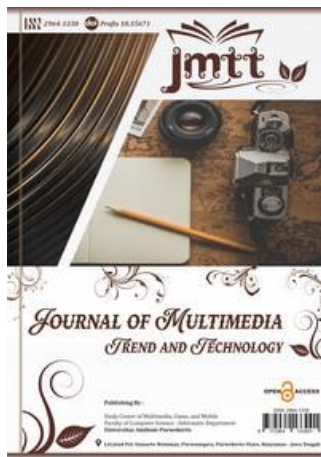


# Usability Evaluation of E-Learning Website User Experience Using the TUXEL Method: A Technique for User Experience Evaluation in Learning Management System

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## ARTICLE INFO



### History :

Submit on 26 January 2025  
Review on 20 February 2025  
Accepted on 20 March 2025

### Keyword :

Usability;  
User Experience;  
E-learning;  
Evaluation;  
LMS

## ABSTRACT

The purpose of this study was to determine the usability and User Experience (UX) on the E-Learning.net website with three aspects, namely general usability, pedagogical usability and user experience. This study uses the TUXEL method, a method used to evaluate usability and user experience in e-learning using three questionnaires, namely the problem reporting table, general LMS evaluation checklist and user experience evaluation. Data collection through validated questionnaires was then distributed to respondents by taking samples using non-probability sampling techniques. The sample used was obtained from a study of students at SMK N 12 Malang with a sample size of 10 students with characteristics of having knowledge about e-learning. The data obtained were analyzed using the descriptive analysis method. The evaluation results obtained from the three questionnaires, namely the problem reporting table, found 14 problems from the four variables, namely login, general interface, assignments and assessments. In the General LMS evaluation checklist, 18 problems were found from the four variables, namely Help and Documentation, LMS Learnability, Learning Through the LMS and LMS Flexibility. In the User Experience Evaluation, a positive mean value was obtained. The E-Learning website excels in the dimensions of support, innovation, creativity and motivation. E-Learning.net is suitable for use in independent learning.

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## INTRODUCTION

In the current era of globalization, the development of the internet is very rapid. There are many advantages obtained from the use of the internet, one of which is that information can be easily obtained and distributed [1]. These advantages also have an impact on the world of education, namely that it is easier for students to get learning materials quickly without limitations of place, distance, space and time. One form of technology with the world of education is Information and Communication Technologies (ICT) [2][3].

In the world of education, ICT is used as a tool for students to find learning topics, solve problems and provide solutions to problems in the learning process. ICT as an educational medium is e-learning. Learning Management System (LMS) is a special platform that provides educational content, activity activities and support for managing learning programs by combining technology with the aim of expanding learning in different environments [4].

ISO 9126-1 (2001) defines usability as the capacity of a software product to be understood, learned, used and made interesting to users when used under certain conditions. Usability in LMS or elearning in this case is different from the others [5].

Usability in LMS is a factor that has a major impact on the teaching and learning process. If the platform does not provide good usability, students will spend more time trying to learn how to use it than learning the educational content [6].

Usability is also a key factor for the acceptance, satisfaction and efficiency of academic institutions, regardless of the knowledge, experience or guidance of students [7]. LMS in addition to offering good usability, must be effective in meeting the objectives of the pedagogical object as an instructor, which is necessary to integrate educational quality into the platform usability evaluation process. Usability in pedagogy relates to how the platform facilitates learning from the material provided [8].

Currently, e-learning in Indonesia is mostly website-based, for example E-Learning.net, quipper, ruangguru.com, etc. In website-based e-learning, usability and user experience must be factors that are considered because e-learning can be said to be good if it provides good usability and a positive user experience (UX) [1][9]. Failure to meet these qualities can result in dissatisfaction, resistance, misunderstanding or misuse of the Learning Management System (LMS), which leads to criticism and low acceptance of the platform [2][10]. This means that usability and UX need to be evaluated because they consider aspects such as how easy the system is to learn, its usefulness and user satisfaction with it including emotional responses from users [11].

The author chose E-Learning.net which is one of the startups with the first education platform operating in 2004 which focuses on education-based services and is ranked 5th in startups in Indonesia based on startupranking.com compared to other education websites such as ruangguru.com, quipper and Squaline.

This study uses the Technique for User Experience Evaluation in e-learning (TUXEL) method adapted from Nakamura's research. TUXEL is a method for measuring usability and UX in e-learning [12][13]. TUXEL used is version 2.0 which has three stages of assessment, namely using the Problem Reporting table questionnaire, General LMS. Evaluation and User experience Evaluation. A Technique for User Experience Evaluation in E-learning or abbreviated as TUXEL is a method for evaluating how effective and how useful the LMS is based on the principles of Human Computer Interaction (HCI), such as usability and UX [14]. TUXEL is a form of usability and UX evaluation in LMS based on the perspective of students and using questionnaires in data collection. The stages in TUXEL 2.0 are task definition, checklist matching, usability inspection, pedagogical inspection and UX evaluation [15][16].

ISO 9241-210 (2010) defines UX as "a person's perceptions and responses derived from the use and/or anticipated use of a product, system or service". Hassenzahl, on the other hand, proposes an approach involving pragmatic aspects (related to task accomplishment) and hedonic aspects (related to emotions) [17]. In this way, hedonic aspects contribute directly to positive experiences, while pragmatic aspects facilitate the potential to achieve goals such as "being autonomous", "being

competent”, among others. Hassenzahl state that in addition to making software usable, aspects such as enjoyment and satisfaction should be the main goals on the system will be much more attractive and thus will improve UX [18][19]. The main requirements for UX evaluation methods are that they should be lightweight (not requiring many resources), fast and relatively easy to use [20]. From the usability and UX evaluation conducted on the E-Learning.net website, the expected output is to be able to find problems on the E-Learning.net website, provide an overview of the results of user experience, recommend the E-Learning.net website for what type of learning and what target users, and provide the advantages and disadvantages of the E-Learning.net website based on the results of the respondents.

### METHOD

E-Learning.net is an LMS or online learning system that was first created in 2014. E-Learning.net, which acts as a platform in the world of education, provides learning materials from Elementary School (SD), Middle School (SMP), High School (SMA), National Examination (UN) and SBMPTN questions from previous years. The features owned by E-Learning.net are being able to access materials, practice questions and videos based on education levels and college entrance exams, and blogs related to the experiences or stories of E-Learning.net users.

To solve the problems that have been previously stated, this study will use the TUXEL Evaluation method. The stages that will be carried out can be seen in Figure 1 below:

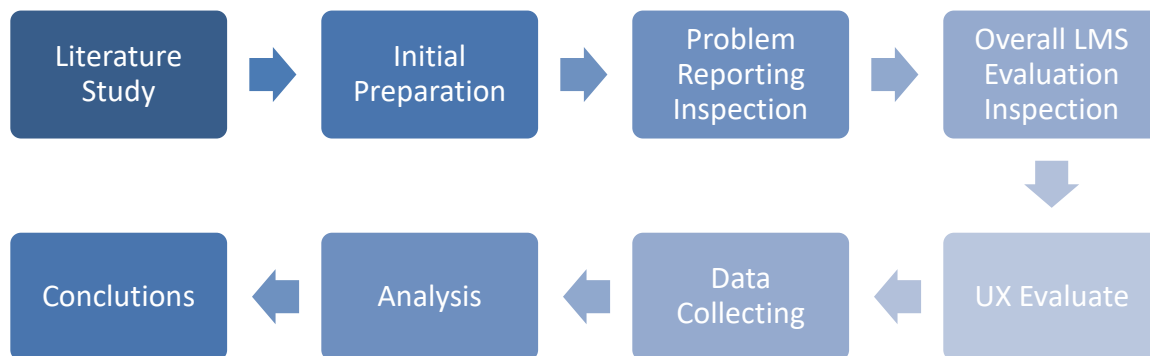


Figure 1. Research flow

The literature study discusses the theoretical basis used to support the research objectives, namely the evaluation of usability and user experience on the E-Learning.net website. The literature study used was obtained from papers, journals and other relevant sources. The literature studies used in this study are Usability, User Experience, Learning Management System, TUXEL.

The preparation of the questionnaire was carried out by referring to the dimensions contained in the TUXEL 2.0 method. At this stage, the preparation of the questionnaire was made by translating the TUXEL 2.0 dimensions from the original version into Indonesian. The questionnaires contained in TUXEL 2.0 are Problem Reporting Table, General LMS Evaluation and User Experience Evaluation.

Validation The questionnaire to be distributed is adapted from Walter's research, namely the TUXEL 2.0 dimension, Problem Reporting Table, General LMS Evaluation and User Experience Evaluation. The TUXEL 2.0 dimensions and the three questionnaires that have been translated into Indonesian are then distributed to several experts to check their readability and then revised. The expert in this study is a lecturer at the Faculty of Computer Science, Brawijaya University.

In the Questionnaire, the Problem Reporting Table is an adaptation of similar research which is the first stage of filling out the questionnaire. The questionnaire used is the Usability Inspection - Problem Reporting Table or the problem reporting table on usability. In the Problem Reporting Table

there is an item ID, Location and task, description of the problem, recurrence of the problem found and the page or section that experiences the recurrence of the problem. These five items must be filled in by respondents who refer to the TUXEL 2.0 dimensions. In the Problem Reporting Table is a usability inspection that aims to analyze the usability function on the LMS.

The General LMS Evaluation questionnaire is an adaptation of previous research which is the second stage of filling out the questionnaire. The questionnaire used is the General LMS Evaluation Checklist or general LMS evaluation related to pedagogical usability, namely how the platform facilitates learning from the material provided. The general LMS evaluation consists of four variables, namely Help and Documentation, ease of learning LMS, learning through LMS, and flexibility of LMS. An explanation of the four variables can be seen in Table 1.

Table 1. Variabel category of LMS Aspect

| Variable Category      | Description   |
|------------------------|---|
| Help and Documentation | Evaluate whether the LMS has support and materials  |
| LMS Learnability       | Evaluate how easy the LMS is to learn   |
| Learning Through LMS   | Evaluate the LMS allows learners to use the platform in learning                              |
| LMS Flexibility        | Evaluate the LMS allows learners to have control over their learning process and the platform |

In the User Experience Evaluation is an adaptation of similar research which is the last stage of filling out the questionnaire. In this 3rd questionnaire is an assessment which is an adjective of 12 items divided into six dimensions which can be seen in Table 2. Measurement of user experience evaluation uses a semantic differential scale with a range of -3 to 3 and respondents can provide comments in the form of criticism and suggestions for the LMS used.

Table 2. UX Dimensions in TUXEL

| No | Parameter      | Item  |
|----|----------------|---|
| 1  | Attractiveness | Disliked / Enjoyable                              |
| 2  | Dependability  | Uncomfortable to use / Comfortable to use         |
| 3  | Efficiency     | Not as expected / as expected                     |
| 4  | Novelty        | Hindering / Supportive                            |
| 5  | Perspicuity    | Inefficient / Efficient Impractical / Practical   |
| 6  | Stimulation    | Conventional / Innovative Not creative / Creative |

There are three categories of perception levels in user experience evaluation based on the mean results obtained. The mean value obtained for each item will be categorized according to the perception level category. The grouping can be seen in Table 3.

Table 3. Level categories based on mean

| Level Category | Mean value distance |
|----------------|---------------------|
| Positif        | >0.8                |
| Normal         | -0.8 until 0.8      |
| Negatif        | <-0.8               |

In data collection using answers from respondents through questionnaires. Before distributing the questionnaires, respondents were given tasks for conditioning the evaluation environment with the aim of providing convenience when filling out the questionnaires. There are three types of questionnaires distributed to respondents in the form of hard copies that are given directly.

According to Macefield on the uxatters website, research shows that from three to twenty participants can provide valid results, and a good range is between five and ten participants. Based on this, this study used ten people as respondents and were students of SMK N 12 Malang.

The sampling technique using non-probability sampling is a sample taking method that does not provide an equal opportunity to be selected as a respondent. Purposive sampling is part of non-probability sampling where respondents meet certain criteria, including having accessed and having knowledge of e-learning.

## RESULT

### 3.1. Problem Report

In the problem reporting table, there are four variables with different numbers of item codes according to respondents. In the login variable, there are two problem item codes found which can be seen in Table 4.

Table 4. Number of respondents reporting problems with the Login Variable

| Item Code | Number of Respondent |
|-----------|----------------------|
| LF2       | 9                    |
| LF1       | 1                    |

The description of the problem in the login variable is: (LF2) LMS does not inform users of the mandatory columns when signing up or logging in; (LF1) LMS does not provide feedback when performing an action, namely there is no error or success notification when logging in. In the General Interface variable, there are four problem item codes found which can be seen in Table 5.

Table 5. Number of respondents reporting problems with the General Interface Variable

| Item Code | Number of Respondent |
|-----------|----------------------|
| VD5       | 1                    |
| N1        | 3                    |
| N6        | 3                    |
| N5        | 8                    |

The description of the problems in the general interface variable are: (VD5) regarding low contrast on the E-Learning.net website; (N1) regarding navigation that is almost invisible; N6, namely the website does not provide a search engine to find information faster, but the search engine only uses content code keywords; (N5) namely the page does not provide a difference between links that have been visited or not visited. In the Assignments variable, there are five problem item codes found which can be seen in Table 6.

Table 6. Number of respondents reporting problems on the Assignments Variable

| Item Code | Number of Respondent |
|-----------|----------------------|
| L2        | 3                    |
| LF4       | 3                    |
| LF6       | 1                    |
| LF5       | 4                    |
| LF1       | 3                    |

The description of the problems in the Assignments variable are: (L2) regarding the lack of instructions/instructions that are unclear and less objective, especially in practice questions; (LF4) not being informed on how to fill in the answers correctly; (LF6) namely the LMS does not show the progress of an action taken by the user; (LF5) namely the LMS does not ask for confirmation before taking important actions; (LF1) namely the LMS does not provide feedback when taking actions related to tasks. In the Assessments variable, there are three problem item codes found which can be seen in Table 7.

Table 7. Number of respondents reporting problems in the Assessments Variable

| Item Code | Number of Respondent |
|-----------|----------------------|
| 001       | 7                    |
| IF1       | 5                    |
| IF2       | 5                    |

The description of the problems in the Assessments variable is: (001) namely the LMS does not provide a score on the completion of tasks to track user performance; (IF1) namely the LMS does not provide direct feedback in the form of right or wrong answers when answering a task; (IF2) namely the feedback given by the LMS is not relevant/in accordance with the problem or question answered.

### 3.2. General LMS Evaluation

In the general LMS evaluation, there are four variables with different numbers of item codes according to respondents. In the Help and Documentation variable, there are two problem item codes found which can be seen in Table 8.

Table 8. Number of respondents who reported problems with the Help and Documentation variable

| Item Code | Number of Respondent |
|-----------|----------------------|
| HD2       | 2                    |
| HD3       | 3                    |

The description of the problems in the Help and Documentation variable is: (HD2) namely users do not find what they need easily in manual or online help; (HD3) namely instructions provided in manual or online help to overcome problems or difficulties are displayed in a way that is not simple and straightforward. In the LMS Learnability variable, there are four problem item codes found which can be seen in Table 9.

Table 9. Number of respondents reporting problems with the LMS Learnability Variable

| Item Code | Number of Respondent |
|-----------|----------------------|
| L1        | 5                    |
| L3        | 2                    |
| L6        | 1                    |
| N3        | 2                    |

The description of the problems in the LMS Learnability variable is: (L1) LMS is not intuitive so that users have difficulty doing activities/tasks; (L3) namely users cannot complete an activity/task without being accompanied or assisted by others; (L6) namely users will not know how to use the LMS again after not using it for a long time; (N3) namely users have difficulty using the LMS to access anything/anywhere. In the Learning Through the LMS variable, there are six problem item codes found which can be seen in Table 10.

Table 10. Number of respondents reporting problems with the Learning Through the LMS variable

| Item Code | Number of Respondent |
|-----------|----------------------|
| CL1       | 6                    |
| CL2       | 7                    |
| CL3       | 8                    |
| CL4       | 4                    |
| CL5       | 8                    |
| OO2       | 9                    |

Problem description in the Learning Through the LMS variable, item code (CL1) is that the LMS does not give me access to group activities or discussion forums; (CL2) is that the LMS does not allow users to connect and communicate with colleagues/or other teachers easily; (CL3) is that the LMS does not allow users to see the history of what other colleagues have done, such as the most read content, the most popular assignments, etc. (CL4) is that the LMS does not allow users to share files, photos, videos and educational materials; (CL5) is that the LMS does not provide access to provide complaints and answer questions from other users; (OO2) the LMS does not allow users to see progress in learning. In the LMS Flexibility variable, there are six problem item codes found which can be seen in Table 11.

Table 11. Number of respondents reporting problems with the LMS Flexibility Variable

| Item Code | Number of Respondent |
|-----------|----------------------|
| FL2       | 6                    |
| FI3       | 8                    |
| P1        | 7                    |
| P2        | 5                    |
| P3        | 8                    |
| AI1       | 6                    |

The description of the problems in the LMS Flexibility variable is: (FL2) users cannot consult previous learning materials when they have doubts; (FI3) namely LMS does not provide opportunities for users to seek additional feedback from teachers when they have questions about content, activities or other problems; (P1) namely LMS does not allow users to change the interface; (P2) LMS does not provide shortcut buttons to increase user productivity; (P3) namely LMS does not provide a choice of languages used; (AI1) namely LMS does not allow users to evaluate and assess their own learning outcomes.

### 3.3. User Experience Evaluation

The median results of user experience with a range of -3 to 3 on twelve parameters from ten respondents are shown in Figure 2. The mean results obtained from the division of items from the six parameters can be seen in Table 12.

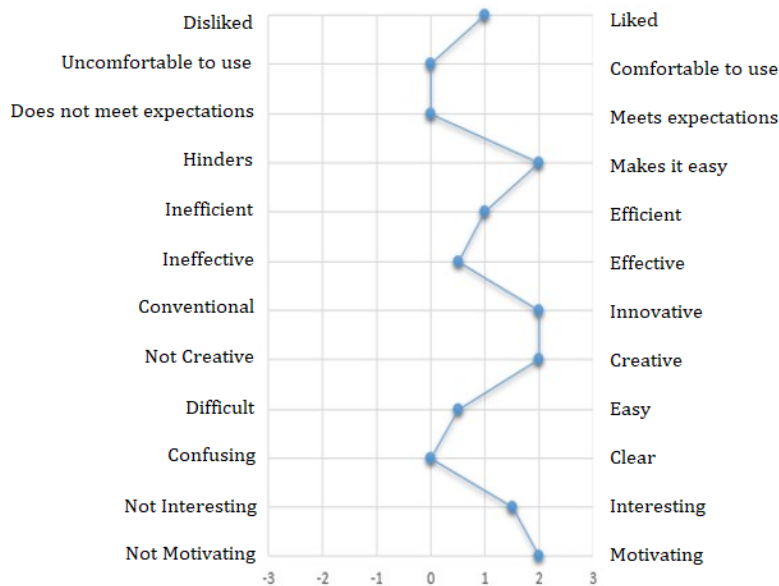


Figure 2. Median Results of E-Learning.net user experience

Table 12. Mean results of UX dimensions

| Item Code      | Number of Respondent |
|----------------|----------------------|
| Attractiveness | 1                    |
| Dependability  | 1.15                 |
| Efficiency     | 0.95                 |
| Novelty        | 1.65                 |
| Perspiciuity   | 0.4                  |
| Stimulation    | 1.7                  |

## DISCUSSION

### 4.1. Problem Reporting Table Analysis

In the Login variable, (LF2) is the item most chosen by respondents. Both items in the login variable should show the message correctly and use simple language to provide a solution [21]. In the General Interface variable, in order to create a good assessment, improvements are needed in several items. The color combination between the background and the menu on the main page should use different color tones so that the menu displayed can be seen clearly. Search engines should use keywords so that when users search for material or something, they can immediately find the answer. Link or material markers should be distinguishable with the aim that users can find out their progress or activities that have been accessed. In the General Interface variable, (N5) is the item most chosen by respondents. In the items in the General Interface variable, especially in item N5, the system must always provide information to users about the activities accessed when running the system. In item (N6) in accordance with Nielsen's sixth principle. Recognition rather than recall, namely the system must provide choices, objects or actions where users do not need more effort and help users find something in the system.

Of the five items in the Assignments variable, (LF5) is the item most frequently chosen by respondents in the Problem Reporting Table. From the problems obtained, the website should provide objective instructions on the material or practice questions so that users do not feel confused when accessing or answering questions and provide confirmation when they are going to take an action, for example when they are going to exit when a video is playing, etc. In the assignments variable, a system must provide users with options in the form of feedback when they want to take an action, for example exiting the page while a video is playing, in order to comply with Nielsen's third principle, namely User control and freedom, where users can fully control the activities carried out. Of the three items in the Assessments variable, (O01) is the item most frequently chosen by respondents in the Problem Reporting Table. In the Assessments variable, the use of feedback is needed on this website so that students can find out the answers directly because feedback functions as a tool to determine the success of learning according to [22].

#### 4.2. General LMS Evaluation Analysis

Of the two items in the Help and Documentation variable, (HD3) is the item most chosen by respondents in the General LMS Evaluation. The Help and Documentation variable has similarities with the General Interface variable where respondents consider that they need a search engine [23].

In the Help and Documentation variable, every piece of information must be easy to find and provide information that makes it easy for users to determine steps without having to require more effort, which is in accordance with Nielsen's tenth principle, namely Help and Documentation.

Of the four items in the LMS Learnability variable, (L1) is the item most chosen by respondents in the General LMS Evaluation. The LMS Learnability variable has similarities with the General Interface variable where the incident is repeated, namely the lack of instructions on the website so that e-learning must provide assistance and convenience for users. This applies in doing assignments or practice questions with clear instructions related to the ease of the platform allowing users to obtain important actions in completing a task. Because if the platform does not provide good usability, students will spend more time trying to learn how to use it than studying educational content [24].

Of the six items in the Learning Through the LMS variable, (O02) is the item most frequently chosen by respondents in the General LMS Evaluation [13]. In the Learning Through the LMS variable, learners move from the perspective of gaining knowledge to the perspective of participating or collaborating rather than gaining knowledge on their own, they build it through practice from discussions between members. In this way, it is important that the platform provides tools that enable communication and interaction between learners and teachers to build knowledge collaboratively. Of the six items in the LMS Flexibility variable, items FI3 and P3 are the items most frequently chosen by respondents in the General LMS Evaluation. In LMS Flexibility, it has similarities to the Assessment variable because it requires feedback to see progress in users to support improvements in their learning when doing practice questions, etc. In this way, it is important that the platform provides features that enable communication and interaction between learners and teachers to build knowledge collaboratively [16].

#### 4.3. User Experience Evaluation Analysis

Based on Figure 2, the median obtained for each item in the user experience evaluation has a positive value. The distribution of answers per item has different variations on each scale. In relation to participant perceptions regarding the UX of the LMS, respondents' opinions in the form of comments related to the LMS using the first and second questionnaires were analyzed with the UX section of TUXEL. The results indicate the codes, namely (1) Confusing, (2) Not as expected, (3) Creative, (4) Motivating. With the median value obtained being 0.00 for confusing and not as expected items, 2.00 for creative and motivating items.

Table 12 shows the mean results for the six dimensions on the E-Learning.net website. Of the six mean values obtained, there are five dimensions in the Positive level category and one dimension in

the Normal level category. The five dimensions are in the Positive level category because the mean obtained has been met or above average as evidenced by the mean obtained with a value of >0.8. In the Positive level category, namely the Attractiveness dimension which has a mean value of 1, the Dependability dimension which has a mean value of 1.15, the Efficiency dimension which has a mean value of 0.95, the Novelty dimension which has a mean value of 1.65 and the Stimulation dimension which has a mean value of 1.7. The order from the highest to the lowest mean value is Stimulation, Novelty, Dependability, Attractiveness, and Efficiency. The Perspicuity dimension is in the Normal category because the mean obtained is 0.4 and is in the range of -0.8 to 0.8 where there are two items, namely difficult and confusing, as evidenced by the distribution of answers dominating on a scale of 0. Based on this assessment, the website is in a positive assessment. Failure to meet this quality can result in dissatisfaction, resistance, misunderstanding or misuse of the LMS, which leads to criticism and low acceptance of the platform.

4.4. Combined Analysis of Problem Reporting Table, General LMS Evaluation and UX evaluation questionnaires

Based on the assessment of the three questionnaires, an assessment was obtained that included usability, pedagogical usability and UX evaluation and it was concluded that the advantages and disadvantages of the E-Learning.net website can be seen in Table 13.

Table 13. Power and weakness of E-Learning.net

| Power   | Weakness   |
|---|--|
| Attractive appearance and easy-to-understand website flow   | LMS does not provide instructions in completing practice questions.  |
| As an alternative to independent learning   | LMS does not provide feedback in the form of scores, correct or incorrect answers or links or additional discussions outside of the feedback in the form of discussion of questions via video. |
| Displays detailed information about the E-Learning.net website  | LMS does not provide a search box to go directly to the search destination because the search box on the E-Learning.net website is only valid if you enter the content code.                   |
| The material presented on the E-Learning.net website follows the development of the curriculum in Indonesia | LMS does not provide markers on practice questions/materials/videos that have been accessed.   |
| The E-Learning.net website is considered motivating because it displays various testimonials from users     | LMS does not notify the columns that must be filled in when signing up.  |

CONCLUSIONS

Evaluation results The evaluation results obtained from the Problem Reporting Table questionnaire on TUXEL 2.0 show that there are 14 total problems, namely 2 items in the Login variable, 4 items in the General Interface variable, 5 items in the Assignments variable and 3 items in the Assessments variable. The evaluation results obtained from the General LMS evaluation checklist questionnaire on TUXEL 2.0 show that there are 18 total problems, namely 2 items in the Help and Documentation variable, 4 items in the LMS Learnability variable, 6 items in the Learning Through the LMS variable, 6 items in the LMS Flexibility variable. The evaluation results obtained from the User experience Evaluation questionnaire on TUXEL 2.0 have a median and mean value that are positive in all 12 dimensions, namely there are 7 items in the positive category because they have a mean value

distance > 0.8 and 5 items in the normal category because they have a mean value distance < -0.8. And the most superior on the E-Learning.net website is the supporting, innovative, creative and motivating dimensions.

### Acknowledgement

The author would like to thank the University of Merdeka Malang for providing facilities for the research. As well as support in special data collection in the software engineering laboratory.

### Author Contributions

Analysis: A.S.A, Writer: A.S., Validation: A.S.A, Translation: A.S.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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