RESEARCH ARTICLE | MAY 08 2023

Usability e-learning system at university: A systematic literature

R. Arri Widyanto ✉; Meidar Hadi Avisenna; Rayhan Vibi Rahadyan

AIP Conference Proceedings 2706, 020026 (2023)
https://doi.org/10.1063/5.0120292

Usability E-learning System at University: A Systematic Literature

R. Arri Widyanto[1, a)], Meidar Hadi Avisenna[1] and Rayhan Vibi Rahadyan[2]

[1]*Department of Information Technology, Universitas Muhammadiyah Magelang, 56172, Indonesia*
[2]*Department of Informatics Engineering, Universitas Muhammadiyah Magelang, 56172, Indonesia*

[a)] *Corresponding author: arri_w@ummgl.ac.id*

Abstract. The use of e-learning during the pandemic is increasingly popular since the advice to conduct online learning. It causes several educational institutions in elementary schools, junior high schools, senior high schools, and universities developing and utilizing the e-learning system. Increasing the use of e-learning will increase researches on e-learning testing using the usability method. This research aimed to gain the ideal usability value of the e-learning system. The results are expected to provide recommendations on e-learning systems applied to high schools and universities. This research used the Systematic Literature Review (SLR) method to observe researches related to e-learning usability testing using the research gate, science direct and Google scholar databases. Usability eLearning system can be used to measure various attributes with a wide. The method used to test the usability of an e-learning in previous research, uses a variety of methods and the scale used is not limited. The test is not only in the aspect of learnability, memorability, efficiency, error and satisfaction as adopted from Nielsen however, is supported by another attributes. Develop a new framework for usability testing of an e-learning so that the usability testing method uses the same standards.

INTRODUCTION

E-learning is a web-based remote learning concept and a second generation learning method after traditional learning [1]. This concept emerged using artificial intelligence techniques to support new functions [2]. E-learning is a popular learning system during the pandemic because of government regulations that prohibit face-to-face learning at schools or universities to avoid the spread of Covid 19. Therefore, there has been a change in learning methods from face-to-face to e-learning systems. Utilization of e-learning can be conducted asynchronously by uploading material in the e-learning system or synchronously using virtual classes [3]. All education levels from the elementary school, junior high school, senior high school and university utilize the e-learning system. The implementation of e-learning in schools and universities is different. For example, in elementary and junior high schools, they do not use a Learning Management System (LMS), but use the WhatsApp application to share materials and collect assignments. In addition, the evaluation is constructed by compiling questions using a Google form. In the senior high schools and universities, e-learning is conducted by the LMS. So far there has been no research that measures the usefulness of e-learning used in the student learning process. There are several methods of measuring usability and user satisfaction. First, the usability method to measure user behavior [4–7]. This method found that the self-efficacy appeared had a significant influence on the ease of use and behavioral intentions. Another measurement is fuzzy dematel to measure ambiguity problems with the context of usability problems in multiple criteria [8]. Empirical study of Usability evaluation are also used to evaluate the usefulness of personalized adaptive e-learning systems by considering several criteria [9]. The study of usability was also conducted using single-center research, mix-methods using the System Usability Scale (SUS) questionnaire and qualitative interviews [10]. Mokhtar and friends measure the benefits and satisfaction of e-learning users using multiple regression analysis [11]. The utilization of the USE Questionnaire proved as the right choice because this questionnaire provides a lot of information about aspects of the system that can be improved [12]. This study aims to provide an overview to the reader about the ideal usability value of the e-learning system. The results are expected to provide recommendations on e-learning systems applied to high schools and universities.

3rd Borobudur International Symposium on Science and Technology 2021
AIP Conf. Proc. 2706, 020026-1–020026-6; https://doi.org/10.1063/5.0120292
Published by AIP Publishing. 978-0-7354-4447-8/$30.00

METHOD

The researchers compiled a literature review by conducting a systematic search on science direct, research gate, and Google scholar published from 2014 to 2020. This research aimed to determine the effectiveness of usability methods in evaluating e-learning systems. The systematic search aimed to gain articles, methods and other factors relating to usability testing on e-learning systems. This research used Systematic Literature Review with keywords usability e-learning system and utilized the boolean operators as follows: "testing" OR "Evaluation" OR "Assessment" AND "usability" AND "e-learning" OR "online learning" OR "online class "OR LMS.

The inclusion criteria of this research were: (1) Usability testing conducted on the e-learning system. (2) The use of usability aspects. (3) E-learning is applied in high schools and universities. Meanwhile, the exclusion criteria were: (1) the testing conducted aside from using usability. (2) The system being tested is not e-learning or online class. (3) The range of time aside from 2014 to 2020. (4) Not an English journal. (5) The journals contain simply abstracts or incomplete explanations. (6) The application is not in senior high school or college.

The usability and e-learning data were widely available in online databases. These data were selected and formed 67 articles. These articles were re-selected related to the criteria. It is because there were not English articles, incomplete and they were not about usability e-learning. The result was 26 complete articles on the usability of e-learning, involved from science direct (2), research gate (6) and Google scholar (18). Furthermore, the articles were assessed by the researchers independently based on the title, abstract and content. The results resulted 6 articles for review. The process was shown in Figure 1 below:

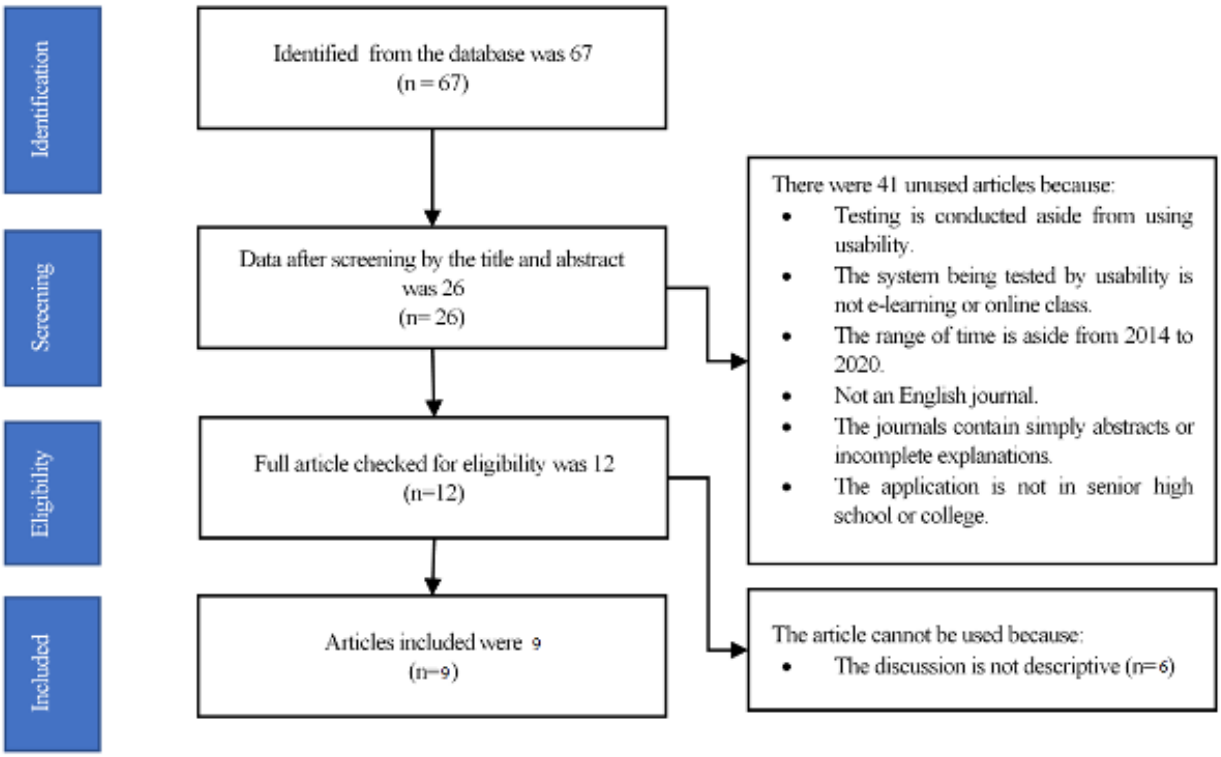

FIGURE 1. PRISMA diagram of the research

RESULTS AND DISCUSSION

Results

Table 1. was an analysis of the comparison process and a summary of several studies related to usability.

TABLE 1. A summary of article results

No	Title	Author	Key words	Method	Focus and Contribution	Finding
1	Assessing the Relative Importance of an E-learning system's Usability Design Characteristics Based on Students' Preferences	Ahmed Alshehr, Malcolm Rutter	E-learning system, higher education, usability evaluation, usability principles preference, Saudi Arabia.	Descriptive	This study contributed to the field of evaluating the usability of e-learning systems by revealing the USE factors which were the most common factors for usability testing in e-learning environments in Saudi Arabia.	This study found the information quality attribute as the most important variable affecting the usability of e-learning systems in all categories.
2	Assessing the Usability of Learning Management System: User Experience Study	Maha M. Althobaiti, Pam Mayhew	HCI, Usability, LMS, E-learnin, Jusur.	Descriptive	The research process concentrated on generating phenomenological data to find out problems and systems from a reflexive view of the users. From the findings, the system could be observed as an example of an E-learning application that could be used and requested from the student perspective.	Phenomenological data was found to find out the problem and system from the reflexive view of its users.
3	Evaluating Usability of E-Learning Systems in Universities	Nicholas Kipkurui Kiget, Professor G. Wanyembi	e-learnin, moodle, usabilit, learnability.	Descriptive	This study focused on Moodle as an LMS	There were differences perceptions between lecturers and students.
4	Usability evaluation of personalized adaptive e-learning system using USE questionnaire	Didik Hariyanto, Kohler Thomas, Triyono, MB.	Usability evaluation, Personalized e-learnin, Adaptive e-learnin, USE questionnaire.	Descriptive	Personalized e-learning	The research findings indicated that students accept the usefulness of an adaptive e-learning system in all aspects. Furthermore, the results of multiple linear regressions indicated that the variables of usability, simplicity of use, and simplicity of learning affect satisfaction simultaneously. Finally, the regression results also revealed that the usability and simplicity of use variables partially affect satisfaction, while the simplicity of learning variable did not effect.

No	Title	Author	Key words	Method	Focus and Contribution	Finding
5	Usability factors predicting continuance of intention to use cloud	Lillian-Yee-Kiaw Wang, Sook-Ling Lew, Siong-Hoe Lau, Meng-Chew Leow	Psychology, Behavioral psychology, Information science, Education, Cloud e-learning, Continuance intention, Usability factors, Structural equation modeling.	Descriptive	Testing the theoretical model of e-learning cloud applications	Validating the theoretical model used to test cloud e-learning applications. The results showed that students' comprehension of technology does not affect their continued intention to use Cloud e-learning applications. In contrast, the continued intention to use e-learning Cloud is strongly influenced by positive subjective experiences of students such as being confident and enjoying learning through Cloud applications.
6	Usability of Learning Moment: Features of an E-learning Tool That Maximize Adoption by Students	Andrew Chu, Dea Biancarelli		Descriptive	E-learning tools	The importance of involving e-learning users in every system design process.
7	Extension of technology acceptance model by using system usability scale to assess ehavioral intention to use e-learning	Anastasia Revythi & Nikolaos Tselios	Learning management system, Behavioral intention to use, Technology acceptance model, Systemusability scale, Partial least squares.	Descriptive	Examine the acceptance of using an LMS such as eClass and the impact of behavioral intentions on their decision to use it.	Efficacy factors have a significant impact not only on perceived ease of use, but also on behavioral intentions.
8	Exploring user satisfaction for e-learning systems via usage-based metrics and system usability scale analysis.	Nouzha Harrati, Imed Bouchrika, Abdelkamel Tari, Ammar Ladjailia	E Learning, Moodle, Usability, Usability evaluation	Descriptive	Model evaluasi elearning.	The System Usability Scale score is not a sufficient measure to express the actual level of acceptance and satisfaction of lecturers with the use of an e-learning system, but a positive user experience and better usability are very important for an e-learning system.
9	Perceived Usability Evaluation of Microsoft Teams as an Online Learning Platform During COVID-19 using System Usability Scale and Technology Acceptance Model in India	Debajyoti Pal, and Vajirasak Vanijja	COVID-19, Online learning, Perceived usability, System Usability Scale (SUS), Technology Acceptance Model (TAM)	Descriptive	The test uses 2 methods, namely System Usability Scale (SUS) and a modified Technology Acceptance Model (TAM) which are used together.	The results obtained from the survey show similarities and equivalence between the two methodologies.

Discussion

Ahmed Alshehri, et al. found that the quality of information is the most important variable that affects the usability of e-learning systems in all categories of usability attributes [13]. Their study contributed to the field of evaluating the usability of e-learning systems by revealing the USE factors which are the most common factors for usability testing in e-learning environments in Saudi Arabia.

Besides the certain factors including 'motivation to learn', it was also important to discover the strengths and weaknesses related to the use of LMS [14]. Their study discovered phenomenological data to assess problems and systems from the user's reflexive point of view. The differences perceptions between lecturers and students also affected the use of e-learning [15]. It was evidenced by a study conducted by Kiget, et al. in a study focused on Moodle as an LMS.

The variables of usability, simplify of use, and simplify of learning simultaneously affect user satisfaction [16]. The research findings indicated that students accept the usefulness of an adaptive e-learning system in all aspects. Furthermore, the results of multiple linear regressions indicated that the variables of usability, simplicity of use, and simplicity of learning affect satisfaction simultaneously. Finally, the regression results also revealed that the usability and simplicity of use variables partially affect satisfaction, while the simplicity of learning variable did not affect e-learning user satisfaction in personalized e-learning.

Another test was based on usability level with the attributes of Computer Self Efficacy (CSE), Continuance Intention (CI), Enjoyment (E), Perceived Ease of Use (PEU), Perceived Usefulness (PU), and User Perception (UP) [17]. The findings indicated that the theoretical model used to test cloud e-learning applications should be validated. In addition, students' comprehension of technology did not affect their continued intention to use Cloud e-learning applications. In contrast, the continued intention to use e-learning Cloud was strongly influenced by positive subjective experiences of students such as being confident and enjoying learning. The user involvement was also important in developing an e-learning system [10].

Anastasia Revythi & Nikolaos Tselios found that Efficacy factors have a significant impact not only on perceived ease of use, but also on behavioral intentions. [4]. Nouza Harrati et. Al. found the System Usability Scale score is not a sufficient measure to express the actual level of acceptance and satisfaction of lecturers with the use of an e-learning system, but a positive user experience and better usability are very important for an e-learning system[18]. Another study using SUS and TAM which is used to measure an e-learning simultaneously, shows the results that the similarities and similarities between the two methodologies [19].

CONCLUSION

Based on the above discussion, it was found that the quality of information is an important variable in testing the usability of e learning systems. Other factors are learning motivation to use, user perception and success factors also have a significant influence on the usability of an e learning system. Measurement of the usability of the e-learning system can be done using various attributes with a wide scale.

The method used to test the usability of an e-learning in previous research, uses a variety of methods and the scale used is not limited. The test is not only in the aspect of learnability, memorability, efficiency, error dan satisfaction as adopted from Nielsen [15] however, is supported by another attributes. The next research development is to develop a new framework for usability testing of an e-learning so that the usability testing method uses the same standards.

ACKNOWLEDGMENTS

The authors would like to thank the Chancellor of the University of Muhammadiyah Magelang who has funded this research with the contract number: 114/Kontrak/PRVI-PLR/2021.

REFERENCES

1. Hassanien, A.E. *Machine Learning Paradigms: Theory and Application*; Hassanien, A.E., Ed.; Springer, 2019; Vol. 801; ISBN 9783030023560.
2. Shekapure, S.; Patil, D.D. Performance Based Adaptive Personalized E Learning system. *Int. J. Recent Technol. Eng.* **2019**, *8*, 5988–5991, doi:10.35940/ijrte.B3696.078219.
3. Cakiroglu, U. Evaluating students' perspectives about virtual classrooms with regard to Seven Principles of Good

Practice. *South African J. Educ.* **2014**, *34*, doi:10.15700/201412071201.
4. Revythi, A.; Tselios, N. Extension of technology acceptance model by using system usability scale to assess behavioral intention to use e-learning. *Educ. Inf. Technol.* **2019**, *24*, 2341–2355, doi:10.1007/s10639-019-09869-4.
5. Setiawan, A.; Arumi, E.R.; Sukmasetya, P. FUZZY MEMBERSHIP FUNCTIONS ANALYSIS FOR USABILITY EVALUATION OF ONLINE CREDIT HOUR FORM. *J. Eng. Sci. Technol.* **2020**, *15*, 3189–3203.
6. Purnomo, T.A.; Widyanto, R.A.; Setiawan, A.; Hendradi, P.; Suksmasetya, P. Usability analysis of disaster information systems using usability testing. *J. Phys. Conf. Ser.* **2020**, *1517*, doi:10.1088/1742-6596/1517/1/012089.
7. Setiawan, A.; Primadewi, A. First time user experience of academic information system: An evaluation of usability. *IOP Conf. Ser. Mater. Sci. Eng.* **2020**, *821*, 012044, doi:10.1088/1757-899X/821/1/012044.
8. Muhammad, M.N.; Cavus, N. Fuzzy DEMATEL method for identifying LMS evaluation criteria. *Procedia Comput. Sci.* **2017**, *120*, 742–749, doi:10.1016/j.procs.2017.11.304.
9. Didik, H.; Triyono, M.B.; Kohler, T. Usability evaluation of personalized adaptive e-learning system using USE questionnaire. *Knowl. Manag. E-Learning* **2020**, *12*, doi:10.34105/j.kmel.2020.12.005.
10. Chu, A.; Biancarelli, D.; Drainoni, M.L.; Liu, J.H.; Schneider, J.I.; Sullivan, R.; Sheng, A.Y. Usability of Learning Moment: Features of an E-learning Tool That Maximize Adoption by Students. *West. J. Emerg. Med.* **2019**, *21*, 78–84, doi:10.5811/westjem.2019.6.42657.
11. Mokhtar, M.I.; Yuki, M.H.M.; Yusuf, N.A.M.; Yusof, N.S.M.; Omar, M.S. Students' Satisfaction towards e-Learning System: A Case Study of Politeknik Tuanku Syed Sirajuddin. *Int. J. Adv. Res. Educ. Soc.* **2020**, *2*, 42–51.
12. Faria, T.V.M.; Pavanelli, M.; Bernardes, J.L. Evaluating the usability using USE questionnaire: Mindboard system use case. *Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics)* **2016**, *9753*, 518–527, doi:10.1007/978-3-319-39483-1_47.
13. Alshehri, A.; Rutter, M.; Smith, S. Assessing the relative importance of an e-learning system's usability design characteristics based on students' preferences. *Eur. J. Educ. Res.* **2019**, *8*, 839–855, doi:10.12973/eu-jer.8.3.839.
14. Althobaiti, M.M.; Mayhew, P. Assessing the usability of learning management system: User experience study. *Lect. Notes Inst. Comput. Sci. Soc. Telecommun. Eng. LNICST* **2016**, *160*, 9–18, doi:10.1007/978-3-319-28883-3_2.
15. Kiget, Nicholas Kipkurui, G., Wanyembi, P.G.; Peters, A.I. Evaluating Usability of E-Learning Systems in Universities. *Int. J. Adv. Comput. Sci. Appl.* **2014**, *5*, doi:10.14569/ijacsa.2014.050815.
16. Hariyanto, D.; Triyono, M.B.; Yogyakarta, U.N.; Koehler, T. Evaluasi kegunaan e-learning adaptif yang dipersonalisasi sistem menggunakan kuesioner USE. **2021**, 1–24.
17. Wang, L.Y.K.; Lew, S.L.; Lau, S.H.; Leow, M.C. Usability factors predicting continuance of intention to use cloud e-learning application. *Heliyon* **2019**, *5*, e01788, doi:10.1016/j.heliyon.2019.e01788.
18. Harrati, N.; Bouchrika, I.; Tari, A.; Ladjailia, A. Exploring user satisfaction for e-learning systems via usage-based metrics and system usability scale analysis. *Comput. Human Behav.* **2016**, *61*, 463–471, doi:10.1016/j.chb.2016.03.051.
19. Pal, D.; Vanijja, V. Perceived usability evaluation of Microsoft Teams as an online learning platform during COVID-19 using system usability scale and technology acceptance model in India. *Child. Youth Serv. Rev.* **2020**, *119*, 105535, doi:10.1016/j.childyouth.2020.105535.