



The Design of Web Service-based Minimum Competency Assessment Application with the REST Method in Senior High Schools

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Abstract—To monitor quality improvement and student learning outcomes, schools must adopt a Minimum Competency Assessment (MCA). The Minimal Competence Assessment consists of two sub-tests: literacy and numeracy. This is in accordance with the provisions of the Indonesian Ministry of Education, Culture, Research and Technology in order to improve the quality of learning and student learning outcomes. The existing test method has limits with school resources that cannot satisfy the quota of pupils who can utilize the program jointly. In addition, the existing system is incapable of displaying student grades because the evaluation is a cumulative score for the whole student body. Hence, the school constructed a web service-based application utilizing the Representational State Transfer approaches so that it could independently administer complete numeracy and literacy assessments to its pupils, allowing schools to track their students' numeracy and literacy improvement. The system is constructed utilizing two distinct platforms, namely web-based apps and mobile applications based on Android. Web-based application was developed for admin and teachers while mobile application was developed for students. The findings of this study's testing indicated that the web service application performed as predicted. According to the findings of the questionnaires given to evaluate the application's usability using the Nielsen technique, teachers were happy with the application's Learnability, Memorability, Efficiency, Errors, and Satisfaction. The majority of instructors are satisfied with the implementation of this Minimum Competence Application, according to the survey findings.

Keywords—Web service; REST API; minimum competence assessment.

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I. INTRODUCTION

In Indonesia, the development of apps based on cellular technology continues to rise. With mobile learning, this may be utilized to improve the quality of education [1]. Mobile learning may be utilized as an alternative to regular classroom instruction and yields comparable learning effects [2]. Mobile learning can assist in providing information that is centered on the requirements of students, as mobile devices are available at any time and in any location [3]. The majority of the mobile learning applications created and evaluated in the higher education industry are utilized to give students with materials [4]. This is consistent with Butler et al [5] study on the usage of mobile learning in corporate training, which found that younger learners are more likely to get mobile learning than older trainees.

The Ministry of Education, Culture, Research, and Technology in Indonesia replaced the National Examination

with the Minimum Competency Assessment (AKM) in order to improve the quality of learning and student learning outcomes [6]. The Minimal Competence Assessment consists of two sub-tests: literacy and numeracy. Literacy is the capacity to understand, use, assess, and reflect on written materials, whereas numeracy is the ability to think employing concepts, methods, facts, and mathematical tools in solving problems. An-Nurmaniyah Senior High School is a school located in Tangerang City. Presently, the institution has over 850 students enrolled in various majors. Government-administered numeracy and literacy assessments are presently administered using a website-based method that limits schools to 45 pupils each year. The website-based system established for the current literacy and numeracy exams cannot additionally display the results of each student's completed tests since the system's assessment is based on the aggregated scores of all students for their school. In a circumstance like this, the school cannot observe the

minimum ability of each student, thus the system is not successful in seeing the progress and learning results of all students while studying. In accordance with the prevailing conditions, the school aims to in-dependently implement numeracy and literacy examinations for all its pupils every year. This is done so that the school can gauge student development based on the examinations given. To implement this test, a system is needed that can enable the implementation of the test so that it may be carried out properly. The state of the laboratory room which only contains 35 computers is not adequate to satisfy the demands of students to carry out tests. Given these circumstances, a mobile and web-based solution was designed to assist instructors and students with test administration.

To link the two systems with distinct bases, we need a solution that can combine the systems. The technology employed is a web service. Web service is a service that comprises a collection of databases and is accessible via a variety of platforms, including mobile-based systems and websites. The way that may be utilized to construct web service technology is the Representational State Transfer (REST) Application Programming Interface (API) method. REST has been established as a common protocol for developing and integrating services across several platforms; hence, it is frequently referred to as the Restful application programming interface (API) [7]. REST is a communication mechanism for exchanging data between a server and a client using the HTTP protocol [8]. The advantage of the REST technique is that it can be utilized by a range of different programming languages and platforms and is easier than other ways [9][10][11]. REST applications are commonly utilized for the creation of web-based or mobile services [12]. REST-based apps are more suited for mobile devices that have limited capabilities, rely on wireless networks, and consume fewer resources [13].

Based on the explanation above, this research focuses on building mobile-based applications and websites that are connected to online services that may assist schools to execute numeracy and literacy examinations efficiently. When the application has been constructed, it is required to conduct an evaluation. Usability is a measure of how simple it is for young people to navigate an application's user interface. Usability is an essential aspect of application development [14][15]. Usability level measuring can employ a questionnaire-based evaluation approach [16]. In this study, questionnaires were provided to instructors to test the usability level of the applications being created.

II. MATERIAL AND METHOD

The method used in this research is the waterfall method. This method was performed step by step starting from requirements gathering, analysis, design, coding, testing, implementation, and implementation verification through a questionnaire. The stages of the waterfall model are described as shown in Figure 1.

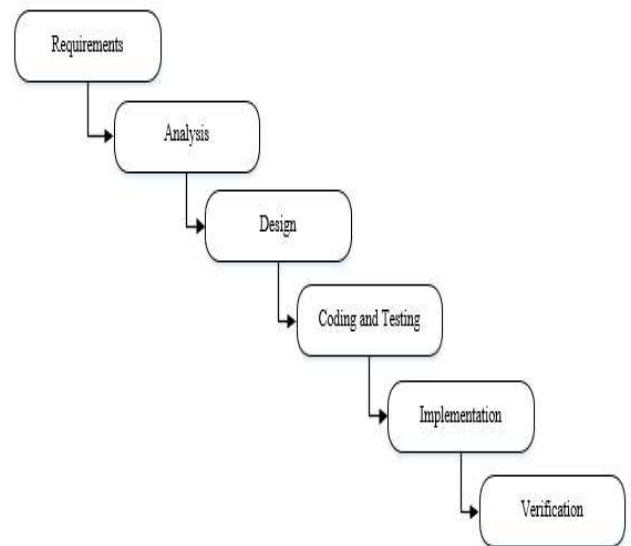


Fig. 1 Research Method

At the design stage, a web service development plan was produced using the Representative State Transfer (REST) method, a website design, and a mobile application design. The REST design is necessary because REST has a function as a recipient of HTTP requests made by users to the database and sends the data back to the user in the form of JSON data. There are several methods implemented including the get and post methods. The following is the process of sending data from the client to the server, receiving data from the server for the client, and the web service design table.

A. Application of the GET Method

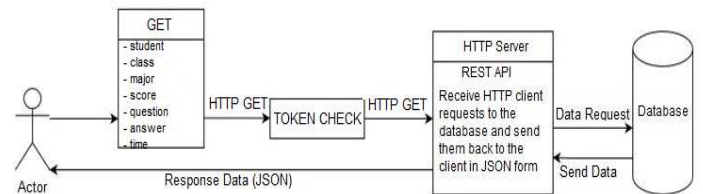


Fig. 2 Process of Implementing the GET Method

The GET method process as described in Figure 2 functions to display data requested by the user to the API to then be forwarded to the database. But before making a request, a user will check whether he has a token or not. If it doesn't have a token, the request will fail.

B. Application of the POST method

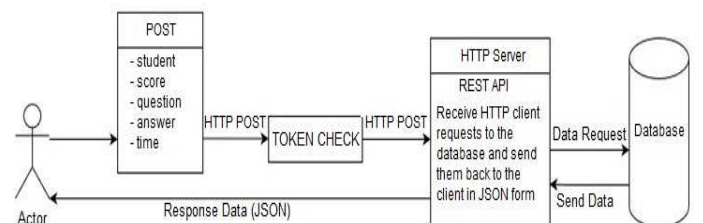


Fig. 3 Process of Implementing the POST Method

The second method is POST. The method described in Figure 3 functions to add data re-requested by the user to the

API to then be forwarded to the database. Apart from adding data, the post method is also used to delete and change data. But before making a request, the user will first check whether the user has a token or not. If it doesn't have a token, the request will fail.

C. Web Service Design

The relationship between User Client, Web Server, and Database Server is illustrated through the deployment diagram in Figure 4.

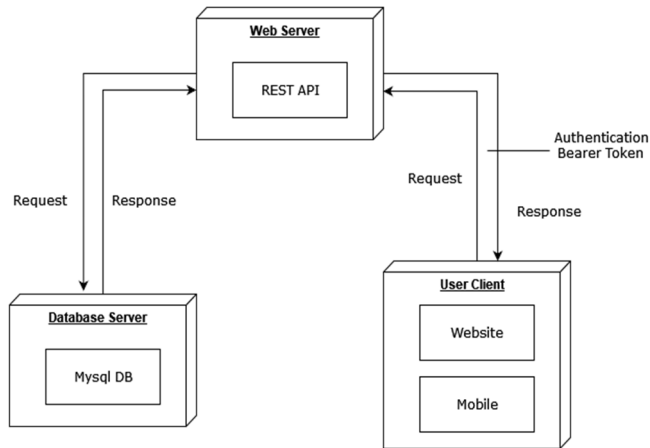


Fig. 4 Deployment Diagram

III. RESULT AND DISCUSSION

The following is a screen display of the application that has been implemented according to the screen design. The screen display is divided into two, namely the screen display on website-based applications and the screen display on mobile-based applications.

A. Mobile Application

The following image is the display of the start page on the mobile application. There is a login menu for users and an account verification menu. If the login is successful, proceed to the Home menu as shown in Figure 5, Figure 6 and Figure 7.

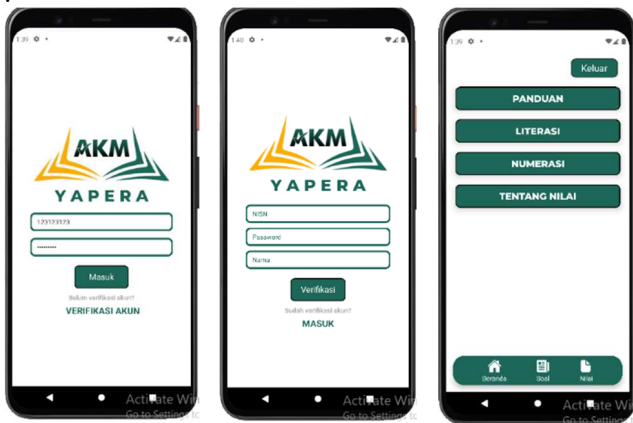


Fig. 5 Login

Fig. 6 Verification

Fig. 7 Home Page

The types of tests are divided into two test groups, namely literacy tests and numeracy tests. Students can choose one of them and start to work on the test. At the end of the session, there is a final score. Students can also see detailed values of

the results obtained as shown in Figure 8, Figure 9, Figure 10, Figure 11, and Figure 12.



Fig. 8 Test Type



Fig. 9 Literacy Test



Fig. 10 Numeracy Test



Fig. 11 Score



Fig. 12 Score Detail

B. Web Application

Web-based application was developed for admin and teachers. Web-based applications are used to fill in student data, class data, and question-and-answer data.

When the user successfully logs into the system, the user will get a token. When the token is successfully obtained, the user can access the features on the website. If the token is deleted, then the website will redirect the user to the login page by force. The following shows the login screen and token on the application. Token states are depicted as shown in Figure 13, Figure 14, Figure 15, and Figure 16.



Fig. 13 Login Page

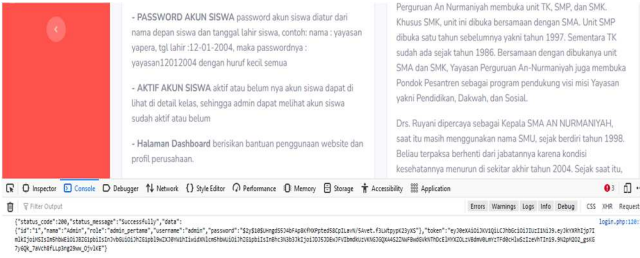


Fig. 14 Token Page Screen Display

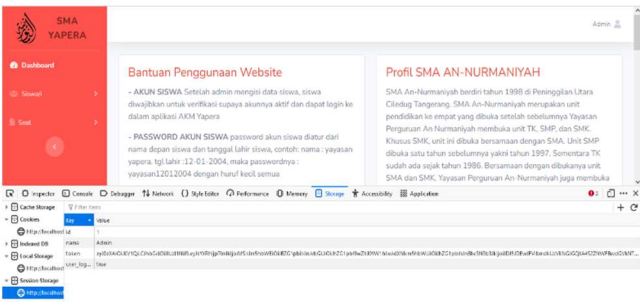


Fig. 15 Save the Token in Session Storage

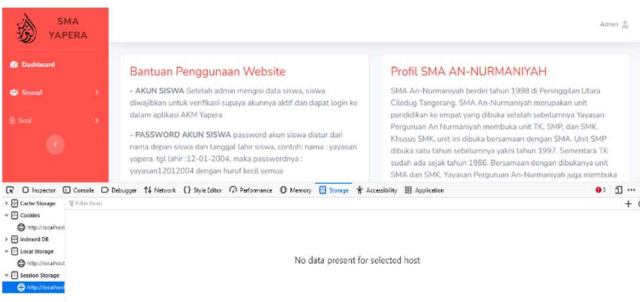


Fig. 16 Token Deletion

Moreover, admins and teachers can add classes, add students, and add questions as well as set the time for conducting the test, illustrated in Figure 17, Figure 18, Figure 19, Figure 20, and Figure 21.

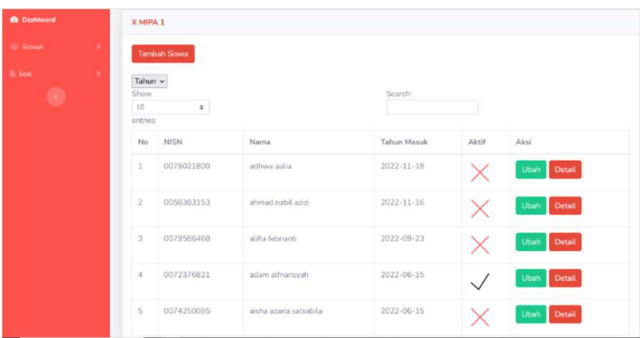


Fig. 17 Class Detail

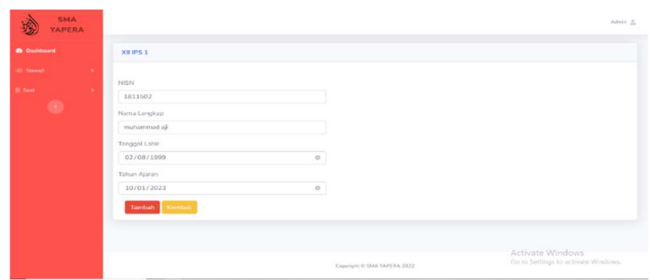


Fig. 18 Add Student Page

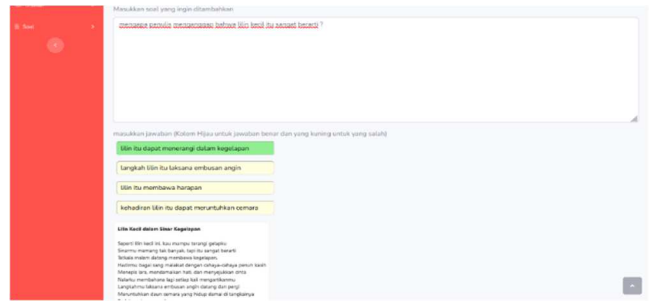


Fig. 19 Add Question Page

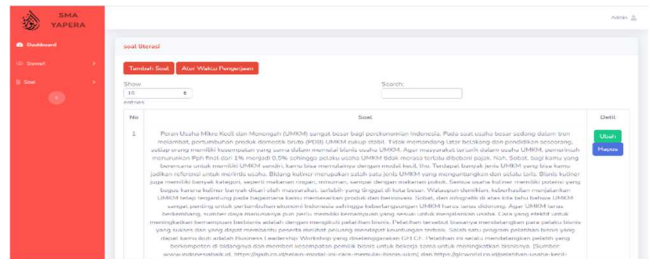


Fig. 20 Question Page

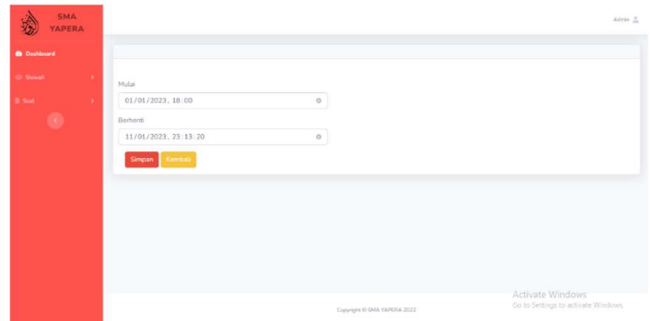


Fig. 21. Time Management

C. Verification

The verification process is carried out using a questionnaire model. Filling in the questionnaire was carried out after the respondent used the Minimum Competency Assessment system. In filling out this questionnaire, the respondents were school teachers. This is done with the aim of knowing the satisfaction of using the Minimum Competency Assessment application from the teacher's perspective.

In filling out this questionnaire there are several variables used based on the Nielsen method, namely learnability, efficiency, memorability, errors, and satisfaction. This variable is useful for measuring whether the implemented application meets the teacher's expectations.

From the results of processing the questionnaire, the profiles of respondents who were sampled in this study were

obtained, namely 8 people. Respondents were given 18 questions according to Table 1 below.

TABLE I
QUESTION LIST

Code	Question
Learnability	
L1	I can learn Minimum Competency Assessment Application easily.
L2	I can learn the Minimum Competency Assessment Application navigation flow easily.
L3	I can learn the use of the Minimum Competency Assessment Application without written instruction.
L4	I get specific information on the Minimum Competency Assessment Application easily.
L5	I understand the content of the information presented easily.
Memorability	
M6	I remember how to use the Minimum Competency Assessment Application easily.
M7	I memorize each navigation direction to easily navigate features and content.
M8	I remember how to use the Minimum Competency Assessment Application if I use it again after a while.
Efficiency	
EF9	I can quickly access the menus and features on the Minimum Competency Assessment Application.
EF10	I can quickly get the information I am looking for.
EF11	I can complete test tasks quickly.
Errors	
ER12	I encountered an error or bug when using the Minimum Competency Assessment Application.
ER13	I found that there is a menu on the Minimum Competency Assessment Application that doesn't work according to its function.
ER14	I couldn't find the menu I wanted to find.
Satisfaction	
S15	I feel overall happy with the look of the Minimum Competency Assessment Application design.
S16	I feel comfortable using the Minimum Competency Assessment Application.
S17	The color composition and placement of the content didn't confuse me.
S18	The use of Minimum Competency Assessment Application is in accordance with the expectations of the business I do.

Each statement is given 5 answer choices which are divided into the interpretation of positive statement values and the interpretation of negative statement values, illustrated in Table 2 and Table 3.

TABLE I
POSITIVE INTERPRETATION

Answer	Percentage Rate	Interpretation
Strongly Agree (SA)	81 - 100%	Very Satisfied
Agree (A)	61 - 80%	Satisfied
Neutral (N)	41 - 60%	Neutral
Disagree (D)	21 - 40%	Not Satisfied
Strongly Disagree (SD)	1 - 20%	Very Dissatisfied

TABLE II
NEGATIVE INTERPRETATION

Answer	Percentage Rate	Interpretation
Strongly Disagree (SD)	81 - 100%	Very Dissatisfied
Disagree (D)	61 - 80%	Not Satisfied
Neutral (N)	41 - 60%	Neutral
Agree (A)	21 - 40%	Satisfied
Strongly Agree (SA)	1 - 20%	Very Satisfied

The following is the result of calculating respondents' satisfaction with the Minimum Competency Assessment application which is shown in Table 4 below.

TABLE III
RESPONDENT SATISFACTION RESULT

Code	S	A	N	D	S	Total Score	Average	Interpretation
L1	1	5	2			31	77.5%	Satisfied
L2	1	6		1		31	77.5%	Satisfied
L3	1	5	1	1		30	75%	Satisfied
L4	3	4	1			34	85%	Very Satisfied
L5	2	5	1			33	82.5%	Very Satisfied
M6	2	4	1	1		31	77.5%	Satisfied
M7	2	4	1	1		31	77.5%	Satisfied
M8	1	5	2			31	77.5%	Satisfied
EF9	2	5	1			33	82.5%	Very Satisfied
EF10	1	5	2			31	77.5%	Satisfied
EF11	2	5	1			33	82.5%	Very Satisfied
ER12		1	3	2	2	28	70%	Satisfied
ER13		1	2	3	2	30	75%	Satisfied
ER14			2	4	2	32	80%	Satisfied
S15	3	3	2			33	82.5%	Very Satisfied
S16	2	4	2			32	80%	Satisfied
S17	2	2	4			30	75%	Satisfied
S18	1	4	3			30	75%	Satisfied

From the calculation results as shown in table 4, the average value of the respondents' answers is divided into the categories of satisfied and very satisfied. And when converted to the average value of the variables, the user is satisfied with the Minimum Competency Assessment application seen from the variable learnability, memorability, efficiency, errors, and satisfaction.

TABLE IV
VARIABLE VALUE SCORES

Variable	Average Percentage	Result
Learnability	79.5%	Satisfied
Memorability	77.5%	Satisfied
Efficiency	80.83%	Satisfied
Errors	75%	Satisfied
Satisfaction	78.12%	Satisfied

IV. CONCLUSION

Based on the outcomes of the application's design, analysis, development, and testing, the installation of the Minimum Competency Assessment application may proceed smoothly. There are two sides to apps: web-based applications and Android-based mobile applications. The web service employs

the REST API approach to link systems running on different platforms in accordance with its function. Teachers were happy with the application's Learnability, Memorability, Efficiency, Errors, and Satisfaction, according to the findings of a questionnaire issued to instructors to test the application's usability using the Nielsen technique. The majority of instructors are satisfied with the implementation of this Minimum Competence Application, according to the survey findings.

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