Analysis of jejak bali virtual class using usability testing, including concurrent think aloud techniques and performance measurement techniques

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Abstract. Jejak Bali is a website created specifically by PUSTEKKOM to manage learning activities so Bali Provincial Education Office can carry out supervision and guidance for e-learning in Bali. Many obstacles were experienced by teachers and students when using Jejak Bali. It encouraged the design of a study looking at the usability of a system from a user perspective to increase user satisfaction. The methods used were usability testing technique, Concurrent Think Aloud, and Performance Measurement which measured the effectiveness, efficiency, and user satisfaction. The population of this study were teachers and students from SMAN 2 and SMKN 3 Denpasar. In measuring Performance Measurement and CTA, the sample used consisted of 40 participants including teachers and students as well as 86 users who used the questionnaire SUS. The results of the research were: (1) Jejak Bali, for teacher and student users, was still ineffective because there were still errors made while doing the assigned assignments, (2) Jejak Bali which was seen from the time when teacher and student users were working was still inefficient because of the differences of the significant time from the advanced group to the beginners, (3) Jejak Bali still did not meet user satisfaction as seen from the results of the SUS questionnaire recapitulation in which a teacher scored 49.0 and a student scored 48.3. Because the value obtained was below 60 in the percentile rank, so it can be concluded that Jejak Bali still did not meet usability good as seen from the results obtained.

1. Introduction

Today, almost every education utilizes information technology, for example in the use of learning management systems of electronic (LMS), e-learning programs, and training content. One example of learning using an LMS is in Jejak Bali Virtual Class (Bali Creativity Exploration Network). Jejak Bali is a website specially created by PUSTEKKOM to manage SMA/SMK learning activities in Bali. Its implementation involves schools as virtual class administrators, educators as virtual class managers who have a role in the success of virtual class implementation, students as virtual class participants who get learning facilities to increase understanding of a material, and administrators who have the access rights in managing the entire system. With the creation of the Jejak Bali page, the province can indirectly fully control the learning activities of SMA/SMK in Bali.

Measuring the success of implementing a system can be done by determining the user's ability when using the system. The main factor that can be used as a guidance in measuring the success rate of implementing a system or software is usability and level of measurement. Results of usability of a system can be used as a benchmark to describe the usefulness of the system or user acceptance [1].
Usability evaluation is a process that involves users so they can study and use products in order to achieve user convenience aspects, such as effectiveness, efficiency, and user satisfaction with the use of the system as a whole [2]. Usability means ensuring that something works well for a specific purpose without discouraging the user [3]. The method for evaluating a design in an outline consists of two including the method carried out by involving the user in the evaluation process, namely testing and inquiry [4]. Among the categories of methods that are currently most widely used due to their accuracy is usability testing method.

Based on the results of interviews that were conducted with several teachers and students, it was known that there were obstacles when using Jejak Bali, including student users who were overwhelmed and confused when registering for classes, only a few students could access the class that has been given by the teacher and were diligent in checking the system, and many students were left behind in the ongoing learning. Teacher users also experienced difficulties when they wanted to conduct joint learning in the lab because the system ran slowly when it was accessed simultaneously. In terms of usefulness, Jejak Bali is very good to use, especially for distance learning because it can be used to study anywhere and anytime. However, with the discovery of the obstacles experienced by both teachers and students when using the system based on the interviews that have been conducted, researchers were interested in conducting research on usability testing using Techniques of Concurrent Think Aloud (CTA) and Performance Measurement which can measure the effectiveness, efficiency, and user satisfaction.

CTA is an evaluation technique of think aloud that is carried out when the respondent is interacting with a web object [5]. CTA is an evaluation technique of think aloud whose user-based testing method involves end users to continuously verbalize what is being thought when using the system. By verbalizing, it allows the observer to interpret which part of the interface has a problem [6]. Meanwhile, Performance Measurement is used to generate quantitative data regarding the performance of respondents when they perform tasks during usability testing [7]. In accordance with the problems that have been identified above, the purpose of this study was to evaluate Jejak Bali from the user side by using usability testing of CTA techniques and Performance Measurement as well as formulating recommendations to improve Jejak Bali. As for the benefits that can be provided in this research, for Academics, this research was expected to be a useful reference for further research as well as to add insight and knowledge regarding Analysis Usability Testing on Jejak Bali. Moreover, for the Jejak Bali Developer Party, it was hoped that it could contribute in providing information and suggestions so the developer could find out the level of usability to receive useful input for further system development. It was also expected that users could improve their understanding and hopefully could increase user insight to find out the level of usability of the system they used.

2. Research Method
This research was a survey research that took a sample from one population and used a questionnaire as the main data collection tool. The type of research method chosen was descriptive analysis. The meaning of analytical descriptive method is a method that functions to describe or provide an overview of the object under study through data or samples that have been collected in which the results will be processed and analyzed to draw conclusions [8]. The research was conducted at SMAN 1 Denpasar and SMKN 3 Denpasar. The sample of this study were 40 people consisting of 20 students as well as 20 teachers who used Jejak Bali in which to measure user satisfaction, the System Usability Scale (SUS) questionnaire was applied to 86 respondents consisting of teachers and students.

1. Preparation for this research was conducted by selecting research topics, conducting literature studies by reading journals and reference books, formulating problems, determining research objectives, and determining the methodology used.
2. Data collection was carried out in stages, namely identifying the data needed to solve problems, conducting discussions with user respondents about the research object, and taking data by using Usability Testing and Performance Measurement technique which was done by recording screens using software and playing back the data from the videos. Then, the respondent's processing time was calculated from the video to measure efficiency and effectiveness. Furthermore, the
Concurrent Think Aloud (CTA) technique was combined by filling out the System Usability Scale (SUS) questionnaire to obtain qualitative and quantitative data. In the CTA, when the subject was carrying out the Usability Testing scenario task, the facilitator would not interfere the session but providing assistance.

3. Data processing and analysis were processed with evaluation techniques, namely: Technique Performance Measurement data processed which measured the speed and accuracy of the respondent in completing the assigned task and CTA (Concurrent Think Aloud) technique which was combined by filling out the System Usability Scale (SUS) questionnaire used to help the process of repairing the Jejak Bali page. After the data were processed, the data would be analyzed.

4. The design of Wireframe Jejak Bali was by processing the data obtained, then the results of the analysis were used as a reference in making recommendations for improving Jejak Bali by making a design interface Wireframe system.

3. Result and Discussion
Based on the results of the data analysis, in usability testing with the Performance Measurement technique and Concurrent Think Aloud (CTA) and the process of Usability using a questionnaire technique, the aspects analyzed in this study were effectiveness, efficiency, and user satisfaction.

3.1 Effectiveness
Analyzing the effectiveness was done by looking at the number of errors or failures made by respondents when working on each task that had been given. The performance measurement was carried out by 40 respondents consisting of 20 teacher respondents and 20 proficient student respondents and beginners. The followings were the results of the effectiveness of what respondents did based on each category of users from Jejak Bali.

| Assignment                                                                 |
|-----------------------------------------------------------------------------|
| 1. Login (Login)                                                            |
| 2. Changing personal data profiles                                          |
| 3. Adding class                                                              |
| 4. Adding module                                                             |
| 5. Adding tasks                                                              |
| 6. Adding quizzes                                                            |
| 7. Adding online exam                                                        |
| 8. Students who attend classes viewed                                       |
| 9. Add announcement                                                          |
| 10. Adding a rating                                                          |
| 11. Exit (Log Out)                                                          |

**Table 1. Teacher User Respondent Scenario Task.**

| Task | Task | Task | Task | Task | Task | Task | Task | Task | Task |
|------|------|------|------|------|------|------|------|------|------|
| 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   |
| NR   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   |
| Error| 0    | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 2    |

**Table 2 Teacher User Error Data.**

| Task | Task | Task | Task | Task | Task | Task | Task | Task | Task | Task |
|------|------|------|------|------|------|------|------|------|------|------|
| 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   |
| NR   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   |
| (Error)| 0%  | 0%  | 0%  | 10% | 0%  | 0%  | 0%  | 0%  | 0%  | 20% | 0%  |

**Advanced Average 3%**
From several factors that caused errors for teacher users as seen in Table 2, out of 11 assignments given to the respondents, teachers mostly experienced errors when doing task 4, tasks 5, task 6, and task 10. The percentage of errors or errors occurred in the advanced group, including on assignments 4 and 10 were 10% and 20%, while the percentage of errors or errors in the beginner group on task 4, task 5, task 6, and task 10 were 70%, 10%, 50%, and 90%. However, the existence of a task that had a high error value of 90% indicated that there was still a problem of usability on Jejak Bali which was used as the object of the research. Therefore, from the point of view of teacher users, the system was not effective yet.

**Table 3. Student User Respondents Scenario Task.**

| Task | 1. Log (Log) | 2. Changing personal data profile | 3. Choose a class | 4. Viewed announcement | 5. Downloading module | 6. Uploading duty | 7. Opens quiz features | 8. Opens exam features | 9. Seeing the value | 10. Exit (Log Out)* |
|------|--------------|----------------------------------|------------------|-----------------------|----------------------|------------------|----------------------|----------------------|-------------------|
| NR   | 10           | 10                               | 10                | 10                    | 10                   | 10               | 10                   | 10                   | 10                | 10                |
| (Error) | 0           | 0                                | 0                 | 0                     | 0                    | 0                | 0                    | 0                    | 2                 | 0                 |
| Total Error | 0%   | 0%                               | 0%                | 0%                    | 0%                   | 0%               | 0%                   | 0%                   | 0%                | 20%               |

**Beginner Average 22%**

*NR: Number of Respondents

From several factors that caused errors for student users as seen in Table 4, from the 10 assignments given, it was known that respondents made mistakes when working on task 5, task 6, and task 9. The percentage of errors conducted by the advanced group, especially on task 9 was 20%. Whereas, mistakes (errors) in the novice group were conducted on task 5, task 6 task 7, the task 9 with the percentage values of 60%, 20%, 10%, and 60%. The errors which were still conducted by the beginner group indicated that there were still problems of usability. Thus, it could be said that from the point of view of student users, the system was not effective yet.

**Table 4. Student User Data Error.**

| Task | Task | Task | Task | Task | Task | Task | Task | Task | Task |
|------|------|------|------|------|------|------|------|------|------|
| NR   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   |
| (Error) | 0   | 0    | 0    | 0    | 0    | 0    | 0    | 2    | 0    |
| Total Error | 0% | 0%   | 0%   | 0%   | 0%   | 0%   | 0%   | 0%   | 20%  |

**Advanced Average 2%**

| Task | Task | Task | Task | Task | Task | Task | Task | Task | Task |
|------|------|------|------|------|------|------|------|------|------|
| NR   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   | 10   |
| (Error) | 0   | 0    | 0    | 0    | 6    | 2    | 1    | 0    | 6    |
| Total Error | 0% | 0%   | 0%   | 0%   | 60%  | 20%  | 10%  | 0%   | 69%  | 0%   |

**Beginner Average 15%**

*NR: Number of Respondents
3.2 Efficiency
Measuring efficiency was done by comparing the advanced and the beginner group respondents by using the Mann Whitney U-Test. The followings were the hypotheses used for each task. H0: There was no difference in term of time for task 1 in the beginner and the advanced groups. H1: There was a difference in term of time for task 1 in the beginner and the advanced groups. If the respondent did not receive H0 from the test of each task so it could be concluded that the user interface with the Jejak Bali page had a good efficiency value. Conversely, if the respondent rejected H0 and accepted H1 from the test in each task, it indicates that the user interface with the Jejak Bali page had a poor efficiency value. Table 5 and Table 6 showed the output test of statistical testing using the Mann Whitney U-Test on teacher and student user respondents.

| Task | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|------|---|---|---|---|---|---|---|---|---|----|----|
| p-value | 0.096 | 0.049 | 0.010 | 0.033 | 0.060 | 0.020 | 0.130 | 0.070 | 0.02 | 0.43 | 0.01 |
|       | 6  | 9  | 3  |    |    |    |    |    |    |    |    |

In making conclusions about this data processing, each p-value for each task was compared with the α value which is 0.05. If the p-value was less than 0.05, the decision was to reject the H0 hypothesis and accept the H1 hypothesis, whereas if the p-value was greater than 0.05, the decision was to accept the H0 hypothesis and reject the H1 hypothesis. The conclusion obtained from the teacher user data in Table 5 was that from the 11 assignments given, 5 tasks did not have a significant time difference and 6 tasks had a significant time difference from the teacher respondents between the advanced and novice user groups. Based on the data obtained, the percentage of tasks with a significant time difference was higher than those with no significant time difference. Thus, it could be concluded that Jejak Bali system for teacher users was not efficient yet.

| Task | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------|---|---|---|---|---|---|---|---|---|----|
| p-value | 0.006 | 0.010 | 0.000 | 0.005 | 0.007 | 0.005 | 0.112 | 0.154 | 0.152 | 0.05 |
|       | 9  |    |    |    |    |    |    |    |    |    |

The conclusion obtained from the student user statistics data in Table 6 was from the 10 assignments given to the respondents, 4 tasks had no significant time difference between the respondents and 6 tasks had a significant time difference between the advanced and novice user group respondents. Based on the data obtained, the percentage of tasks with a significant time difference was higher than those with no significant time difference. Therefore, it could be concluded that Jejak Bali system for student users was not efficient yet.

3.3 User Satisfaction
Concurrent Think Aloud technique was combined by filling out the System Usability Scale (SUS) questionnaire to obtain qualitative data. Qualitative data generated from processing with CTA techniques were in the form of verbal data from respondents which were obtained from interviews by using voice recording media. Thus, the researcher could listen to the recorded data loop from each respondent in order to make the data that could be presented in writing. The result of the recording process would be presented in the form of data conclusions suggested by Footprint user respondents of Jejak Bali. The teacher user respondents gave suggestions: 1. Added a menu or feature that allowed the teacher to change the students’ password so they could help students who had forgotten their passwords, 2. There must be a button (information) feature that appeared in each entry in the class identity to avoid
confusion in filling the class. 3. Added a feature that allows sharing material/modules created to other classes. 4. Added an optional feature for random questions displayed for students. 5. In the question and answer options, there must be features to add images or symbols and features to add discussion to the questions. Meanwhile, student user respondents provided suggestions: 1. You could add a chat feature for students who want to ask directly to the teacher or were embarrassed to ask in the discussion forum, 2. The information button could be used to help beginners as an aid or guidance to enter class. 3. You could add a discussion view for each question that had been answered, 4. You could add the description of the mistakes made, the correct answers, and could not be answered when taking online quizzes or exams.

After the verbal data of the respondents in the form of suggestions through the CTA technique were obtained, then the questionnaire was distributed System Usability Scale (SUS) to the respondents with the aim at seeing user satisfaction by recapitulating the results of the assessment conducted by the respondent to determine the value of the average user of Jejak Bali. The following tables showed the results of the summary of the impression of Jejak Bali user satisfaction by using the System Usability Scale (SUS) questionnaire applied to 86 respondents including teacher and student users which were shown in Table 7 and Table 8.

| Ri | Score-i | Final Score-i | Ri | Score-i | Final Score-i | Ri | Score-i | Final Score-i | Ri | Score-i | Final Score-i |
|----|---------|--------------|----|---------|--------------|----|---------|--------------|----|---------|--------------|
| R1 | 25      | 62.50        | R12| 12      | 30.00        | R23| 15      | 37.50        | R34| 24      | 60.00        |
| R2 | 25      | 62.50        | R13| 11      | 27.50        | R24| 26      | 65.00        | R35| 23      | 57.50        |
| R3 | 13      | 32.50        | R14| 12      | 30.00        | R25| 21      | 52.50        | R36| 24      | 60.00        |
| R4 | 17      | 42.50        | R15| 21      | 52.50        | R26| 22      | 55.00        | R37| 22      | 55.00        |
| R5 | 24      | 60.00        | R16| 18      | 45.00        | R27| 22      | 55.00        | R38| 20      | 50.00        |
| R6 | 13      | 32.50        | R17| 16      | 40.00        | R28| 21      | 52.50        | R39| 25      | 62.50        |
| R7 | 20      | 50.00        | R18| 19      | 47.50        | R29| 28      | 70.00        | R40| 21      | 52.50        |
| R8 | 10      | 25.00        | R19| 20      | 50.00        | R30| 20      | 50.00        | R41| 24      | 60.00        |
| R9 | 14      | 35.00        | R20| 19      | 47.50        | R31| 23      | 57.50        | R42| 23      | 57.50        |
| R10| 16      | 40.00        | R21| 15      | 37.50        | R32| 17      | 42.50        | R43| 23      | 57.50        |
| R11| 14      | 35.00        | R22| 15      | 37.50        | R33| 24      | 60.00        | R44| 13      | 32.50        |

**Average Score 49.00**

| Ri | Score-i | Final Score-i | Ri | Score-i | Final Score-i | Ri | Score-i | Final Score-i | Ri | Score-i | Final Score-i |
|----|---------|--------------|----|---------|--------------|----|---------|--------------|----|---------|--------------|
| R1 | 17      | 42.50        | R12| 11      | 27.50        | R23| 17      | 42.50        | R34| 21      | 52.50        |
| R2 | 25      | 62.50        | R13| 24      | 60.00        | R24| 23      | 57.50        | R35| 17      | 42.50        |
| R3 | 23      | 57.50        | R14| 26      | 65.00        | R25| 20      | 50.00        | R36| 17      | 42.50        |
| R4 | 12      | 30.00        | R15| 22      | 55.00        | R26| 18      | 45.00        | R37| 16      | 40.00        |
| R5 | 12      | 30.00        | R16| 23      | 57.50        | R27| 23      | 57.50        | R38| 24      | 60.00        |
| R6 | 11      | 27.50        | R17| 27      | 67.50        | R28| 18      | 45.00        | R39| 20      | 50.00        |
| R7 | 11      | 27.50        | R18| 24      | 60.00        | R29| 22      | 55.00        | R40| 19      | 47.50        |
| R8 | 12      | 30.00        | R19| 22      | 55.00        | R30| 25      | 62.50        | R41| 20      | 50.00        |
| R9 | 12      | 30.00        | R20| 19      | 47.50        | R31| 24      | 60.00        | R42| 19      | 47.50        |
| R10| 12      | 30.00        | R21| 22      | 55.00        | R32| 27      | 67.50        |     |          |              |
| R11| 13      | 32.50        | R22| 26      | 65.00        | R33| 15      | 37.50        |     |          |              |

**Average Score 48.30**

After the data obtained by using the Questionnaire System Usability Scale (SUS) including R-i (Respondent-i), Score-i (Total score of respondents-i), and Final Score-i (Final Score -i), the average user data were obtained in which 49.00 for teacher users and 48.30 for student users which was followed
by determining the grade of the assessment results. The first determination was seen from the viewpoint of the level of user acceptance, grade level, and adjective rating in which the level of user acceptance included three categories, namely not acceptable, marginal, and acceptable. Meanwhile, in term of the grade level, there were six scales, namely A, B, C, D, E, and F. Moreover, the adjective rating consisted of worst imaginable, poor, ok, good, excellent, and best imaginable as shown in Figure 1 below.

Based on the recapitulation of assessment results of user respondents by using the SUS Questionnaire applied to 86 respondents including teacher and student users, in the teacher users group, a score of 49.0 was obtained to indicate Acceptability Ranges or user acceptance. For those who scored below 50 belonged to the category of Not Acceptable. Moreover, the Grade Level was in the F category because the group got score below 60. In addition, the Adjective Rating was in the OK category because the group got score between 38 and 52. Furthermore, the Percentile Rank score obtained was below 51 so it entered the Grade F category in which Grade F is the smallest value in the Percentile Rank. Whereas, the student group respondents obtained an average value of SUS with a score of 48.3 with Acceptability Ranges or user acceptance in which they were included in the category of Not Acceptable because they got a score below 50. Moreover, the Grade Level was in the F category because they got a score below 60, while the Adjective Ratings entered the OK category because the value obtained was between 38 and 52. For the Percentile Rank, the value obtained was Grade F. Based on the data above, it could be concluded that Jejak Bali is not acceptable (Not Acceptable) by both the teacher and student user groups. Moreover, for their satisfaction in the use (Adjective Ratings) of the system was still obtained the OK value. Thus, it could be concluded that respondents were not satisfied with the use of Jejak Bali virtual class.

4. Identification of Improvements and Suggestions
Recommendations for improvements made on the Jejak Bali page were based on the difficulties and suggestions given by teacher user respondents through Concurrent Think Aloud (CTA) and a questionnaire including adding features and display adjustments. The addition of features, such as adding message features between teachers and students, adding information features when the teacher added a class, adding a random option feature for questions, adding discussion on questions, providing options for adding questions in the form of images or symbols on quizzes or online exams, were made. Whereas, for student user respondents, the additional features made were in the form of messages between students and teachers and adjustment of the display on the module page, assignments, quizzes, and online exams.
5. Conclusion

Based on the results of the research on usability analysis of Jejak Bali Classes by using usability testing techniques, including Concurrent Think Aloud and Performance Measurement, it can be concluded as follows.

1. Effectiveness was carried out by looking at the number of errors or failures made by respondents when working on a given task. Based on the results of performance measurements that had been carried out on teacher users, the percentage of errors occurring in the expert group showed the average value of 3% for the advanced group and 22% for beginners. Whereas, in the student user group, the average score for the advanced group was 2% and for the beginners was 15%. The overall error percentage of teacher and student users did not exceed 68%, but because the assignment received a percentage value of 90%, there was still a usability problem in the Jejak Bali system which was used as the object of the research. Based on the conclusions above, Jejak Bali seen from the user point of view was still not effective.

2. Efficiency was done by comparing the time needed to complete the tasks required by the advanced group respondents with the time needed by the novice group respondents by using the Mann Whitney U-Test method. From the 11 tasks given, 5 tasks did not have a significant time difference and 6 tasks had a significant time difference from the teacher user respondents between the advanced and novice user groups. Whereas, in the student user respondents, From the 10 tasks given to the respondents, 6 tasks did not have a significant time difference and 4 tasks had a significant time difference between the respondents of the advanced and novice student groups. Since the percentage of tasks with a significant difference was higher than those that did not have a significant difference in time, so it could be concluded that Jejak Bali system was not efficient for both student and teacher users.

3. User satisfaction had been obtained through the System Usability Scale questionnaire in which the results of each question given to the respondent were analyzed. In the teacher user group, a score of 49.00 was obtained in the Percentile Rank. Meanwhile, the student group respondents obtained an average value of SUS with a score of 48.30. Based on this data, it could be concluded that Jejak Bali system was not accepted (Not Acceptable) by both the teacher and student user groups. Additionally for their satisfaction in the use (Adjective Ratings) of the system still obtained an OK value. Thus, it could be concluded that respondents were not satisfied with the use of the Jejak Bali Virtual Class.

4. Recommendations for improvements made on the Jejak Bali page were based on the difficulties and suggestions given by the teacher user respondents through Concurrent Think Aloud (CTA) and the ongoing questionnaire, including adding features and customizing displays. The addition of features such as adding message features between teachers and students, adding information features when the teacher added a class, adding a random option feature for questions, ading discussion on questions, providing options for adding questions in the form of images or symbols on quizzes or online exams were also made. Whereas, for student user respondents, additional features were made in the form of messages between students and teachers and adjustment of the display on the module page, assignments, quizzes, and online exams.

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