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Cross-Platform Course Assessment Mobile Application for the University of Mindanao using Text Analytics API and Weighted Incremental Algorithm

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ABSTRACT

The course assessment mobile application is an app that aims to transform the University of Mindanao's traditional surveying or assessment of courses by the students. The innovative and technological way of conducting course assessments in every term eases the entire process take with less time, effort, and cost for materials. Incorporated with a real-time database, assessment results are sent directly to the database, and reports are obtained within seconds. The mobile application is intended for the students of the university who are currently enrolled. Upon logging in using the student's ID number and surname, the student shall select the course to be assessed and, then, proceed with the survey. The assessment results are then analyzed to produce quantitative and qualitative reports through the web application. This web app uses the weighted incremental algorithm to compute the mean scores, and a text analytics API is used for the analysis of the comments and shall be administered by the Student Assessment Office. The study is mainly about the technologies apropos the development of a mobile application, and more specifically, on producing quantitative and qualitative reports on UM Course Assessment that will serve as the basis for further action on the courses offered by the university.

Key words: Course assessment, mobile development, data analysis, text analytics API, weighted incremental algorithm

1. INTRODUCTION

In an era where the application of technology is everywhere, educational institutions have to keep up with new and emerging technologies, bringing the educational experience to a higher level to improve quality of life. As one of Mindanao's largest universities, the University of Mindanao in Davao City, Philippines, is expected to provide an array of services to a fairly large community. In providing services to students, it is vital to solicit feedback from them. Feedbacks will give the administration ideas on how services should be improved.

Course Assessment (CA), for instance, primarily aims to extract feedback from the students on the quality of the course they are taking. It has been practiced by the university to conduct an assessment once in each term for every subject there is. The non-teaching staff of the university is assigned to conduct an assessment on each classroom, bringing answer sheets, survey questionnaires, and pencils with them. Each student shall have one of each material and shall return them to the assessor afterward. The students are to fill in the answer sheets by writing or shading, which are later scanned through a machine for analysis.

The UM Course Assessment Mobile Application is seen as another progress regarding the university's adaptation to technology. It transforms the accustomed paper-and-pencil manner of assessment, providing results faster. The student has to fill in the necessary information about the course and rate it with its corresponding survey question. The student may give suggestions or comments before submission. The feedback from the mobile app is sent directly to the database of the system. From this point, the administrator, who has access to the web application of the system, generates computations such as frequency and percentage of responses and means per item using the Weighted Incremental algorithm. This calculates the frequency, mean, and percentage of ratings and items. Results may be viewed in Google Sheets. Then, a ranking of faculty, as well as of items, may be obtained. The ranking of faculty is the basis of which faculty members are in need of improvement. Further, the strengths and improvement opportunities result are the basis on what the university's assets are regarding the course's quality, and what services are in need of action. For classification and interpretation, suggestions, and comments will go through Text Analytics API, which may be viewed in Google Sheets. Taking the assessors and the students into consideration, it will take up less time and effort if the assessment is right in their smartphones.

The current type of paper-and-pencil assessment requires the university to supply a lot of materials, and the assessors have to bring enough of these along with them. Moreover, most students find it difficult to read the survey questions on one paper and answer on a separate sheet. Some even don't read

the survey questions at all because shading alone goes in for quite a while already. Filling in and shading circles also consume more time than tapping the mobile phone.

With these at hand, the proponents want to earnestly take part in addressing this unsatisfactory estate in an innovative, technological way by developing a Course Assessment (CA) mobile application for the University of Mindanao.

2. RELATED SYSTEMS

Presented in this section are the synthesis of related systems and articles of different concepts and approaches concentrating on creating a Course Assessment mobile application for the University of Mindanao.

2.1 MOOC Collaborative Assessment Feedback Engine (M-CAFÉ)

In MOOCs or Massive Open Online Courses, like in a regular school setup, timely feedback from students can be helpful for instructors. M-CAFE aims to numerically assess an online course, the instructor's performance, and provide textual suggestions on course improvements [1]. Like M-CAFÉ, UM Course Assessment mobile app aims to let the students of the University of Mindanao assess their engagement with a specific course where students can also provide comments and suggestions about it. However, unlike M-CAFÉ, the UM CA app doesn't require students to register using email and stipulate basic information like age, gender, years of college-level education, and others. The student simply has to key in their ID number, then be directed to a page containing survey questions about the course. UM CA app accepts ratings on a scale of 1-5 (1 represents "Strongly Disagree," and five represents "Strongly Agree") while M-CAFÉ takes 1-10 (1 represents "Very Low," and 10 represents "Very High").

2.2 Dartmouth College Course Assessment

Dartmouth College established a web-based course assessment program in 2006. It is designed so that no one's identity could be tracked. All students complete the assessment for most courses, excluding off-campus, independent study, honors, research, and thesis courses. Students are required to assess all eligible courses each term before they may view grades online [2]. Like Darmouth College course assessment, this study envisions to evaluate the student learning at the specific courses. The key difference between the two is that Dartmouth College course assessment is a web application while the project is a mobile application, it will be deployed on mobiles because mobile phones are more accessible and more convenient for the students. They can download and install the application anytime.

2.3 University of Wisconsin-Madison Digital Course Evaluation Surveys

The University of Wisconsin-Madison has digital course evaluation surveys that allow academic departments and programs to more efficiently and effectively assess student learning at the course and program levels [3]. Likewise, this study aims to create a mobile-based university course assessment that envisions to improve the university's quality of courses, help the teachers clarify their learning objectives, and know what the students want to learn. Similarly, both are designed digitally because it is more accessible and flexible than the common paper-and-pencil type of assessments or evaluation surveys.

2.4 Online self-assessment and students' success in higher education institutions

The study validates the effects of the University of Mindanao's course assessment tests as a formative assessment strategy for all courses, to see whether to improve the subject or not. The students' results, such as test scores and pass rates, are compared for the same course but also judged against the performance of the same course taught by another faculty. The analysis points out that there is a statistically significant difference between the performances of the teacher in the same subject, as not all of them received the same scores. Positive effects are also seen in students, especially when scores are higher, thus no action required for improvement. Results point out that a small increase/decrease in pass rates could significantly impact the overall score of the faculty. i.e., high rates of student failure, high student attendance, and so forth [4].

3. METHODOLOGY

3.1 Data Gathering

In the gathering of data, most of the information collected was from the interviewed staff of the University of Mindanao–Course Assessment Office concerning the processes of the current course assessment and the problems encountered. Further, a sample questionnaire and dummy data of the course assessment's results were requested since the actual lists of results are confidential.

3.2 Development Tools

The following subsections are different tools that were used to design and develop the Course Assessment Mobile Application.

3.2.1 Firebase Real-time Database

This tool is a cloud-hosted database. It was used for adding, accessing, and managing content in the database of both mobile and web applications.

3.2.2 JavaScript Object Notation

This tool is an open-standard file format that uses human-readable text to transmit data objects consisting of attribute-value pairs and array data types. Data is stored as JSON and synchronized in real-time to every connected user.

3.2.3 JavaScript

This programming tool was used in web development for interactive effects, easy navigation, and even controlling the web application.

3.2.4 Hypertext Markup Language (HTML)

This standard markup language was used for creating the structure of the web application.

3.2.5 Adobe Photoshop

This software application was used in creating the design, prototype, and the user interface of the web application.

3.2.6 Ionic Framework 2 Version 3.9.2

Ionic is a framework used for both web and mobile applications with a single code base. This was used in designing the web and mobile applications such as typography, forms, buttons, navigation, and other interface components.

3.2.7 Charts.js

This application was used in creating a visual representation for the gathered data and results.

3.2.8 Adobe Photoshop

This software application was used in creating the design, prototype, and the user interface of the web application.

3.2.9 Angular 5

This is a platform that makes it easy to build a web application.

3.3 Conceptual Framework

The methodology for development used in this study is the Agile Development and are in forms of the sprint to wit: requirement analysis, design, development and testing, integration, and deployment.

As shown in Figure 1, user input goes through different components to generate the desired output. The project has two platforms; the mobile application was used to acquire data from the students while the web application processes the data and generates outputs. For the mobile application, Java was used as the application's primary language and Ionic as the framework. The web application used HTML5 as the primary language and Angular 5 and JavaScript to augment its design. The PDF and Charts.js were used to generate a graphical representation of data and results. Firebase was used to manage the database, and Node.js and JavaScript handle all the queries.

Figure 1: Conceptual framework of the system

The input, process, output (IPO process) is shown in the following subsections below.

3.3.1 IPO 1

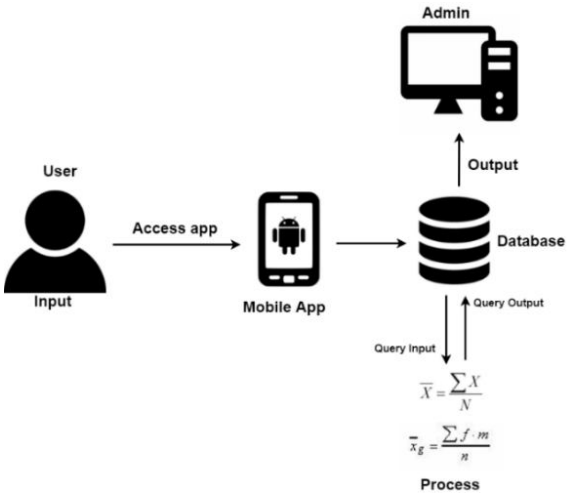

Figure 2: Conceptual framework process 1

The user gains access to the mobile application by connecting to the university Wi-Fi, then logging in using ID number and last name. Once signed in, the enrolled subjects in that specific school year, semester, and term appear in the dashboard. Users can now give ratings according to the given set of questions once a specific course is selected. All the acquired data from the users are directly forwarded to the database. The data is interpreted in the web application using a data analysis method and generates the output.

3.3.2 IPO 2

Figure 3 shows the process of producing qualitative and quantitative reports. The gathered data are directly forwarded to the database to be processed. The process is divided into two parts: qualitative for comments and feedback analysis and quantitative method for items and ratings. In the qualitative method, the data gathered are analyzed using Text Analytics API, and the output can be viewed in PDF. The quantitative method uses the Weighted incremental algorithm to calculate the frequency, mean, and percentage of ratings and items. The raw data from the quantitative method can be viewed in PDF, while the final output is in graphical

representations. The Overall Mean per College computation is a bar graph representation using Charts.js.

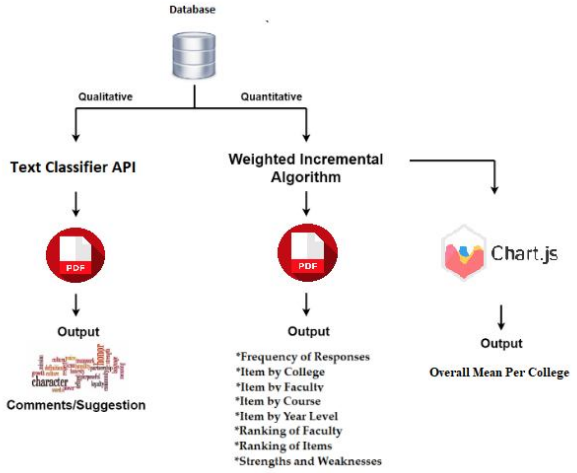

Figure 3: Qualitative and quantitative reports process

3.4 Weighted Incremental Algorithm

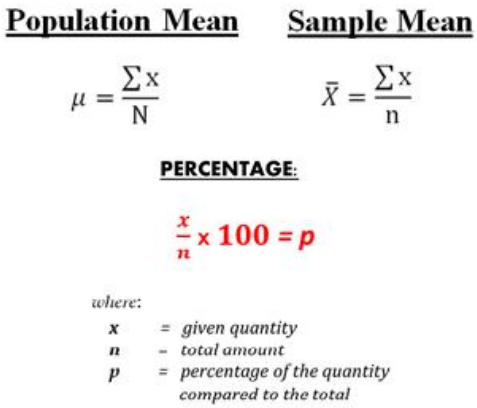

Figure 4: Weighted Incremental Algorithm (frequency, percentage, and mean formulas)

The Weighted Incremental Algorithm is one of the widely used algorithms for computing variance, the frequency occurrence, the mean, and percentages of the given problems. The Weighted Incremental Algorithm is used in solving statistical computations for the study. With this, the frequency and mean of the inputted raw data are computed. Frequency and mean are needed to come up with statistical data where formulas are shown in Figure 4.

3.5 Statistical Analysis

Figure 5 shows the graphical representation of the statistical process on how the raw data are computed and analyzed. Right after the data are forwarded to the database, the web application automatically analyzes the gathered data and generates computations such as frequency and percentage of responses, and mean per items by college, faculty, course, a course with faculty, year level, and session. After the calculation for the mean per items by faculty and by faculty with course, the result for the ranking of faculty with the highest and lowest mean is generated. The overall calculations will result in the ranking of items with the highest and lowest mean, and the strength and improvement opportunities. The ranking of faculty is the basis of which faculty members are in need of improvements relating to their teaching objectives. Also, the strengths and improvement opportunities' result is the basis of what are the universities' assets with respect to quality courses and the services in need of actions.

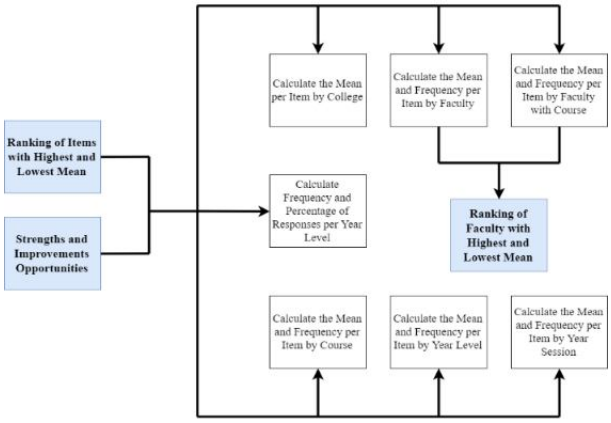

Figure 5: Quantitative outputs generation

3.6 Firebase Database Infrastructure

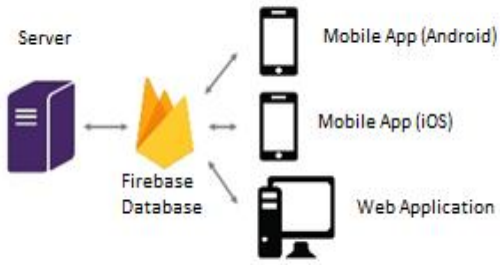

Figure 6: Firebase real-time database infrastructure

Figure 6 shows the infrastructure of the Firebase real-time database. The Firebase real-time database stores and syncs the data between devices in real-time. With this, it easier for the web application to collect data from different devices. It stores data in the cloud and simultaneously receives data from different devices in milliseconds.

3.7 Text Analytics API

The Text Analytics API is a set of text analytics web services built with best-in-class Microsoft machine learning algorithms. The API is used to analyze unstructured text or tasks such as sentiment analysis, keyphrase extraction, and language detection. Text Analytics API extracts information from data. Text analytics API is used to classify and distinguish the data (comments/suggestions) that were inputted by students on the mobile application. The API provides keyphrase extraction that automatically extracts key

points to identify the main points of data. The list of texts indicating key points of the inputted text by the students would be the output of Text Analytics API.

ParallelDots' sentiment analysis is used in this study to categorize qualitative data such as the comments of students on the course as to positive and negative. First, the comment is filtered by the API, removing punctuations to make it more polished. Each word in the sentence or phrase are assigned to corresponding vectors (numeric representation). Second, the vectors undergo recurrent layers before going through the classification layer. Finally, the comment that was processed will have its equivalent sentiment together with a percentage [5].

4. RESULTS AND DISCUSSION

4.1 Prototype

The main goal of this study is to create an intuitive university course assessment mobile application, which can be an effective tool regarding assessing the courses and program level from the students. The project uses data analysis to come up with results, including ranking for courses that are in need of improvement. It also decreases the assessor's workload in conducting the traditional paper-and-pencil type of course assessment. Figures 7-21 shows the graphical representation of the functionalities of the system.

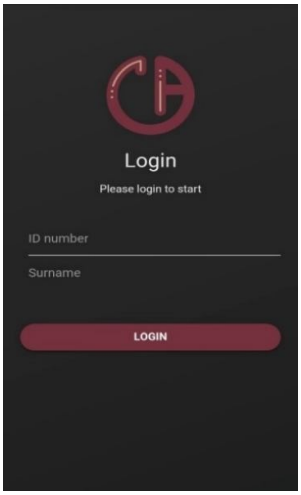

Figure 7: Mobile CA login

Figure 7 shows the login page of the mobile CA app, where students need to enter the ID number and password to access the application.

Figure 8: Mobile CA showing the course enrolled

The course code and title of the enrolled course code are shown in the 'Subject Enrolled Page,' as shown in Figure 8. The student needs to select a specific subject code for him/her to proceed to the questions. The green check icon means that the button is disabled because that course is already accessed and is evaluated.

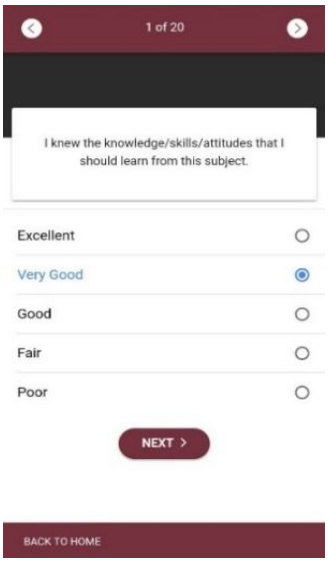

Figure 9: Mobile CA question page

Figure 9 shows the question page containing the evaluation questionnaire the student needs to answer.

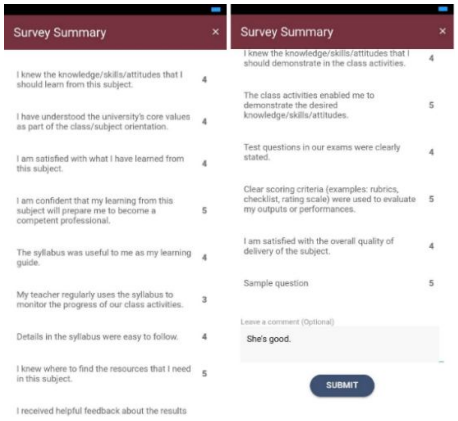

Figure 10: Mobile CA review page and comment section

The page where last part of the assessment in which student writes comments or suggestions as well as review their rated answers is shown in Figure 10. Upon clicking the submit button, a pop-up box will appear for confirmation, as shown in Figure 11.

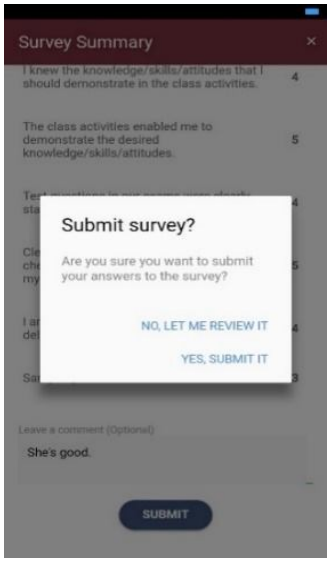

Figure 11: Mobile CA submit assessment

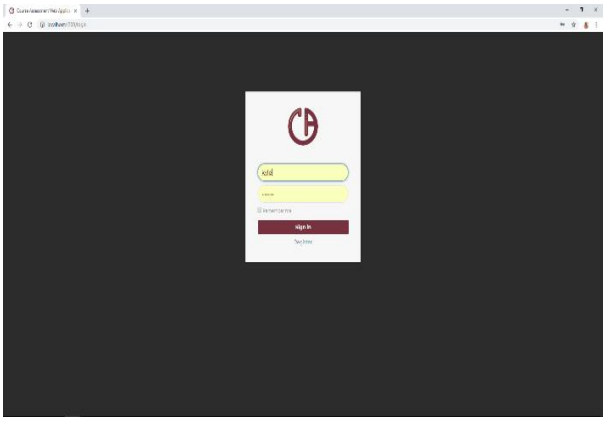

Figure 12: CA admin panel login

Admin gains access to the system by authenticating himself in the admin login module, as shown in Figure 12.

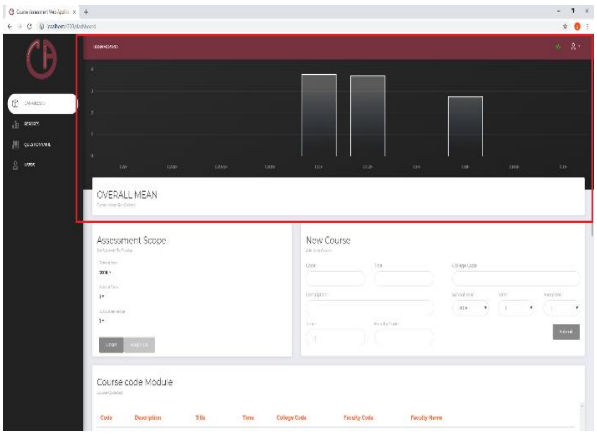

Figure 13: Dashboard – mean per college

Figure 13 shows a bar graph of the overall mean of each college.

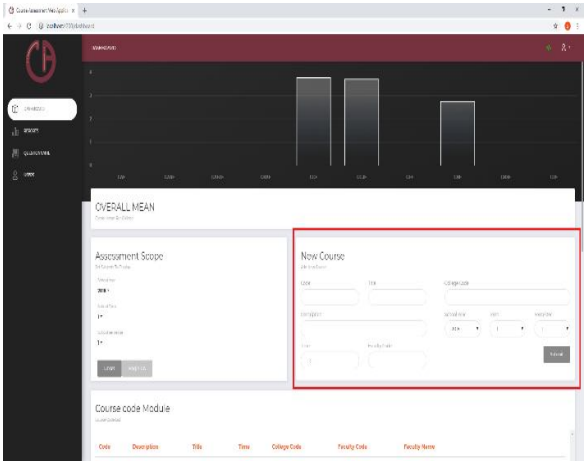

Figure 14: Dashboard – course module

Figure 14 shows the dashboard for the course module where the admin is allowed to set the specific year, semester, and term needed for the assessment.

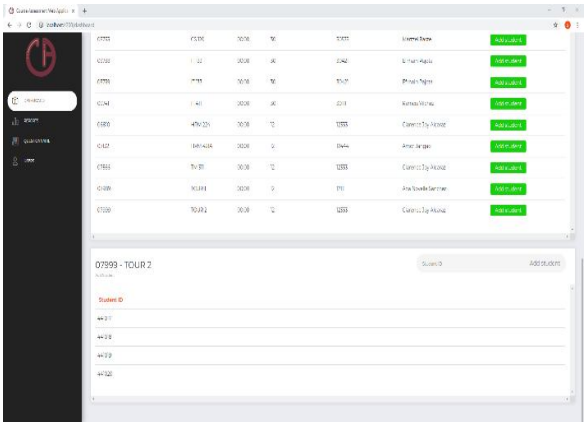

Figure 15: Dashboard – view for courses and add student module

Figure 15 shows the list of courses where the admin is allowed to add and view students who are enrolled in each course.

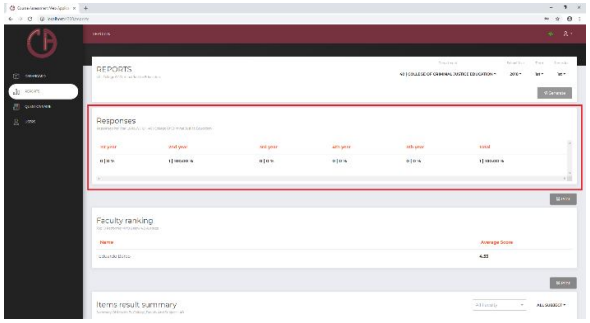

Figure 16: Reports - responses per year level

Figure 16 shows the population of students per year level. But first, to generate reports, the admin must choose the college, term, and semester, then click the generate button.

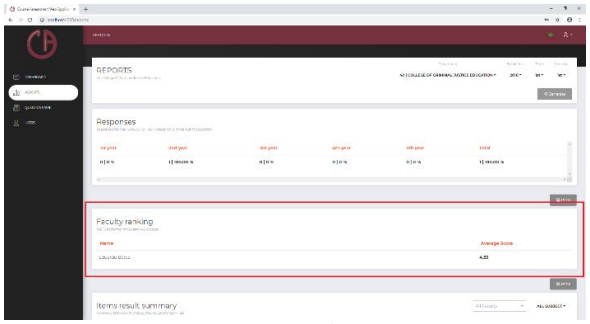

Figure 17: Reports – faculty ranking

Figure 17 shows the module in the app, where the top 10 performers without an average of below 4.0 are shown.

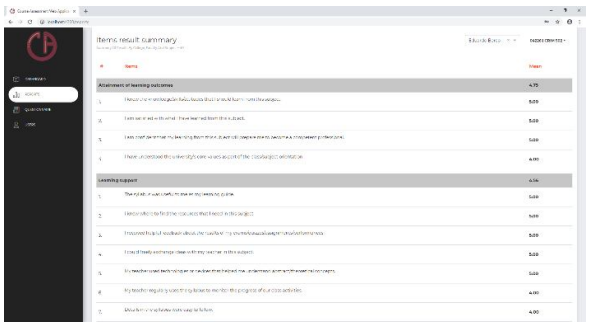

Figure 18: Reports – item result summary

Figure 18 shows the mean of each question by the college, which can be sorted by course code or faculty.

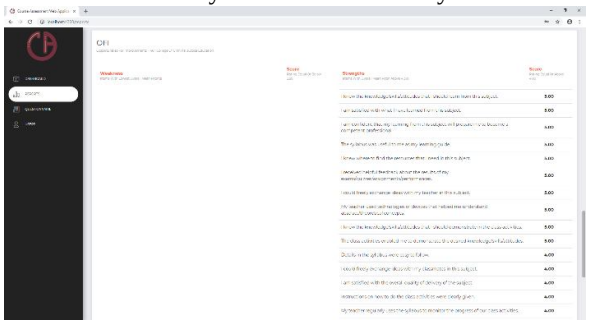

Figure 19: Reports – opportunities for improvement

This report identified the weakness and strength based on the questions and generated mean from the app, as shown in Figure 19.

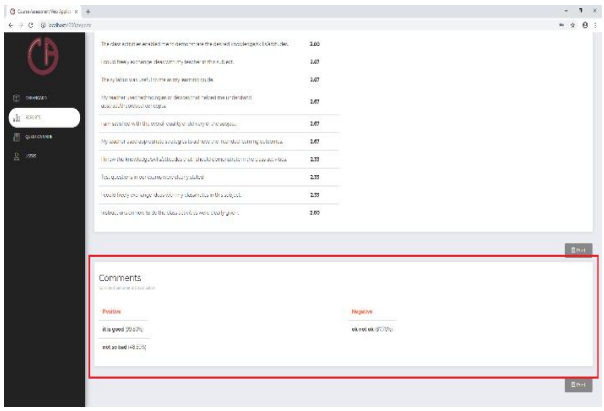

Figure 20: Reports - comments and suggestions

Figure 20 shows the comments and suggestions from each course code, identified as either Negative or Positive, with its equivalent percentage rating.

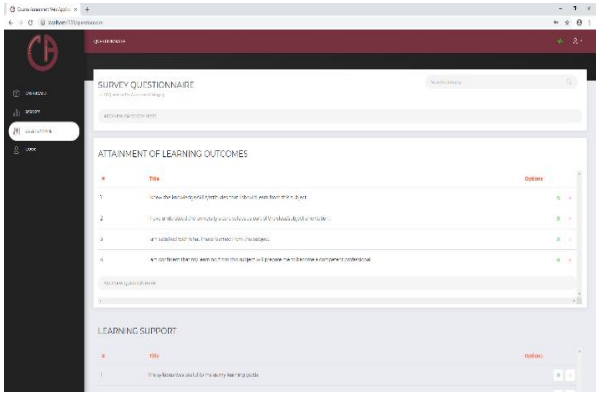

Figure 21: Survey questionnaire module

Figure 21 shows the module where admin can create, edit, and delete questions that are shown in the assessment.

4.2 Compatibility Assessment

In this study, several tests were conducted to wit: android OS version test, iOS version test, android device test, iOS device test, screen resolution test, hardware specification test, internet speed test, web browser test, and beta test participated by fifteen students from the University of Mindanao.

A test for various types of OS versions was conducted with results, as shown in Table 1. The test was conducted for different phones with an android version to detect which versions of OS is the application compatible.

Table 1: Android OS version testing results

OS Version (Android)	Result	Remarks
Kitkat 4.4	Compatible	Recommended
Lollipop 5.0	Compatible	Recommended
Nougat 7.0	Compatible	Recommended

Table 2 shows the result of the test conducted on the iphones with different iOS versions to identify the versions of the iPhone the application is compatible with.

Table 2: iOS version testing results

IOS Version	Result	Remarks
iOS 7.0	Compatible	Recommended
iOS 8.0	Compatible	Recommended

Table 3 shows the result of the test conducted on Android devices within the list to identify those that are compatible with the application.

Table 3: Android device testing results

Android Device	Result	Remarks
Oppo A83	Compatible	Recommended
Samsung Galaxy Grand 2	Compatible	Recommended
Samsung Galaxy Tab 3	Compatible	Recommended

Table 4 shows the result of the test conducted on Apple devices within the list to identify those that are compatible with the application.

Table 4: iOS device testing results

iOS Device	Result	Remarks
iPhone 5s	Compatible	Recommended
iPhone 6	Compatible	Recommended

Table 5 shows the result of the test where the application is installed on the devices with different screen resolutions.

Table 5: Screen resolution testing results

Screen Resolution	Result	Remarks
854 x 480	Compatible	Recommended
960 x 640	Compatible	Recommended
1136 x 640	Compatible	Recommended
1334 x 750	Compatible	Recommended
1024 x 768	Compatible	Recommended

Table 6 shows the result of the test conducted where the application is installed on devices with different RAM.

Table 6: Hardware specification testing results

RAM	Result	Remarks
1GB	Compatible	Recommended
3GB	Compatible	Recommended
768 MB	Compatible	Recommended
1.5GB	Compatible	Recommended
2GB	Compatible	Recommended
512MB	Compatible	Recommended

Tables 7-8 shows the result of the test when the application is used in different platforms with different internet speed.

Table 7: Internet speed testing results – mobile

Speed	Result	Remarks
3 Mbps	Compatible	Recommended
5 Mbps	Compatible	Recommended
10 Mbps	Compatible	Recommended

Table 8: Internet speed testing results – web

Speed	Result	Remarks
3 Mbps	Compatible	Recommended
5 Mbps	Compatible	Recommended
10 Mbps	Compatible	Recommended

A web browser compatibility test was conducted utilizing different browsers for the Web Application platform of the system. Results show that both Opera and Firefox are functional hosts; however, minor issues are depicted as to user's interface (UI) and functionalities. However, the use of the google chrome web browser in accessing the system shows a smooth process that is perfectly functional with no issues in UI, as shown in Table 9.

Table 9: Web browsers testing results

Browser	Result	Remarks
Opera	Compatible with minor UI issues	Recommended
Firefox	Compatible with minor UI issues	Recommended
Google Chrome	Compatible	Recommended

4.3 Installation Testing

An installation test using the following Android and Apple devices was conducted, as shown in the following figures.

Figure 22 shows the actual image where the application is installed in Samsung Galaxy Grand 2 with Android OS version 4.4-KitKat. The Android application did not encounter any issues and is successfully installed.

Figure 22: Installation testing in Samsung Galaxy Grand 2

Figure 23 shows the actual image where the application is installed in Oppo A83 with an Android OS version 7.1-Nougat. The Android application did not encounter any errors and is successfully installed.

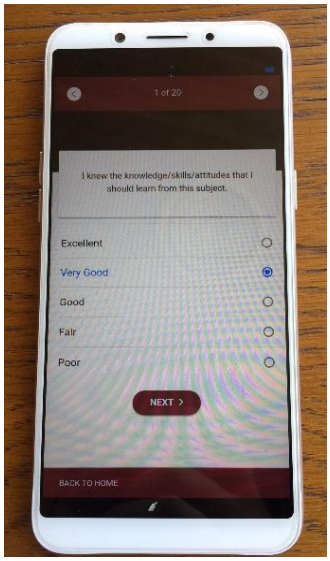

Figure 23: Installation testing in Oppo A83

Figure 24 shows the actual image where the application is installed in Samsung Galaxy Tab 3 with an Android OS version 4.1-Jelly Bean. The Android application did not encounter any issues and is successfully installed.

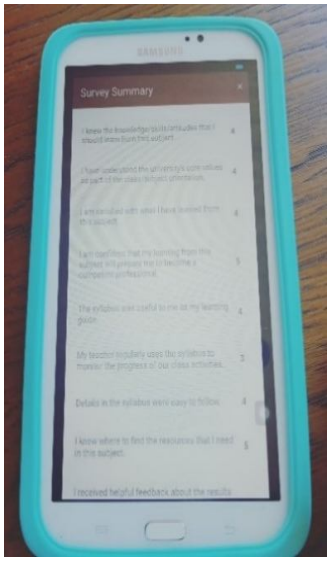

Figure 24: Installation testing in Samsung Galaxy Tab 3

Figure 25 shows the actual image where the application is installed in the iPhone 5s with iOS version 7.0. The application did not encounter any issues and is successfully installed.

Figure 26 shows the actual image where the application is installed in the iPhone 6 with iOS version 8.0. The application did not encounter any errors and is successfully installed.

Figure 25: Installation testing in iPhone 5s

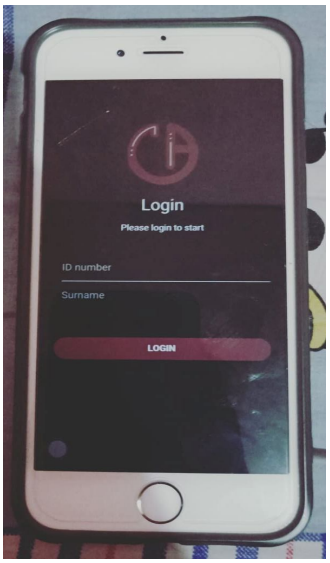

Figure 26: Installation testing in iPhone 6

5. CONCLUSION

All the necessary and primary requirements specified by both developers and institution partner, as well as the objectives of this study, are achieved. The simultaneous collection of data from different stakeholders using the Firebase database was successfully implemented. Further, the analysis and calculation of the collected data using the weighted incremental algorithm were fulfilled. Furthermore, the web application was successful in generating the quantitative report in a graphical manner using Charts.js. Lastly, the interpretation of responses was effectively implemented with the use of text analytics API. In general, the objectives were effectively met and achieved accordingly.

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