Measuring the usability effectiveness of using card menus and tree menus in school web applications

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Article Info	ABSTRACT
	The aim of this research is to measure the usability effectiveness of a web application by using card menus and tree menus using user-friendly criteria and access speed as indicated by the number of clicks made by the user. The method used in this research is the Task-centered User Interface method, where this method allows for planning and evaluating the arrangement of the interface according to user needs. There are four stages in this method, including user identification by conducting needs analysis, the second phase is user interface design. The third phase is the implementation of the card menu and tree menu design, and the fourth face is testing the usability and effectiveness requirements. From the research that has been carried out regarding measuring the effectiveness of using card menus, it is more effective to use than tree menus because you can directly lift the menu and access it. Meanwhile, for usability, the card menus have a higher usability index than the tree menus. Meanwhile, for usability measurements carried out by direct observation and distributing questionnaires, the resulting percentage of user understanding, ease, and speed for the card menu display was 87% and for the tree menu was 60% so that the card menu display was more accepted by users than the tree menu. The new thing provided by the results of this research is in the form of suggestions that can be used by web application developers to use the right type of menu in building web-based applications with the same specifications as in the case of school finance applications. *This is an open access article under the CC BY-SA license.*
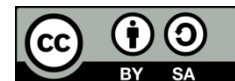
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1. INTRODUCTION

The user interface (UI) and user experience (UX) are part of the system development stages to produce an interactive and attractive web-based application layout that it is easy for users to understand and use [1]–[3]. In the 21st century, technology has becomepart of all humans in the world and will continue to develop in the future [4]. Creating an application is greatly influenced by user needs, so input and suggestions

from users are needed as the first step in designing a system. Building an interaction design for a financial mathematical calculator using user-centered design methods [5], [6].

Creating UX is a challenge that exists before designing the user interface (UI), and in realizing the user interface, you must pay attention to the influence of aesthetics [7], [8]. Meanwhile, the results of the user interface structure that has been created require measuring its utility using the user interface and evaluating the user experience [9]–[11]. When presenting an application display, an interface is needed that can provide convenience for the user so that it provides comfort in operating the application being used. The presentation of the interface is an important point to get a positive impact from users in order to provide a good experience and trust in the level of user satisfaction with using the system.

To assess the success of implementing UX management, it is necessary first to understand what UX management actually is and how to measure or determine good UX management [12]. To obtain research data, a multiphase mixed method approach was carried out consisting of two interview studies and two action research studies. with two different OEMs [13]–[15]. A comprehensive user study conducted to compare the usability of Automated AUI with manual systems resulted in a much more positive user experience compared to manual systems.

Nowadays most of the services are offered through cloud environment, which are accessed remotely [16]. The EnerTrApp mobile web application is an application with a user interface that is designed and evaluated through usability testing to assess its effectiveness, efficiency, and user satisfaction [17]–[19]. Different interaction modes and user interfaces have been developed to evaluate the most suitable and user-friendly interaction modes for operators. Trials were conducted to assess the usability and potential of the application with satisfactory results [20].

From all the literature obtained by the researchers [21]–[23], the research that will be carried out is a measurement of the effectiveness of usability in the use of school financial applications by presenting card menu and tree menu displays. The researchers conducted effectiveness measurements by measuring the speed of menu use, both card menus and tree menus. Meanwhile, usability is carried out by direct observation and distributing questionnaires to users, namely, school financial application operators. The results of the research can provide information on which application display is better and more acceptable for users to use when using card menus or tree menus.

2.   METHOD

The research process carried out by the researcher made research stages that were carried out sequentially in 4 (four) phases, the stages were the first phase of needs analysis, the second phase of user interface design, the third phase of implementation and the fourth phase of testing, [24], [25]. The stages of the research phase can be seen in Figure 1.

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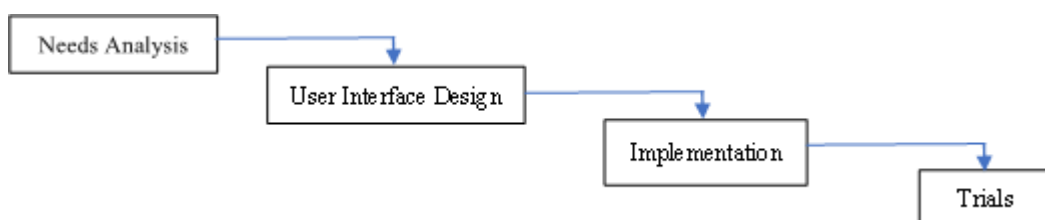

Figure 1. Research stages

Needs Analysis Phase

At the needs analysis stage, researchers obtained information from schools, especially about the needs needed for the school finance application that will be used. The needs for the application include:

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1)   Student Data
   The student data menu, consists of a data menu which is used to store student data, and an add menu, which is used to add student data.
2)   Entry
   For input, it includes the SPP menu which is used to process and input student tuition payment data and other entry menus which are used to process and input BOS and donation data.
3)   Expenditures
   Meanwhile, expenditure is a menu used to process and input expenditure data.
4)   Reports
   The report menu consists of the SPP menu which is used to create reports linked to SPPS and the financial menu which is used to create financial reports.

User Interface Design Phase

   The user interface design stage is to design a display for the school financial application using menu cards and tree menus. Where both models will be created in 1 (one) application which will later be used for testing. The model of card menu display is in Figure 2 and the tree menu is shown in Figure 3.

Figure 3. Menu cards

Figure 4. Tree menu

   The menu card presents menus in blocks, grouped according to application needs, and takes up a lot of space on the application display. By presenting menu cards, users can directly use the menu they need with one click. Meanwhile, the presentation of the tree menu is arranged as a tree according to its groups and does not take up much space on the application display. To access the menu tree, the user must click on the menu at least more than once.

Implementation Phase

   At the implementation stage, the researcher presented the user interface design for the school finance application by presenting a menu card and a tree menu in one application. Where the application will later be used for testing on users. The results of the card menu and the tree menu design display in the resulting school finance application can be seen in Figure 4.
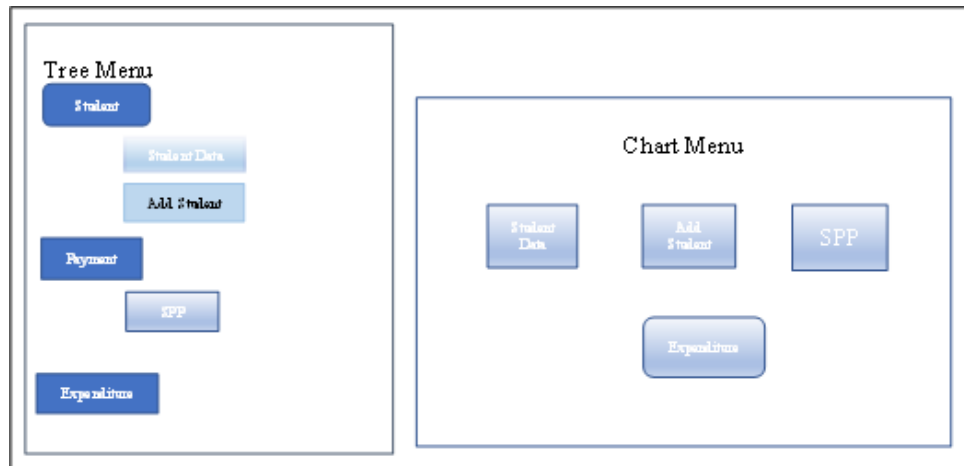
Figure 4. Display of card menu and tree menu

Trial Phase

Meanwhile, for the final phase, a trial was carried out with the objective of measuring the level of usability and effectiveness of the use of school financial applications with card menu and tree menu displays. The usability tests were carried out by researchers by direct observation of school financial application users or school financial operators. Observations were carried out in 3 (three) primary level schools, both elementary and middle school, in the Banyuwangi area. The researcher measured effectiveness by looking at the speed of access to the presentation of menu cards and tree menus in the school finance application. The access speed can be seen from the number of clicks required to enter the menu.

For usability, this was done by observing school financial application operators when using the application and then distributing a questionnaire. The questionnaire was distributed to determine the operator's understanding, ease, and speed in using the application for menu cards and menu trees. The questionnaire questions given include questions for displays with menu cards and questions for tree menus. The questionnaire questions include the following:

1)   Questions for menu cards
    a)   Is the menu card a menu that is easy for users to understand?
    b)   The card menu is a menu that is easy to use to access the intended web page?
    c)   The card menu that is is a quick menu used to access the target web page?
2)   Questions for the tree menu
    a)   The tree menu is a menu that is easy for users to understand?
    b)   The tree menu is a menu that is easy to use to access the targeted web page?
    c)   The tree menu is a quick menu used to access the targeted web page?

Measuring the effectiveness results carried out by researchers on the use of school financial applications, the researchers concluded that card menus are more effective for use in school financial applications than tree menus because the lift menu can be accessed directly by counting the number of clicks made. For card men, you only need 1 (one) click to go to the desired lift menu. Meanwhile, in the tree menu, clicks are made more than 1 (one) click, even more to lift the target menu.

The measurement of usability was carried out by analyzing data obtained when conducting direct observations of the use of school financial applications and distributing questionnaires to operators to determine responses to the use of school financial applications. From the data obtained, the percentage of usability measurements can be calculated.

From the data from the existing questionnaire, data analysis was carried out using a Likert scale with the percentage determination and weight value for each question that was assessed. The weight value table is shown at 1 and for the percentage Table at table 2.

Table 1. Value weights

Answer	Value
Strongly agree	5

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Answer	
Agree	4
Enough	3
Disagree	2
Don't agree	1

Table 2. Percentage of values

Answer	Information
80% - 100%	Strongly agree
60% - 79.99%	Agree
40% - 59.99%	Enough
20% - 39.99%	Disagree
0% - 19.99%	Don't agree

To calculate the percentage measurement, the equation formula is as follows:

$$P = (F/N)*100 \tag{1}$$

Information:
P = Percentage (%)
F = Frequency to be searched for
N = Number of respondents

3. RESULTS AND DISCUSSIONS

In the research process carried out, the researcher carried out the stages specified in the methodology chapter by following 4 (four) stages to measure the effectiveness and usefulness of the card menu and tree menu displays in the school finance application. From the data obtained after conducting needs analysis, design, implementation and trials, researchers produced data from the results of trials and direct observations with 3 (three) schools and 2 (two) financial operators each who were used as respondents. From the 3 (three) questions on each card menu and the tree menu display of 6 (six) respondents, the following calculations were produced:

Calculation of the Questionnaire Regarding The Display The Menu Card

From the questionnaire filling data (number of responses / N) obtained for each question, it is then converted to a number on a Likert scale and then multiplied by the value weight which produces a score (F). After the score (F) is obtained from each question, look for the average score for the questionnaire questions on the menu card. The results of the calculation of the questionnaire for the menu card are in Table 3.

Table 3 Questionnaire calculation of the menu card display

Number	Question	Number of Respondents (N)	Likert Scale	Score (F)	Percentage	Average
1	Is the menu card a menu that is easy for users to understand?	2	5	10	80%	87%
		2	4	8		
		2	3	6		
		0	2	0		
		0	1	0		
2	The card menu is a menu that is easy to use to access the intended web page?	3	5	15	87%	
		2	4	8		
		1	3	3		
		0	2	0		
		0	1	0		
3	The card menu that is is a quick menu used to access the target web page?	4	5	20	93%	
		2	4	8		
		0	3	0		
		0	2	0		
		0	1	0		

Calculation of the Questionnaire Regarding The Display of The Tree Menu

For the tree menu, the same calculation is also carried out, namely by recording the questionnaire filling (number of responses / N) obtained for each question, then converting it to a number on a Likert scale, then multiplying it by the value weight which produces a score (F). After the score (F) is obtained from each question, look for the average score for the questionnaire questions on the menu card. The results of the calculation of the questionnaire for the menu card are in Table 4.

Table 4. Questionnaire calculations for the tree menu display

Number	Question	Number of Respondents (N)	Likert Scale	Score (F)	Percentage	Average
1	Is the menu tree a menu that is easy for users to understand?	1	5	5	73%	
		2	4	8		
		3	3	9		
		0	2	0		
		0	1	0		
2	Tree menu is a menu that is easy to use to access the intended web page?	0	5	0	57%	60%
		1	4	4		
		3	3	9		
		2	2	4		
		0	1	0		
3	The tree menu is a quick menu used to access the targeted web page?	0	5	0	50%	
		1	4	4		
		3	3	9		
		1	2	2		
		0	1	0		

So, with the data produced, the research that has been carried out regarding measuring the effectiveness of using card menus is more effective to use than tree menus because you can directly lift the menu and access it. Meanwhile, for usability, the card menus have a higher usability index than the tree menus. Meanwhile, for measuring usability, which was carried out by direct observation and distributing questionnaires, the resulting percentage of user understanding, ease and speed for the card menu display was 87% and for the tree menu was 60% so that the card menu display was more accepted by users than the tree menu.

4.   CONCLUSION

The research has been carried out following the stages of the research method, and measurements have been carried out and produced data that are presented to the reader. The research results related to measuring the effectiveness of using card menus are more effective than tree menus because you can directly lift the menu and access them. Meanwhile, for usability, the card menus have a higher usability index than the tree menus. Meanwhile, for measuring usability, which was carried out by direct observation and distributing questionnaires, the resulting percentage of user understanding, ease and speed for the card menu display was 87% and for the tree menu was 60% so that the card menu display was more accepted by users than the tree menu.

REFERENCES

[1]   E. Krisnanik and T. Rahayu, "Ui/ux integrated holistic monitoring of paud using the tcsd method," *Bull. Electr. Eng. Informatics*, vol. 10, no. 4, pp. 2273–2284, 2021, doi: 10.11591/EEI.V10I4.3108.

[2]   S. L. Hantgan and S. P. Jariwala, "User-centered mobile health applications for asthma," *Ann. Allergy, Asthma Immunol.*, vol. 130, no. 2, pp. 159–160, 2023, doi: 10.1016/j.anai.2022.11.011.

[3]   Å. Cajander, M. Larusdottir, and J. L. Geiser, "UX professionals' learning and usage of UX methods in agile," *Inf. Softw. Technol.*, vol. 151, p. 107005, Nov. 2022, doi: 10.1016/j.infsof.2022.107005.

[4]   R. Y. Ariyana, E. K. Nurnawati, M. R. Ath-Thaariq, and P. W. Wahyudi, "Implementation of UCD with a kanban board to build an interaction design for an animal recognition application," *J. Soft Comput. Explor.*, vol. 4, no. 4, pp. 233–241, Dec. 2023, doi: 10.52465/joscex.v4i4.263.

[5]   A. S. D. Martha, E. R. T. Setyawan, and R. R. Riskiana, "Measuring Usability on User-Centered Mobile Web Application: Case Study on Financial Mathematics Calculator," *Khazanah Inform. J. Ilmu Komput. dan Inform.*, vol. 9, no. 1, 2023, doi: 10.23917/khif.v9i1.19409.

[6]   R. Rofik, T. F. Anggraini, B. Prasetiyo, and C. B. S. KA, "Application go-sport as a solution to search information on facilities, places, partners, and sports events for students," *J. Student Res. Explor.*, vol. 1, no. 2, pp. 85–93, Jun. 2023, doi: 10.52465/josre.v1i2.164.

[7]   F. Sihaloho and Normah, "Perancangan User Interface (UI) dan User Experince (UX) Aplikasi pendistribution alat-alat kesehatan pada perusahaan PT. Rekamileniumindo Selaras Jakarta Barat," *Indones. J. Softw. Eng.*, vol. 9, no. 1, pp. 33–38, 2023.

[8]   Y. S. Jamilah and A. C. Padmasari, "Perancangan User Interface Dan User Experience Aplikasi Say.Co," *J. Desain Komun. Vis.*, vol. 9, no. 2, pp. 73–78, 2022.

[9]   H. W. Alomari, V. Ramasamy, J. D. Kiper, and G. Potvin, "A User Interface (UI) and User eXperience (UX) evaluation

.

framework for cyberlearning environments in computer science and software engineering education," *Heliyon*, vol. 6, no. 5, p. e03917, 2020, doi: 10.1016/j.heliyon.2020.e03917.

[10]   F. Yu *et al.*, "Innovative UX Methods for Information Access Based on Interdisciplinary Approaches: Practical Lessons from Academia and Industry," *Data Inf. Manag.*, vol. 4, no. 1, pp. 74–80, Mar. 2020, doi: 10.2478/dim-2020-0004.

[11]   M. Nikam, I. Gawali, V. Khollam, A. Lokhande, and J. Mante, "Online UI / UX Platform (Crafter)," vol. 3307.

[12]   A. Hinderks, F. J. Domínguez Mayo, J. Thomaschewski, and M. J. Escalona, "Approaches to manage the user experience process in Agile software development: A systematic literature review," *Inf. Softw. Technol.*, vol. 150, no. May, p. 106957, 2022, doi: 10.1016/j.infsof.2022.106957.

[13]   K. Kapp, M. Sivén, P. Laurén, S. Virtanen, N. Katajavuori, and I. Södervik, "Design and Usability Testing of an Augmented Reality (AR) Environment in Pharmacy Education — Presenting a Pilot Study on Comparison between AR Smart Glasses and a Mobile Device in a Laboratory Course," 2022.

[14]   E. G. Buis, Elaine, S. R. Ashby, Simone, and K. P. A. Kouwenberg, Kristel, "Increasing the UX maturity level of clients: A study of best practices in an agile environment," *Inf. Softw. Technol.*, vol. 154, p. 107086, Feb. 2023, doi: 10.1016/j.infsof.2022.107086.

[15]   O. Leßenich and S. Sobernig, "Usefulness and usability of heuristic walkthroughs for evaluating domain-specific developer tools in industry: Evidence from four field simulations," *Inf. Softw. Technol.*, vol. 160, p. 107220, 2023, doi: 10.1016/j.infsof.2023.107220.

[16]   A. M. T. Mohamed, R. Atan, A. Alshammari, A. Alsahli, and M. N. Rozami, "Service Level Agreement Enforcement Model with Human Factor for Electronic Health Record," *J. Inf. Syst. Explor. Res.*, vol. 2, no. 1, Jan. 2024, doi: 10.52465/joiser.v2i1.204.

[17]   K. M. P. Escanillan-Galera and C. M. Vilela-Malabanan, "Evaluating on User Experience and User Interface (UX/UI) of EnerTrApp a Mobile Web Energy Monitoring System," *Procedia Comput. Sci.*, vol. 161, pp. 1225–1232, 2019, doi: 10.1016/j.procs.2019.11.236.

[18]   X. He, H. Zhang, and J. Bian, "User-centered design of a web-based crowdsourcing-integrated semantic text annotation tool for building a mental health knowledge base," *J. Biomed. Inform.*, vol. 110, no. August, p. 103571, 2020, doi: 10.1016/j.jbi.2020.103571.

[19]   N. Slob, W. Hurst, R. van de Zedde, and B. Tekinerdogan, "Virtual reality-based digital twins for greenhouses: A focus on human interaction," *Comput. Electron. Agric.*, vol. 208, no. October 2022, p. 107815, 2023, doi: 10.1016/j.compag.2023.107815.

[20]   M. Ciccarelli, A. Brunzini, A. Papetti, and M. Germani, "Interface and interaction design principles for Mixed Reality applications: The case of operator training in wire harness activities," *Procedia Comput. Sci.*, vol. 204, no. 2021, pp. 540–547, 2022, doi: 10.1016/j.procs.2022.08.066.

[21]   Y. Yanfi and P. D. Nusantara, "UI/UX design prototype for mobile community-based course," *Procedia Comput. Sci.*, vol. 216, pp. 431–441, 2023, doi: 10.1016/j.procs.2022.12.155.

[22]   T. Le, S. Chaudhuri, J. Chung, H. J. Thompson, and G. Demiris, "Tree testing of hierarchical menu structures for health applications," *J. Biomed. Inform.*, vol. 49, pp. 198–205, 2014, doi: 10.1016/j.jbi.2014.02.011.

[23]   A. Hentati, E. Forsell, B. Ljótsson, V. Kaldo, N. Lindefors, and M. Kraepelien, "The effect of user interface on treatment engagement in a self-guided digital problem-solving intervention: A randomized controlled trial," *Internet Interv.*, vol. 26, no. August, 2021, doi: 10.1016/j.invent.2021.100448.

[24]   S. Medjden, N. Ahmed, and M. Lataifeh, "Design and Analysis of an Automatic UI Adaptation Framework from Multimodal Emotion Recognition using an RGB-D Sensor," *Procedia Comput. Sci.*, vol. 170, pp. 82–89, 2020, doi: 10.1016/j.procs.2020.03.011.

[25]   P. Ebel, J. Orlovska, S. Hünemeyer, C. Wickman, A. Vogelsang, and R. Söderberg, "Automotive UX design and data-driven development: Narrowing the gap to support practitioners," *Transp. Res. Interdiscip. Perspect.*, vol. 11, no. April, 2021, doi: 10.1016/j.trip.2021.100455.