METHODOLOGY

Requirements analysis and design are the most crucial components of software development. The functional demand is analysed first, then the non-functional requirement. Programming approach is the main topic of this chapter. A strategy may be summed up as a set of coordinated actions taken with the goal of creating a code that incorporates various requirements, designs, sensitivities, advancements, etc. A representation that appears to be generally organising how an object is shown can be a presentation approach, although we do agree with a few points of view. To receive the most recent upgrades for your programmes, we must understand how the framework functions, which in some cases necessitates a recent choice about which

strategy to use. As a result, the process for solving the problem is highly appreciated as an effective series of actions. combining tactical operations to complete a given task. The comparisons of the various techniques are covered in this chapter in brief. The expanding methodology's goal is to generate an overview of how the approach will be applied by outlining the inquiry preparation procedure.

A Requirement phase

The system's complete internal and exterior structure, as well as user acceptance of the system that was constructed in line with the specifications, are all impacted by this phase, which is crucial. There must be stakeholders. If the system's need is vague or ambiguous, there will be a considerable dispute. Because of this, it is essential for the developer to first comprehend all the procedures and activity sequences that take place during the teacher assessment event in UTM.

Survey

The purpose of the survey was to obtain the necessary information and requirements from the expected users. The survey's respondents are among UTM lecturers. The evaluation of the survey is based on Kano Model. Attractive (A), must-be (M), one-dimensional (O), reverse (R), and indifferent (I) are the five types of criteria based on Kano Model. Additionally, there is another criterion that use in Kano Model which is Questionable (Q) that will not be considered in survey result since it translates as conflict of interest regarding the feature from the respondent [4]. Table II shows the statistical analysis models are evaluated in a Kano Classified table [5].

TABLE II. STATISTICAL ANALYSIS MODELS ARE EVALUATED IN A KANO CLASSIFIED TABLE.

User Needs		**Unrealized Demand**				
		Like	***Wanted***	***Indifferent***	***Unwanted***	***Hate***
Property Realization	Like	Q	A	A	A	O
	Wanted	R	I	I	I	M
	Indifferent	R	I	I	I	M
	Unwanted	R	I	I	I	M
	Hate	R	R	R	R	Q

Attractive refers to the positive or neutral outcome of a user feedback survey. In general, the user does not anticipate them to have them, and if they do, it will tend to exceed the user's expectations of the total package. The lack of such features has no negative consequences for the user. Must-be denotes that those are the highest-priority user requirements that must be met. If these requirements are fulfilled, the typical reaction is neutral, but if they are not included in the product specifications, they may generate displeasure. One-Dimensional attributes, in contrast to 'Must-Be' attributes, tend to promote user pleasure if offered and raise discontent if not provided. The result of this attribute is either favorable or negative feedback on the service supplied, which in the first case was both neutral and negative. Indifferent attributes are ones that don't seem to have a significant impact on customer response. The user is unconcerned about whether these functionalities are present or not. Reverse qualities are those that create the opposite effect of client satisfaction, in the sense that the feature being offered causes a different response than what was previously perceived [6].

Table III show the summary of the questionnaire result that get from lectures in various faculty in UTM. Most of the respondent stated that dashboard, setting the form are the features that they are looking forward in this application. For others, most of it is in Indifferent which unconcern regarding the features stated. For more detail, in positive side, most indifferent result stated that the respondent expected to have the features in the application. But, in negative side, those features are not very concern by the respondent because their neutral opinion on it.

TABLE III. SUMMARY OF QUESTIONNAIRE RESULTS FROM LECTURER'S VIEW

Question	**Assessed Features**	**A**	**M**	**O**	**R**	**I**	**Total**	**Category**
Q3	View Dashboard	8				2	10	A
Q4	Use dashboard information filter	2				8	10	I
Q5	Generate report					10	10	I
Q6	Variation of form					10	10	I
Q7	Set form for evaluation	9				1	10	A
Q8	Set form based on course	7				3	10	A

	and section							
Q9	Do self-evaluation					10	10	I

Interview

The elicitation for this project added with several short interview with UTM Academic Leadership (UTMLead) administrator which is Prof. Madya Dr. Mohd Nihra Haruzuan Mohamad Said. He is one of the admins that manage the evaluation process for Student Evaluation of Teaching (e-PPP) system in UTMLead. Since we are in pandemic season and most of UTM staff work at home, the interview is based on emails by giving out several question regarding his opinion to elicit the requirements for this application. The summary from multiple interviews with him, the requirements has been decided for UTMLead admins user.

There also another short interview with some lecturer's in UTM where they have been asked regarding their opinion regarding current e-PPP and what their problem when using the existing system. From those interviews, the elicitation of the requirements is based on their wish on added features in proposed application.

The Swimlane diagram in Figure 1 depicts the roles and duties of stakeholders, as well as the business process of teaching evaluation methods. It is noteworthy that the evaluation operations are carried out manually, and that using the existing e-PPP system for solely the evaluation functions is extremely time demanding.

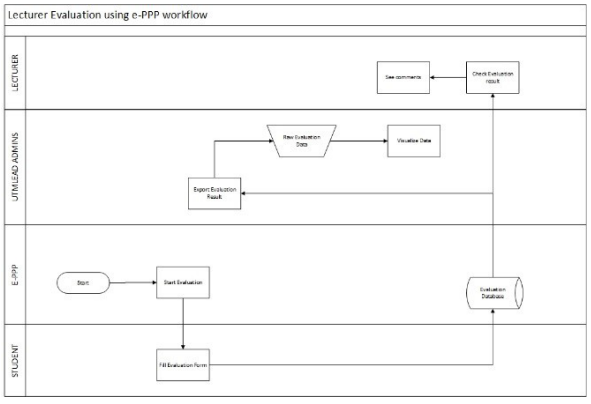

Figure 1. Swimlane diagram for existing system

Figure 1 show how the business process occurs by using existing e-PPP system for teaching evaluation process. e-PPP system is use only for collecting the evaluation data gather from students in UTM by fill the form in the system. The form also has common criteria and rubric that have been set and cannot be changed. The form is consisting of rubrics that evaluate the lecturer on how they conduct their teaching. It also evaluates the lecturer whether they use the technologies or application provided by UTM.

If UTMLead wants to conduct different type of evaluation, they will manually distribute the form to the student through the lecturer. This is because of the e-PPP system have permanent form that be used for evaluation every semester. Figure 2 shows the one of the examples forms that been used outside of the e-PPP system.

Penilaian Pengajaran Pensyarah Elektronik untuk UTM Open Distance Learning (ODL)

Instruction: Please rate your learning satisfaction in UTM ODL using the following indicator:

1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree,
4 = Slightly Agree, 5 = Agree 6 = Strongly Agree

No	Item	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Design & Organization (25%)							
1	The course is well-planned; learning activities and assessment appropriately constructed						
2	The instructor clearly communicated course learning outcomes						
3	Lecturer provided clear instructions on how to participate in course learning activities						
4	Lecturer clearly communicated important course topics.						
5	Lecturer clearly communicated important due dates/time frames for learning activities.						
6	Lecturer recommended relevant learning materials/resources.						
	Maximum total Score	= 36					
Feedback & Assessment (25%)							
7	Lecturer gave feedback on assessment in a timely manner						
8	Lecturer gave assessment that accurately measured learning outcomes.						
9	Lecturer gave continuous assessment throughout the course to gauge my understanding.						
10	Lecturer provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives.						
	Maximum total Score	= 24					
Facilitation / Implementation (25%)							

Figure 2. Form example from UTMLead

After the evaluation ends, the UTMLead admins will manually extract the data from the existing system in spreadsheet without any visual summary of the result. Figure 3 show the sample data that given by UTMLead for analysing the evaluation result. The data are arranged by matric number and their course with section. After that, if they want to do analysing process for the evaluation, they need to use third party application that can convert raw data into graphical view such as Tableau, Power BI, or generate manually using spreadsheet application.

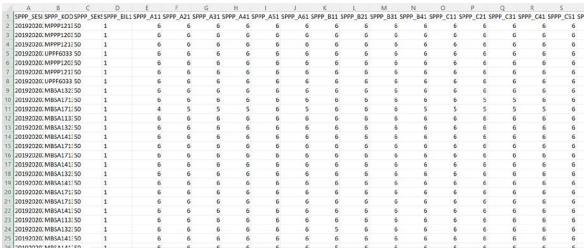

Figure 3. Sample of Evaluation result

Figure 4 show the business flow for UTM DTE application. This application has implemented all manual operations that has been discuss in current system analysis. The manual process has been automated in the system. It can lower the time consumption for the stakeholder to do teaching evaluation.

The major change between existing system and UTM DTE application is that UTMLead admins can manage forms by create forms based on the needs for the evaluation. Furthermore, UTM DTE also can let lecturer to set the forms create by UTMLead admins for the teaching evaluation for each course that they teach. After evaluation session ends, lecturer and UTMLead can access the dashboard to view the summary of evaluation result in graphical view. Lastly, they can generate analytical report based on evaluation data in dashboard.

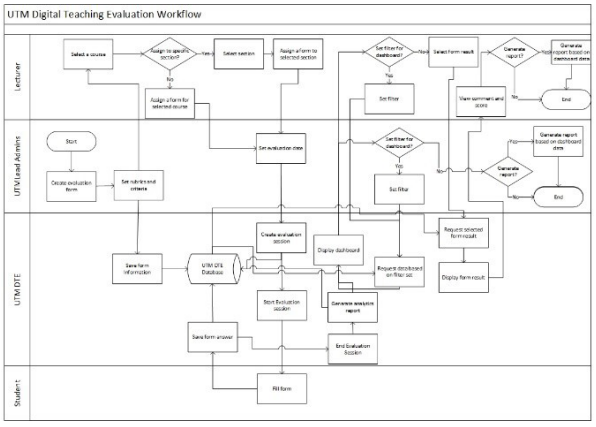

Figure 4. Swimlane diagram for UTM DTE system

B Analysis phase

Based on the user requirements and functionality that should be included in the system development, a use case diagram is generated during the analysis phase. The use case diagram for the UTM DTE is shown in Figure 5. There are four different user roles in this system.

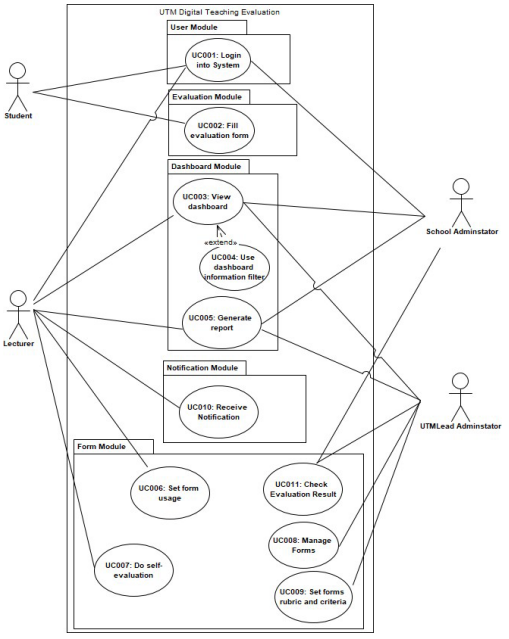

Figure 5. Use Case Diagram of UTM DTE application

C Design Phase

Architecture Style

Model-View-Controller (MVC), which consists of the three layers Model Layer, View Layer, and Controller Layer, is the architecture pattern used in creating the UTM Digital Teaching Evaluation. During system construction, this architecture is utilised to plan the total system. System architecture design is used to describe the system's architecture and framework, which defines a solution that meets all the stakeholders' technical and operational expectations. MVC was chosen for the UTM DTE application because of its features of straightforward code maintenance, ability to recycling code, and minimal coupling between layers. The system is divided into three components in MVC architecture, each of which is independent of the others [7]. The data of the application is stored in the Model component, which might be an object or a group of objects. The information is displayed to the user in a precise format using View component. The logical core of the application is contained in the Controller component [8]. Figure 6 show the MVC model architecture for UTM DTE application.

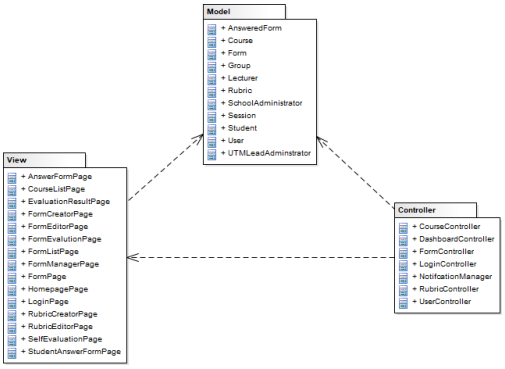

Figure 6. The MVC model architecture for UTM DTE application

Because the primary components are independent of one another (low coupling), MVC enables for easy exchange, enhancement, or even addition of new user interfaces, which will benefit users in terms of system usability. In this architecture, there will be three major components: Model, which is the main part that interacts directly with the main data and functions of the system, Controller, which receives data from the View component and manages it for services, and View, which is associated with its controller to present users with information in a specific format depending on what type of user.

Architecture Model

Figure 7 show the system architecture for UTM Digital Teaching Evaluation. The system has 4 component that run together so that the system can carry out all the functions in UTM DTE application.

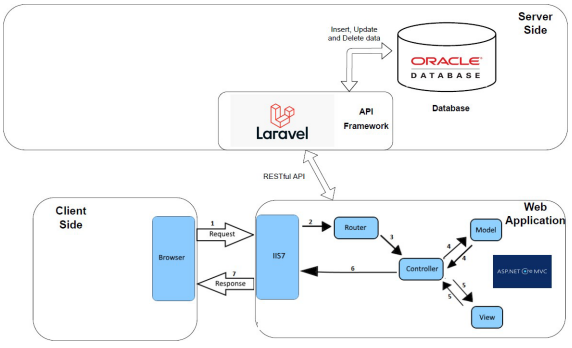

Figure 7. System Architecture of UTM Digital Teaching Evaluation

Client side is an interface for the system that will carry out the request form the user of the system. The request will be sent to backend of the system to be process and produce response based on the request made.

Web application is the main component of the system. It will be the engine for the system process the request from client side and generate the response and send it to client side. The web application component will be develop using ASP.Net Core MVC framework that using C#

Database component is act like data warehouse that will save all information that required for the system using Oracle Database. Database will interact with web application for supply the data needed and save any data received from it. The interaction will be using RESTful API which an API that using RESTful URL to access the database. The RESTful API component developed using Laravel framework based on PHP.

For the UTM DTE's user interface, the component is develop using Razor page which include in ASP.Net Core MVC. Razor page able to integrate basic webpage component which is HyperText Markup Language (HTML). Razor page also able implement Bootstrap framework for the Cascading Style Sheets (CSS).

Figure 8 depicts the UTMLead Administrator user interface for dashboard. This page shows the analysis regarding form usage and evaluation. This page also give ability to UTMLead Administrator to filter the analysis based on school, faculty, lecturer, and subject. UTMLead Administrators also able to export answers based on chosen form in .xlsx file.

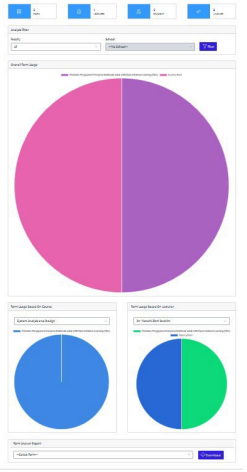

Figure 8. UTMLead Administrator user interface for dashboard

Figure 9 depicts the UTMLead Administrator user interface for manage form. This page allows UTMLead Administrator to add, update and remove form in the UTM DTE.

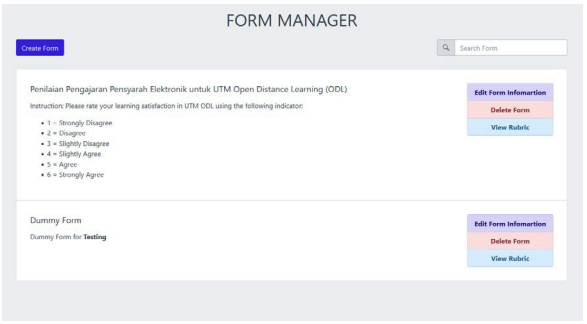

Figure 9: UTMLead Administrator user interface for manage form

Figure 10 depicts the UTMLead Administrator user interface for manage rubric for chosen form. This page give access to UTMLead Administrator to add, update and remove rubrics based on chosen form.

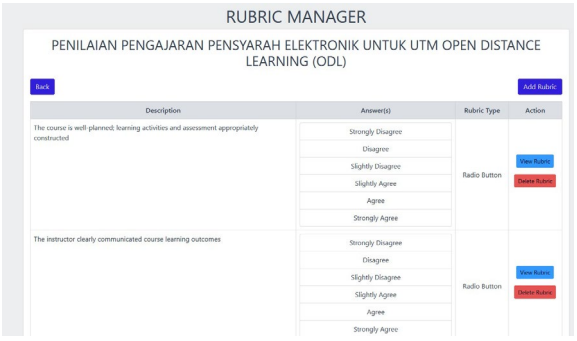

Figure 10. UTMLead Administrator user interface for manage rubric

Figure 11 depicts the lecturer user interface set form for the upcoming evaluation period. This page give access to lecturer set a form that have been created by UTMLead. Lecturer also able to see what are the rubrics that will be evaluate when using the form.

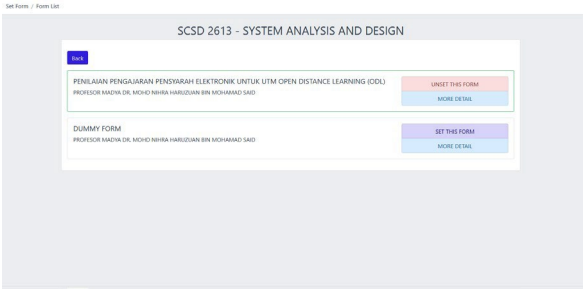

Figure 11. Lecturer user interface set form

Figure 12 depicts the student user interface to evaluate the lecturer based on the course that they take for the semester. The student will evaluate the lecturer based on the form that have been set by their lecturer.

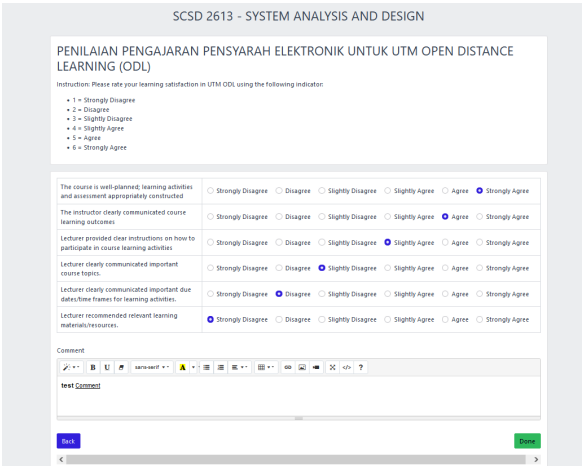

Figure 12. Student user interface to evaluate the lecturer

Figure 13 depicts the lecturer user interface to do self-evaluate based on given evaluation from the students after evaluation period. Lecturers able to check the evaluation from each student anonymously.

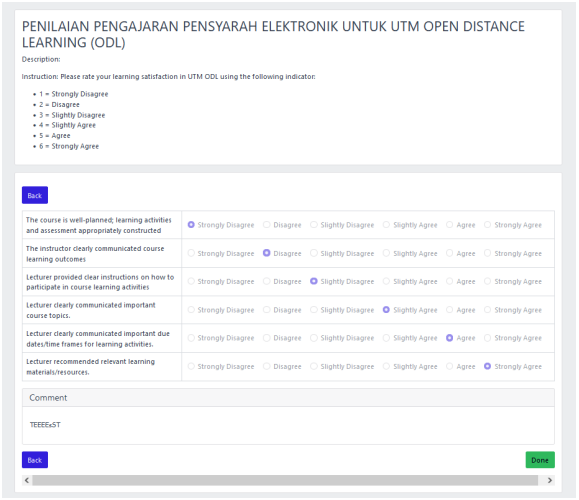

Figure 13: Lecturer user interface to do self-evaluate

IV TESTING AND RESULTS

A Functional Requirements

User Acceptance Testing (UAT)

The UAT is a type of acceptance testing that involves putting the built system through its paces with real-world users. The goal of UAT is to collect feedback and suggestions from stakeholders or targeted consumers to improve the product in the future. Furthermore, by doing the UAT, developers can have a better understanding of the users' behavior while using the system.

The UAT session was conducted using Google Form that consists of questions regarding the satisfaction of using UTM DTE application from user perspective. The result from the form shows that most of the feedback was good and need to improve more in usability and time taken on doing all task given during the UAT session.

Figure 14 shows a graph of the users' comprehension of the tasks they are given, with the x-axis representing the degree of difficulty, from 1 (Very Easy) to 5. (Very Hard). The amount of tester is shown on the y-axis in the interim. Most testers found it easy to understand how actions were executed.

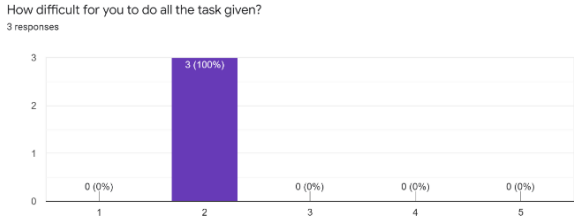

Figure 14. The complexity of completing all the tasks

Figure 15 shows a graph of the users' likeness of the interfaces use in the application, with the x-axis representing the degree of likeness, from 1 (Strongly Disagree) to 5. (Strongly Agree). The amount of tester is shown on the y-axis in the interim. Most of the respondent shows that they like the user interface of the application.

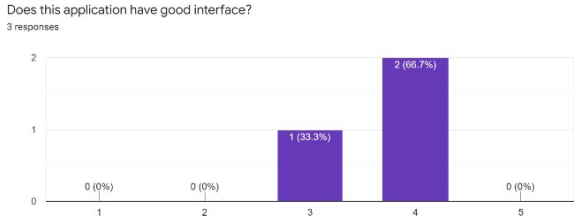

Figure 15. Respondent answer for application's interface

Figure 16 shows the graph regarding user respondent for how the system able to help them to do teaching evaluation activity. From the result, user is neither agree nor disagree whether the system able to help them to do the activity. Which means that the system can help to do the activity but need to add more feature and functions into the system.

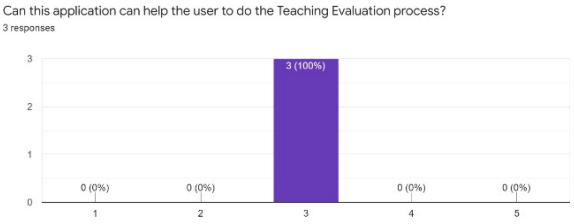

Figure 16. Respondent answer for capability of the application

Black-Box Testing

Black box testing is a type of testing that solely looks at the system's input and output. This type of testing does not include the system's fundamental algorithm or structure. Typically, system developers do black box testing to uncover flaws or bugs that may influence the system's ability to generate the required result.

Table IV shows the result of the black box testing on the login function for UTM DTE application. The result shows that all the test cases have pass since all action have executed as expected.

TABLE IV. BLACK BOX TESTING ON LOGIN FUNCTION

Test ID	**TC001-1**	**TC001-2**	**TC001-3**	**TC001-4**	**TC001-5**	**TC001-6**
Attribute	**Inputs**					
UTMID	-	mn.asyraaf	-	-	mn.asyraaf	mn.asyraaf
Password	-	-	12345	-	12345	54321
Result	**Actions**					
Required error message (blank field)	x	x	x	x		
Credential does not match error message						x
Login successful					x	
Login As	Failed	Failed	Failed	Failed	Student	Failed
PASS	/	/	/	/	/	/

B Non-functional Requirements

Apache JMeter

Apache JMeter is use for doing stress and load testing for HTTP request for RESTful API in the server of the UTM DTE application. The result of the test is determined based on the graph generated by JMeter.

From the graph, the data that need to be looked at are Deviation and Throughput that visualize using red and green line respectively. The throughput of a server refers to its ability to handle a large amount of data. The better the server performance, the higher the throughput [9]. For Deviation, it represents the deviation from the mean. The lower the number, the better [9].

Figure 17 depicts the result when testing POST request for Login function in UTM DTE application. The graph shows that the throughput and deviation at good level. This shows that the application's backend able to handle many requests in a period.

Figure 17. Graph generated by JMeter

OWASP Zed Attack Proxy (ZAP)

OWASP Zed Attack Proxy is an application use to do penetration testing regarding the security of the backend server for UTM DTE application. ZAP able to detect the vulnerability of the domain from any kind of web attack that can harm the server. The result of the test shows in form of flags that means the risk of getting attack by outsider.

Figure 18 depicts the result when the application undergoes penetration test using the ZAP. Those flags show the risk generated by ZAP that means of vulnerability of the application's backend.

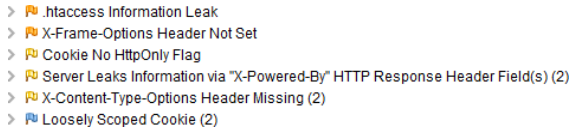

Figure 18. Result after penetration test generated by ZAP

V CONCLUSION

From the study, the teacher assessment tool development started by constructing use case descriptions, activity diagrams, sequence diagrams, and a step-by-step plan that breaks down the database and interfaces. Those flows and diagrams are formulated based on requirements elicitation conducted through surveys and interviews. This study also provides a thorough explanation of how the system design based its primary functions based on requirements elicitation. After the developments were complete, several tests were run with the targeted user. Those test results are used to identify whether all requirements have been fulfilled and implemented in the system. Finally, suggestions for future system enhancements are included under the strengths and shortcomings of the system. Based on the study, we were able to achieve three main goals regarding our system development.

The first goal is to elicit and examine the issues surrounding the current teaching assessment process at UTM. Provide the essential requirements, including functional and non-functional requirements, based on the elicitation of the requirements utilizing the interview approach and survey technique.

The project's second goal is to design an appropriate web-based application to address a problem with the approach that is currently being employed at UTM for the teaching evaluation process. The Software Requirement Specification (SRS) and Software Design Documentation (SDD) have been generated to achieve this goal.

The accomplishment of the third objective, which is to construct the UTM DTE application in accordance with the user requirements acquired in the first objective, can be observed through the deployment of the UTM DTE application in the web server. The UTM DTE application is tested using Black Box testing and User Acceptance Testing for functional needs, as well as Apache JMeter and OWASP Zed Attack Proxy for non-functional requirements

VI LIMITATIONS AND FUTURE STUDIES

UTM DTE application is developed specifically for UTMLead and lecturer from UTM. The is due to the reason that the operation and procedure for the teaching evaluation may be different from other higher institution. There are several unsupported functions or features for the UTM DTE application as shown as below:

a) UTM DTE application did not support the function to give advice to lecturer for improving their teaching assessment.
b) UTM DTE application unable to save form that need to have score calculation.
c) UTM DTE application can only be access through web browser in computer or mobile phone.

d) UTM DTE application is a stand-alone application that need access separately using its own URL.

For the UTM DTE application, there are numerous ideas and suggestions. Both the developer and the stakeholder sides have made proposals.

First, the application should be enhanced by implements artificial intelligence that able to consult the lecturer in which part of the evaluation that need to be improve. This feature able to help lecturer to understand more about the analysis of their evaluation results.

Secondly, UTM DTE application should be available as mobile application. As we know, most of the UTM DTE's user target already own smartphone that easier to bring and access the application everywhere. The addition of the mobile feature is quite easy since most of the data can be access from using API from server. So, the implementation of mobile application only needs to develop the frontend of the application.

Lastly, UTM DTE application should be able to accept the form that using scoring basis. This means that the application able to automatic calculate the score based on the evaluation given by the students. The scoring feature also able to help lecturer and UTMLead Administrator to analyse the evaluation easier.

ACKNOWLEDGEMENT

We spoke with a wide range of people, including academics, practitioners, and researchers, when writing this study. They have aided in the development of our knowledge and ideas. We really want to thank everyone who came out to help; without them, I wouldn't have been able to get this work done. This thesis would not have been the same without her ongoing assistance and attention.

All of our colleagues and other people who have helped on various occasions have our deepest gratitude. Their opinions and advice are helpful. Unfortunately, there isn't enough room to list them all here. All of our family members deserve our gratitude.

We also want to thank our parents, who have always supported us and given us advice as we worked on this study.

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