



## The Application of E-Test On English Subject Using The Model View Controller

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### Abstract

*The problem that occurs in one of the high schools is that there is no online-based English exam system, and they still use paper for their assessments. This causes teachers to be unable to give exams to students if they do not attend school. The purpose of this research is to create an online exam system to facilitate exam administration using the Model View Controller (MVC) to assess online English exams. The analytical method uses the System Usability Scale (SUS), to collect data using an electronic test (e-Test). Unifield Modeling Language (UML), a visual modeling technique used in designing and building object-oriented software for E-Test applications. The results showed that the use of the E-test application in a comparison class in English subjects could improve student learning outcomes to a higher level, from a score of 81.7 to 90.9. When compared to the control class, there was a slight increase, namely an increase in value from 71.5 to 75.8. This proves that the E-test application is effectively used by students for english subjects.*

*Keywords: model view controller; e-test, system usability scale; UML*

### 1. Introduction

Administrative, teaching, and learning processes are some of the various activities that occur in senior high schools. The teaching-learning process (PBM) is the primary activity in the two activities. Teachers and students participate in PBM. Students are the object of the lessons, with teachers providing the teaching materials. Each subject is examined by the teachers in order to gauge the student's proficiency. Students respond to teacher questions when the exam is being administered. As a result, it enables teachers to give a score to indicate a student's degree of achievement in a subject. The bulk of software has word learning as its central topic, and its features are getting more and more sophisticated[1]. It is hoped that the cost of using paper resources will decrease as a result of the exam being administered electronically. Being able to administer exams online at any time and from any location makes this method of administration more flexible[2].

Recently, the examination is conducted conventionally. This means that the examination

process has not used a computer as a tool. It uses sheets of paper on questions and answers. In addition, students must attend examinations according to the schedule set by the school. This process is not effective and the results obtained by the teacher do not provide complete information about the answers from students[3]. The conventional method does not teach pupils how to communicate and use computers proficiently. As a result, pupils do not acquire essential computer-related knowledge for their future. This makes using a computer to conduct the examination process imperative. An online distant learning system was used with computers in this study to provide more effective and efficient learning[4].

The Computer Based Test (CBT) is one of the ways that computers are used for exams. Because there is an increase in student enthusiasm to learn, learners interact with other students and communicate with them, lecturers, and other students online[5]. A website, which is a system made up of pages of data and information, is used to administer an online examination remotely. Each page includes text, graphics, sound, animation, or a combination of these.

The page combinations that make up an interconnected collection of pages must be both static and dynamic. A hyperlink, also known as a hypertext link, is used to connect each page[6].

Our approach to knowledge has changed as a result of the advancement of new digital technologies and their acceptance in daily life[7]. Learning and technology are the two main components of e-learning. Technology serves as the learning process's medium, which means that it is used in the same way as other online resources in order to acquire knowledge [8]. Client servers must be implemented on the internet network in order for the website to be supported by computer networks. Many users can be served by this network[9]. The exam can therefore be administered simultaneously for a large number of students and subjects. Additionally, the teacher can distribute the questions at random so that each student receives a unique set of questions based on the identity they are using. As a result, each student has a lower chance of answering questions fraudulently. The teacher's ability to deliver ratings at both the time and the place is also facilitated by this approach. Through a computer with an internet connection, the teacher can review the exam.

Tomas Moravec, Petr Stepanek, and Petr Valenta have done a number of studies on online exams or related researches with the title *The Influence of Learning Tools on the Results of Students at the Tests*. This study introduced online learning materials.

The analysis compared the test results, and it became clear from the comparison that the use of E-learning materials has a beneficial effect on student learning outcomes. Researchers also believe that students who solely rely on the materials may suffer as a result of e-learning tools. The hypothesis was not supported by the trials that were done, nevertheless. Analysis of the sample's data from the control group from the prior year, which demonstrated that the degree of truth did not alter at all in the absence of an e-learning tool, allowed for the confirmation of the study's findings [10].

The goal of this study on the online test system was to make the exam administration easier. The findings of this study will help every teacher and student make the best use of computer technology. As a result, it will make it easier for students and educators to administer exams in each school in the future.

## 2. Research Methods

This study created a mechanism for online testing. As test data, tests were conducted using each user's feedback [10]. Students and teachers who responded to the pre-set questions provided the test data. These statistics served as the response to queries formulated

using the System Usability Scale (SUS) technique [11].

The questions used in this research included the use of hardware, software, and websites using cellular networks [12] called Elektronik Test (E-Test).

### 2.1 Instrumen

The standard of questions consist of 10 items with 5 scales. The list of questions is presented in Table 1, with the lowest scale score in the form of strongly disagree (STS) to strongly agree (SS) with weighting as follows: (1) for Strongly Disagree, (2) for Disagree, (3) for Netral, (4) for Agree, (5)5 for Strongly Agree [13].

Table 1. The Instrument of Question

Instrument	Scale
1 I think that I would like to use this system frequently.	1-5
2 I found the system unnecessarily complex.	1-5
3 I thought the system was easy touse.	1-5
4 I think that I would need the support of a technical person to be able to use this system.	1-5
5 I found the various functions in this system were well integrated.	1-5
6 I think there are too many in consistencies in this system.	1-5
7 I would imagine that most people would learn to use this system very quickly.	1-5
8 I found the system very cumber some to use.	1-5
9 I felt very confident using the system.	1-5
10 I needed to learn a lot of things before I could get going with this system.	1-5

The manufacturing sources for the instruments in Table 1 are from Original question of System Usability Scale digital equipment corporation, 1986 [13].

The basic rules for calculating the results of the E-Test test are the basic formula for calculating the SUS score, namely: (a) For each odd numbered statement, the respondent's answer scale is reduced by 1. (b) For each even numbered statement, the score is 5 minus the respondent's answer scale. (c) The outcome score scale is from 0 to 4 (four being the most positive response). (d) Add the scale of the respondent's answer and multiply it by 2.5. (e) Determine the average value of answers from all respondents. (f) The characteristics of the respondents are active users, skilled users, and ordinary users.

Respondent data came from the teacher's answers, namely from 5 English teachers and 25 respondent data came from students who were taken in one of the classes in English lessons. The answer to this question is based on teacher and student assessments of the online exam system for English subjects.2.2 Data Analysis

The implementation of E-Test applied the Model View Controller (MVC) architecture, which is to create a model data to represent information from the database,

view to display data, and a controller to combine the two and handle other tasks [14]. Model, View, Controller (MVC) is an application development architecture that emphasizes 3 important components. The three components each have a focus of attention, responsibility and logic so as to speed up their performance [2]. MVC structure allows applications to be more secure and reusable.

MVC is used to separate data access and business logic from data presentation and user interaction. Writing program code by using the MVC architecture is better organized and the application is easier to develop. Model, View, and Controller are closely related one to another. Therefore, all of the three must refer to each other [15]. Model-View-Controller (MVC) is a concept introduced by the founder of Smalltalk (Trygve Reenskaug) to make one type of network data packet into another type of data along with processing (model), from process manipulation (controller) and display (view) for presented in a user interface [16]. The Model View Controller cycle can be seen in Figure 1 [17]:

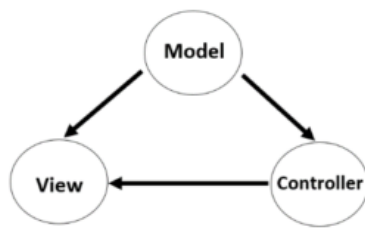


Figure 1. Model View Controller Cycle

Three components make up the Model View Controller (MVC): Model: The model in a web application represents the data structure. The model often includes database-related functions like data retrieval, data updating, data insertion, data deletion, and so forth. Information is provided to users in (b) View. View often refers to a web page where the client may see the displayed content. (c) The controller, which offers services that connect the Model and View. Controllers have features that help connect models and views. The highest level of all MVC tiers is the controller [18]. The Controller is in charge of handling user input and designating the model and view to execute the action depending on that input.

One benefit of the MVC architecture is that since the model and view are kept apart, multiple views can use the same model. As a result, because all access to the model passes through this component, the model components of an application are simpler to implement, test, and maintain.

One of the well-known frameworks that already supports MVC is Codeigniter. The codeigniter framework makes it fast to construct web applications.

The outcome suggests that MVC application is

superior than traditional application development. The view controller model's architecture makes use of research [17]. The most fundamental and widely used strategy in MVC is layering. Layering is merely a piece of logic that separates the methods in our code into several classes. This strategy is the most well-liked and readily recognizable. The flexibility to reuse code is this method's key benefit [20].

The application of the online exam methodology uses a visual modeling technique in the manufacture and design of object-oriented software, namely the Unified Modeling Language (UML). Writing standards or blueprints called UML contain business processes, writing classes in certain languages, and other elements (21). Several UML diagrams are widely used when creating systems. They consist of layouts, activity diagrams, class diagrams, and component use case diagrams. Use cases are descriptions of anticipated system functionality that illustrate how actors and systems interact. Actors in use cases are representations of humans or systems operating within the system (21).

### 2.3. Design Procedure

The E-test application design procedure consists of 5 stages, namely: At Analysis Phase, identification and analysis of needs is carried out in developing the system and studying the literature. At Design Stage, the form of the developed application will be verified or the appropriate system development method will be selected. The steps taken at this stage are (a) Observation (b) Material analysis, to analyze whether the material is in accordance with the expected competencies and find out the appropriate material to be developed in the E-test application. The following steps are taken at Development Stage: (a) Designing a prototype, namely making an initial design (prototype) of the E-test application whose contents are adjusted to the applicable syllabus and lesson plan. (b) Validation Stage. The validation used is the validation of test material and media. Validate the test material to see whether the E-test application that has been designed follows the course syllabus. The E-test media application that has been developed is consulted and discussed with experts (lecturers). Validation activities are carried out by filling out validation sheets, and discussions until a valid and feasible E-test application is obtained.

Table 2. E-test Application Validation Aspects

No	Aspects of	Data Collection Method	Instrument
1	Content and interest	Discussion with learning media experts and primary network education and training teachers	Validation Sheet
2	Media and Language		

The E-test application validity instrument shows that

the results of the E-test application validity test have an average value of Aiken's V of 0.92. The assessment range with Aikens V ranges from 0 – 1, so from this range the number 0.600 can be interpreted as having a fairly high coefficient value. From the test results of the E-test application instrument, a value of  $V = 0.92$  is obtained, which means  $\geq 0.6$ , so the results are stated in the Valid category.

At Implementation Stage, practicality tests and tests are carried out effectiveness by using research instruments addressed to teachers and students as respondents. The results of the practicality test of the teacher's response to the E-test application were carried out by 3 English teachers, the results of which can be seen in Table 3.

Table 3. Practicality of Teacher Responses to the E-test application.

No	Teachers	Total	Percentage%	Category
1	Respondent 1	50	90,9	Very practical
2	Respondent 2	49	89,1	Very practical
3	Respondent 3	48	87,3	Very practical
Average			89,1	Very practical

Teacher practicality test on the application of the E-test on a wide scale showed an average value of 89.1. From this average value can be It is proven that teachers who teach English courses are very very supportive of the use of the E-test application, because a score of 89.1 is categorized as a result very practical to use as an online English test medium in high school.

The results of the practicality test of student responses to the E-test application on the broad scale denotes value an average of 82.1 which can be categorized as an E-test application This is very practical to use in English lessons. Value taken of 25 students in English lessons.

Testing the effectiveness of this study raised 2 variables, namely the independent variable (x) the E-test application and the dependent variable (y) student learning outcomes. Data on student learning outcomes were obtained in the form of multiple choice tests called cognitive aspects, psychomotor aspects (practice) and affective behavioral aspects. These three aspects were carried out in the comparison class and control class. The pretest, which is a test of cognitive, psychomotor and affective abilities, is given to students before being given treatment, while the Posttest is carried out after students have received treatment. The following is a comparison of student learning outcomes at the beginning and end of learning for the control class and the comparison class.

From Table 4 it can be concluded that these results prove that use of the E-test application in class

comparators in English subjects can improve higher student learning outcomes, namely from a value of 81.7 to 90.9. If compared to the control class there was a slight increase namely an increase in value from 71.5 to 75.8. This proves that in the class that received the treatment, it happened significant increase in value when compared to the class control. This proves that the E-test application is effectively used by students for English subjects.

Table 4. Comparison of Students' Cognitive Learning Outcomes at Beginning and End of Learning in the Control Class and Comparison.

Meeting	Control Class	Comparison Class
Begin	71,5	81,7
End	75,8	90,9

At Evaluation stage, the activity is focused on evaluating whether the application can be used as expected and effectively to improve the quality and student learning outcomes.

### 3. Results and Discussions

#### 3.1 Use Case Diagram

The relationship between each individual use case between teacher and student is depicted in the use case diagram for this system, which is shown in Figure 2.

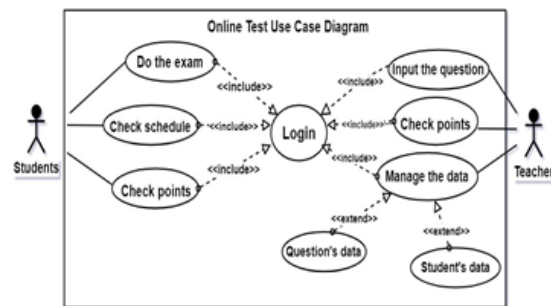


Figure 2. Online Test Use Case Diagram

A use case diagram shows a number of the system's menu options that may be accessed online. The two actors in the diagram are the teacher and the student, and in order for them to both log into the system, both actors must do so first. Students can carry out responsibilities like checking schedules, completing assignments, and reviewing grades. Teachers tasks during this time include data management, question input, and score checking.

#### 3.2 Activity Diagram

Activity Diagram is a flowchart of activities in a running system [21]. It is an action that can be performed by actors. In this system, there are 2 derivative diagrams, namely the teacher activity diagram presented in Figure 2 and the student activity diagram presented in Figure 3.

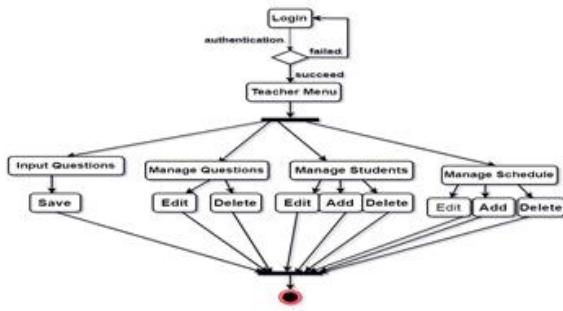


Figure 3. Teacher Activity Diagram

The primary menus in the system that the instructor can choose from are shown in the instructor activity diagram in Figure 3. In this graphic, the teacher menu, which shows activities the instructor can perform, such as entering tasks, managing tasks, managing students, and managing students and schedules, will appear when the teacher logs in. The teacher has the ability to modify the information in the menus for managing tasks, students, and timetables.

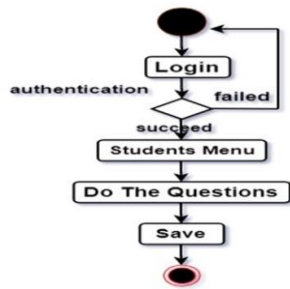


Figure 4. Student Activity Diagram

Figure 4 illustrates students activity diagram which displays a selection of main menus on the system that can be selected by students. The students' menu includes doing tasks.

### 3.3 Class diagram

Class diagram is a description of the structure and description of classes, packages, and interconnected objects such as inheritance, associations and others [19]. Class diagrams provide any information contained by each object. This information consists of behaviors and elements included in system objects. The clas diagram on this system is presented in Figure 5.

The class diagram in Figure 5 contains the objects of teachers, students, participants, classes, questions, tests, and answers. (a) The teachers have to fill in their id, name and password to log in as the teacher user. After that, they can input questions (tasks), edit the questions and delete the questions. The teacher can also enter, edit, and delete the student's name. Then, the teacher can display the results of the online exam. (b) For students, they should enter their id, filling in their name, password and class when they log in. After

that, the students can work on the questions given by the teacher. When the teacher finishes examining the exam results, they can see the results in accordance with their respective passwords. (c) Participants have to enter the id, fill in the data, and work on the essay according to the time limit specified. They can see the exam deadline and finish the task. (d) The teacher must fill in the id and name in the class objects. In the class, the teacher can change, add and delete classes. (e) The question object are entered by the teacher by adding types of questions, images, texts, choices of answers and the answers. The teacher can change, add, and delete the existing data in this object. (f) For exam objects, the id, student's name, class, teacher's name, and test time must be put in by the examinee. Adding, deleting and changing the data can also be done by examinees. (g) The answer object consists of the examinee's ID, questions and answers.

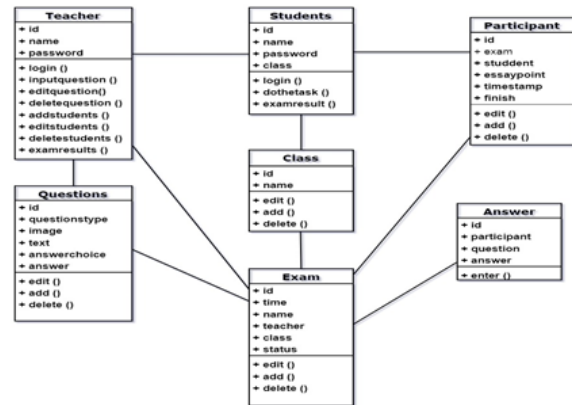


Figure 5. Class Diagram

### 3.4 Programs Layout

Layout is the interface of the system in the form of pages that can be presented by users from the computer's output media. The layout presented in this system consists of login, main teacher, teacher input, execution of questions, answers to questions and recapitulation of values. Login is shown in Figure 6.

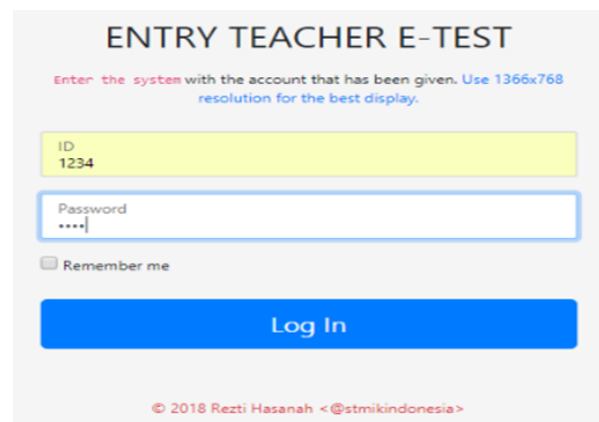


Figure 6. Login



The login page in Figure 6 is the teacher and student access page to enter the main page of the system. Teachers and students must enter a predetermined username and password. After that, click Log In to log in, and the teacher will go to the main page to update information on the student exam.

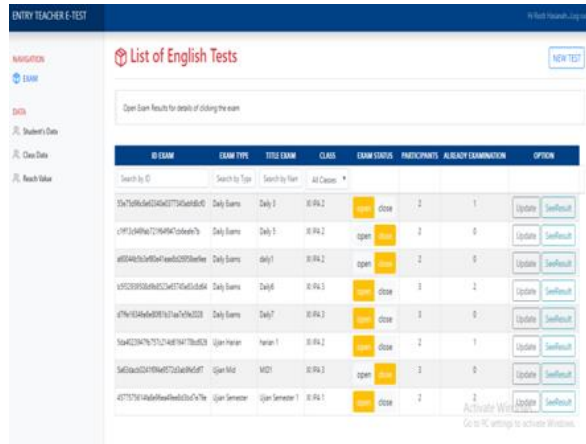


Figure 7. Main Teacher

The teacher's main page in Figure 7 is the initial page after the teacher has successfully logged in. On this page, there is a teacher menu display consisting of Exams, Student Data, Class Data and Subject Data. Here, it is only he teacher who can see the students' data, class' data and subjects' data.

On this home page the teacher can input questions for students and make changes to the questions that have been given.

The teacher input page displayed in Figure 8 is a place to input the data of a new test and questions. This process is performed by the teacher concerned. Questions are submitted by the teacher before the test and it will be displayed during the exam.

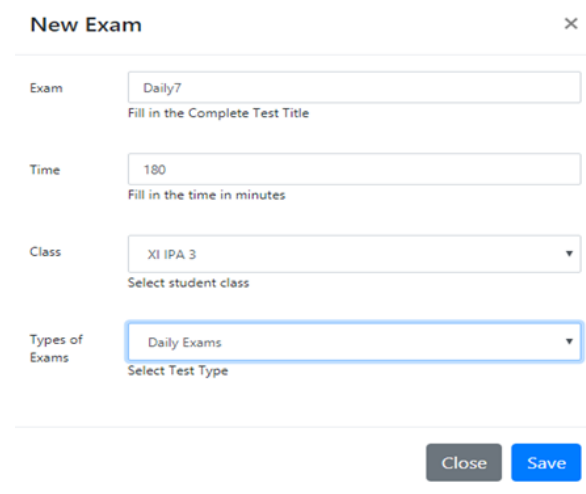


Figure 8. Teacher Input

The display of processing the test form in Figure 9 is

in which students fill out the answers to the exam. This view is displayed when students work and fill in the questions given by the teacher. In this view, 1 question is displayed to be answered directly by the student with a predetermined time.

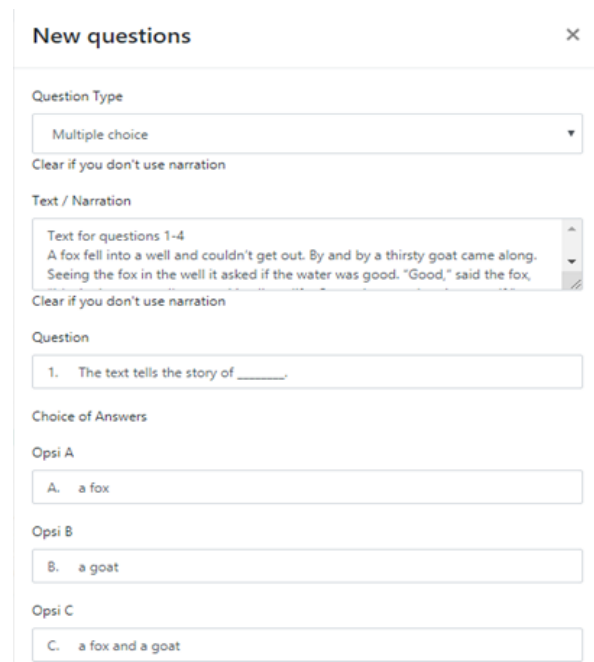


Figure 9. Question Operation

The display of the test results in Figure 10 is in which students can get the results of the test scores. Students can see all their test scores, such as daily scores, mid scores and semester scores which are shown in the form of grades.

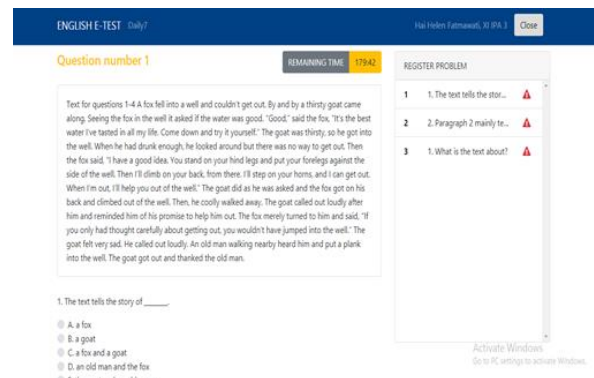


Figure 10. Answer

Figure 11 shows the summary of the teacher's display of the students' grades. The data recapitulation of the final score of the tests that the students have taken is shown on the page view of the score recap. Only the student concerned with their scores can access the system using their ID number.

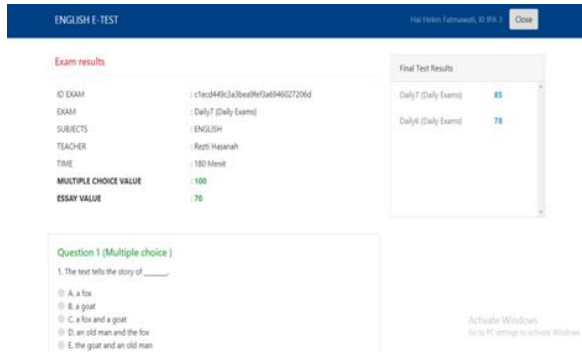


Figure 11. Recapitulation of Scores.

### 3.5 Discussion

In this study, 25 respondents participated in testing the online system. Based on the data from the instrument, each respondent makes an assessment. Table 5 shows one of the responses or ratings from 25 respondents. The results of all assessments will be added up and divided by 25 so that later an average of the respondents' ratings will be obtained.

Table 5. Respondents Answers

Respondent	Rating	Score
1	32 x 2.5	80
2	36 x 2.5	90
3	34 x 2.5	85
4	35 x 2.5	87.5
5	36 x 2.5	90
6	33 x 2.5	82.5
7	34 x 2.5	85
8	32 x 2.5	80
9	36 x 2.5	90
10	32 x 2.5	80
11	33 x 2.5	82.5
12	34 x 2.5	85
13	35 x 2.5	87.5
14	34 x 2.5	85
15	33 x 2.5	82.5
16	34 x 2.5	85
17	32 x 2.5	80
18	34 x 2.5	85
19	35 x 2.5	87.5
20	36 x 2.5	90
21	36 x 2.5	90
22	34 x 2.5	85
23	35 x 2.5	87.5
24	35 x 2.5	87.5
25	33 x 2.5	82.5
Average		2132.5/25 = 85.3

From Table 5 it is known that the average score of all respondents' answers is 85.3. Complete assessment was taken from all respondents, totaling 25 people. Data obtained from questionnaire calculations which can be seen in Table 6.

Table 6. Respondents Judgement

Statement	STS	TS	N	SS	Total
1. I think I want to use this system every time I need it				X	4
2. I find a system that is not too complicated	X				4
3. I think the system is very easy to use				X	4
4. I think I will need help from a technical person to be able to use this system.		X			3
5. I find that many functions in this system are well integrated with each other				X	3
6. I think there are a lot of inconsistencies in this system		X			3
7. I would imagine that some people would learn to use this system very quickly				X	3
8. I find that this system is not very practical to use	X				4
9. I feel very confident in using this system				X	4
10. I need to learn many things before I can use this system		X			3

### 3.6 The Calculation of Average Score (Mean)

Similar to Median and Mode, the average score or Mean is a statistical indicator of centralized trends. Various average score kinds exist, including computed average (arithmetic), geometric average, harmonic average, and others. The calculated average (arithmetic) is what is meant when the term "average" is used alone.

All of the data values from a sample group were added to determine the average score. It was then divided by the quantity of samples. In other words, Formula 1 can be used to get the average score of the samples in a set of random samples with n samples.

$$\bar{r} = \frac{1n(r_1 + r_2 + \dots + r_n)}{1n} = \frac{1n(r_1 + r_2 + \dots + r_n)}{1n} \quad (1)$$

If denoted by sigma notation, the Formula 1 becomes Formula 2:

$$\bar{r} = \frac{1n \sum r_i}{1n} = \sum r_i \quad (2)$$

$\bar{r}$  is the average count,  $r_i$  is the value of sample  $i$ ,  $n$  is the number of samples.

According to previous research, The System Usability Scale (SUS) is a questionnaire that can be used to measure the usability of computer systems according to the user's subjective point of view[10]. Some authors have been interested in the statistical validity of the SUS, and in particular in its factor structure [22][23].

The next stage was to establish the judgement grade, which is depicted in Figure 11, after receiving the final results of the respondent's judgments. There are two ways to complete this task. From the perspective of user acceptance level, grade scale, and adjective rating including level of acceptability, the initial determination is shown. The percentile range (SUS score), which has an assessment grade consisting of A, B, C, D, and F, provides the second determination [20]. The outcomes of Acceptability, Grade Scale, and Adjective Rating were acquired from the two methods of determining the judgement results..

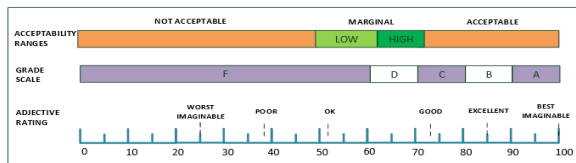


Figure 12. Determination of Judgement Results [24]

When the findings of the average respondent were compared to determine acceptability, grade scale, and adjective rating, the result was 85.3 with the provisions shown in Figure 12. The evaluation outcomes of the E-Test application are as follows based on this result: (a) The use's approval level is classified as acceptable. (b) Category B includes the grade scale level. Adjective rating enters category "excellent" (c). Excellent is one of the grading categories for adjectives.

It is possible to gauge the degree of the user's perspective on the E-Test application from the outcomes of acceptability, grade scale, and adjective rating. Based on the assessment findings, users, such as students, can utilize the E-Test program as a medium to conduct online exams with ease.

#### 4. Conclusion

The research findings indicate that both teachers and students can easily use the online exam system to administer online tests. When compared to paper-and-pencil exams, this technique is cost-effective and time-saving.

#### References

[1] A. W. Soejono, A. Setyanto, A. F. Sofyan, and W. Anova, "Evaluasi Usability Website UNRIYO Menggunakan System Usability Scale ( Studi Kasus : Website UNRIYO )," vol. XIII, pp. 29–37, 2018.

[2] L. Kelen, "Implementasi Model-View-Controller (Mvc) Pada Ujian Online Melalui Penerapan Framework Codeigniter," *J. Pendidik. Teknol. Inf.*, vol. 1, no. 1, pp. 10–16, 2018, doi: 10.37792/jukanti.v1i1.5.

[3] N. Nuryadi, N. H. Marhaeni, and A. Soviyati, "Developing a Realistic Learning Approach on Mobile-based Apps: An Ethnomathematics Tedhak Siten," *Utamax J. Ultim. Res. Trends Educ.*, vol. 4, no. 1, pp. 64–75, 2022, doi: 10.31849/utamax.v4i1.9698.

[4] M. Malan, "The Effectiveness of Cooperative Learning in an Online Learning Environment Through a Comparison of Group and Individual Marks," *Electron. J. e-Learning*, vol. 19, no. 6, pp. 588–600, 2021, doi: 10.34190/EJEL.19.6.2238.

[5] F. F. Amanda, S. B. Sumitro, S. R. Lestari, and I. Ibrohim, "Developing complexity science-problem based learning model to enhance conceptual mastery," vol. 16, no. 1, pp. 65–75, 2022, doi: 10.11591/edulearn.v16i1.20408.

[6] A. Al Ahmad and R. Obeidallah, "Studying the Effectiveness of a Proposed Methodology for Teaching Programming Labs Online and Students ' Perspectives toward it during COVID-19 : A Case Study of Hashemite University," *Int. J. Interact. Mob. Technol.*, pp. 62–80, 2022.

[7] A. Abdul Razak, A. Abdul Razak, and F. Haji Shukor, "Effective Practices for Educators to Increase Online Interaction Quality," *Utamax J. Ultim. Res. Trends Educ.*, vol. 4, no. 1, pp. 1–14, 2022, doi: 10.31849/utamax.v4i1.8355.

[8] L. Alzubaidi et al., *Review of deep learning: concepts, CNN architectures, challenges, applications, future directions*, vol. 8, no. 1. Springer International Publishing, 2021. doi: 10.1186/s40537-021-00444-8.

[9] M. Chan and M. Zhang, "Architecture Design of Datacenter for Cloud English Education Platform," pp. 24–33, 2019.

[10] E. Kurniawan, N. Nofriadi, and A. Nata, "Penerapan System Usability Scale (Sus) Dalam Pengukuran Kebergunaan Website Program Studi Di Stmik Royal," *J. Sci. Soc. Res.*, vol. 5, no. 1, p. 43, 2022, doi: 10.54314/jssr.v5i1.817.

[11] J. R. Lewis and J. Sauro, "Item Benchmarks for the System Usability Scale," *J. Usability Stud.*, vol. 13, no. 3, pp. 158–167, 2018, [Online]. Available: [http://uxpajournal.org/wp-content/uploads/sites/8/pdf/JUS\\_Lewis\\_May2018.pdf](http://uxpajournal.org/wp-content/uploads/sites/8/pdf/JUS_Lewis_May2018.pdf)

[12] U. Scale and S. U. S. Sus, "Validation of the System Usability Scale ( SUS ) VALIDATION OF THE SYSTEM USABILITY SCALE ( SUS );," no. September 2013, 2016, doi: 10.1177/1541931213571043.

[13] W. H. Cheah, N. Mat Jusoh, M. M. T. Aung, A. Ab Ghani, and H. Mohd Amin Rebutan, "Mobile Technology in Medicine: Development and Validation of an Adapted System Usability Scale (SUS) Questionnaire and Modified Technology Acceptance Model (TAM) to Evaluate User Experience and Acceptability of a Mobile Application in MRI Safety Screening," *Indian J. Radiol. Imaging*, vol. 33, no. 1, pp. 36–45, 2023, doi: 10.1055/s-0042-1758198.

[14] A. Hidayat and B. Surarso, "PENERAPAN ARSITEKTUR MODEL VIEW CONTROLLER ( MVC ) DALAM," vol. 2012, no. Sentika, 2012.

[15] Pastima Simanjuntak & Arwin Kasnady, "Analisis Model View Controller (Mvc) Pada Bahasa Php," *J. ISD*, vol. 2, no. 2, pp. 56–66, 2016.

[16] K. Wijaya and A. Christian, "Implementasi Metode Model View Controller (MVC) Dalam Rancang Bangun Website SMK Yayasan Bakti Prabumulih," *Paradig. - J. Komput. dan Inform.*, vol. 21, no. 1, pp. 95–102, 2019, doi: 10.31294/p.v21i1.5092.

[17] M. Ulfa, S. Suryayusra, and S. Hardini, "Penerapan Model View Controller (MVC) Untuk Perancangan Sistem Ruang Buku Indonesia," *CESS (Journal Comput. Eng. Syst. Sci.)*, vol. 5, no. 1, p. 53, 2020, doi: 10.24114/cess.v5i1.15403.

[18] R. Al, "Penerapan Model View Controller dan Object Relational Mapping Pada Pengembangan Sistem Informasi Keanekaragaman Hayati di Taman Nasional Kutai Bontang," vol. 3, no. 2, 2018.

[19] E. Budiman, N. Puspitasari, and T. Obat, "Model View Controller dan Object Relational Mapping Data Borneo Biodiversity Information System," vol. 2, no. 2, pp. 153–162, 2018.

[20] A. Hidayat, "Penerapan Arsitektur Model View Controller ( MVC ) Dalam Perancangan Ekstensi Sebuah Content Management System," no. Mvc, pp. 17–22, 2006.

[21] M Teguh Prihandoyo, "Unified Modeling Language (UML) Model Untuk Pengembangan Sistem Informasi Akademik



- Berbasis Web,” *J. Inform. J. Pengemb. IT*, vol. 3, no. 1, pp. 126–129, 2018, doi: 10.30591/JPIT.V3I1.765.
- [22] G. Gronier and A. Baudet, “Psychometric Evaluation of the F-SUS: Creation and Validation of the French Version of the System Usability Scale,” *Int. J. Hum. Comput. Interact.*, vol. 37, no. 16, pp. 1571–1582, 2021, doi: 10.1080/10447318.2021.1898828.
- [23] I. H. N. Aprilia, P. I. Santoso, and R. Ferdiana, “Pengujian Usability Website Menggunakan System Usability Scale Website Usability Testing using System Usability Scale,” *J. IPTEK-KOM*, vol. 17, no. 1, pp. 31–38, 2015, [Online]. Available: <https://jurnal.kominfo.go.id/index.php/iptekkom/article/view/428>
- [24] A. Bangor, T. Staff, P. Kortum, J. Miller, and T. Staff, “Determining What Individual SUS Scores Mean : Adding an Adjective Rating Scale,” vol. 4, no. 3, pp. 114–123, 2009.