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HEURISTIC EVALUATION OF E-COMMERCE MARKETPLACE

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ABSTRACT

This paper adapts one of the most popular heuristic evaluation techniques to effectively assess the design of an e-commerce marketplace. Heuristic evaluation for the e-commerce marketplace with a detailed explanation is presented as a guideline for the e-commerce marketplace. This research involved usability evaluation that analyses the e-commerce marketplace using a set of design characteristics (usability heuristics). The process of discovering usability problems is one of the three objectives of this project. The selected set of heuristics could significantly influence the results (usability findings) of performed heuristic evaluations. Based on the evaluators' evaluation, a set of heuristics was produced. This will be used as a guideline to be applied to the design of the e-commerce marketplace called University Textbook Marketplace (UniText). The result of this research presents the heuristic evaluation for e-commerce marketplace guidelines to perform a cost-effective usability evaluation of e-commerce marketplace applications. Therefore, improving website design that is both pleasurable and meets the user's and customer's needs.

Keywords: *Usability, Website, E-commerce, Marketplace, Heuristics.*

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1. Introduction

Nowadays, people are spending more time using the Internet in their daily lives. Through the rapid enhancement of information technology, e-commerce plays a significant role in virtually every aspect of life. It reshaped the marketplace from a conventional society to a new one. The dynamic e-business, therefore, has developed an advanced E-Commerce by shortening the business process (Hairuddin *et al.*, 2019). A good user interface design is important in creating an e-commerce marketplace to give the user a better experience while using it. It involves the ease of access and ease of navigation of the systems (Akrajindanon *et al.*, 2017). Jakob Nielsen's 10 Usability Heuristics for user interface design provides a general

guideline for interaction design and with this, better interface design can be achieved and therefore reduce the risk of its failure (Langmajer, 2020; Neilson *et al.* 1990; Paz *et al.*, 2019)

Given the importance of accessibility and usability in determining the efficiency and effectiveness in the use of the website. There are a number of research done by Janom *et al.*, (2010), Fernandez *et al.*, (2012) and Hasan *et al.*, (2012) on the use of heuristic evaluation on e-commerce websites. A method of expert-based evaluation has been developed with a heuristic evaluation that needs no participants and is both inexpensive and fast to carry out. Nevertheless, systemic effects can be achieved with this tool. The foundation of this approach is a set of laws, the heuristics. Heuristics ensure that certain, desirable characteristics of an object being investigated are examined, which leads to positive usability. This paper aims to evaluate and propose a new set of heuristics for an e-commerce marketplace.

Electronic commerce is a relatively new concept that crept into the business vocabulary during the 1970s. A picture of electronic commerce is emerging in which the Internet will become the essential dial-tone for conducting business by the year 2000 (Wigand, 1997 and Hassan *et al.*, 2012). Electronic Commerce (e-commerce) can be business-to-business (B2B) or Business-to-Consumer (B2C) yet is presently vigorously overwhelmed by B2B as far as revenue split. B2B e-Commerce can be available to every single invested individual, including commodity exchange, or restricted to particular qualified members, for example, private electronic markets. B2C e-Commerce, on the other hand, is directed by establishments, for instance, Ama-zon.com, with any individual (Koe *et al.*, 2020). B2B e-commerce may help an organization gain a competitive advantage over its competitors (Janom *et al.*, 2020).

E-commerce has several benefits for a company. One of them is a rise in the company's revenue. The income is raised in two ways: by growing the number of sales of the company and by lowering operating, maintenance, and purchasing expenses. It also gives benefits by increasing customer loyalty and retention since it allows both internal and external communication. So, the after-sales service of the business is high, and customers can give feedback or ask for an inquiry. Besides building the company image and brand, e-commerce also gives many advantages to the customers. The obvious benefit is e-commerce can give more choices and price comparisons of products. Through this, customers can get the best deal for the product they want. The details of the product, like the price and size, will also be available through e-commerce. They also can shop without any limitation of place and time. Another benefit that customers get is that e-commerce provides many optional payment methods such as internet banking and debit or credit card. E-Commerce enables consumers to interact with each other to exchange experiences. This often is done in the review section of the product (Haruna *et al.*, 2020)

Online E-commerce Marketplaces are e-commerce sites operated by third parties, where the products and services are owned by marketplace operators. Following the e-commerce definition, sellers and buyers rely on different institutional mechanisms, another important source of trust. Institutional mechanisms are legally binding arrangements created by third parties to protect the transacting parties against the potential risk of loss (Zucker, 1986). Consequently, an online market must be as rich, complex, and complete as a traditional market and must create extra value for its users (Kambil *et al.*, 2002).

There are several e-commerce websites available. There is a need to evaluate the usability of e-commerce websites to ensure their effectiveness. Among the methods used to evaluate the usability of such websites are user testing and heuristic evaluation methods. The results from these two methods will uniquely identify major and minor problems of the websites (Lamprecht, 2017). Usability problems in a website can be identified using Heuristic evaluation. This method applies a usability inspection method with a set of evaluators to evaluate the product interface to determine whether it satisfies usability principles

(Lamprecht, 2017). Several researchers are using various heuristic evaluation approaches in the literature (Hamid *et al.*, 2020; Csontos *et al.*, 2021; Jimenez *et al.*, 2016). Research on heuristic evaluation of the usability of public administration portals was conducted by (Schön *et al.*, 2017). Another example was done on Portuguese e-commerce websites combining automatic and manual assessment procedures. This research resulted in some accessibility and usability problems in regard to efficiency, effectiveness, and satisfaction by the testers. Therefore, seven recommendations were proposed to enhance the accessibility and usability of the e-commerce website (Ilbahar *et al.*, 2017). The remainder of this paper is organized as follows. In Section 2 heuristic evaluation method is discussed. Section 3 describes the Results and Discussions. The conclusion is in Section 4.

2. Method

2.1 Heuristics Evaluation

Nielsen heuristics provide a general usability of designs despite of the specific capabilities and constraints of modern designs. Therefore, there is a need to incorporate and customize Nielsen heuristics when designing the University Text-book Marketplace (UniText). Below are the steps taken in conducting this research with two main phases. The first phase is to establish an appropriate list of heuristics. The Nielsen theory is combined with other e-commerce website features. The second phase is evaluating designs of UniText based on a set of heuristics. There are six activities conducted. The activities are as follows.

a. Select and brief the evaluators. The evaluators chosen are the end users (lecturer and student) and domain experts (the office admin).
b. Design and develop UniText based on the NHE and e-commerce Features.
c. First evaluation phase. The evaluators will test the UniText prototype with specific elements that to evaluate.
d. Second evaluation phase. The evaluators will carry out the second round of testing whilst applying the chosen heuristics to the elements identified during the first phase.
e. Record problems. The evaluators must record problems encountered.
f. Debriefing session. Collate the evaluators' findings and establish a complete list of problems.

The traditional heuristics evaluation by Nielsen is applied in the evaluations of e-commerce websites with detailed explanations (Neilson *et al.* 1990). There are various evaluations performed for this process. Since we are evaluating an e-commerce system, another aspect to look at is the e-commerce system features to attract online shoppers and to stay relevant and competitive. Table 1 shows Nielsen's Heuristics Evaluation list. Each evaluation will be given a unique identifier for easy mapping.

From the currently existing systems, it is then being observed and analyzed to gain requirement identification. Three websites have been observed. Table 2 shows the main functions of the e-commerce website (ECW) and its descriptions. Each function has a unique identifier.

Table 1. Nielsen's Heuristics Evaluation

NHE ID	Nielsen's Heuristics Evaluation (NHE)	Description
NHE 1	Visibility of System Status	System status and feedback must be available for each interaction.
NHE 2	Match Between System and The Real World	Creating a familiar design will help users to overcome their initial awkwardness.
NHE 3	User Control and Freedom	Users often communicate with the system in a hurry which results in accidents or mistakes. A user must be able to undo the last action.
NHE 4	Consistency and Standards	Design creation should have consistency and standard to make users less confused.
NHE 5	Error Prevention	Simple communication and consistent design help the user from slipping and making error mistakes.
NHE 6	Recognition Rather Than Recall	Provide all the choices and details so that user is not required to recall.
NHE 7	Flexibility and Efficiency of Use	Avoid the app design from overcrowded. Only display relevant UI elements and commands.
NHE 8	Aesthetic and Minimalist Design	Minimalism also helps users to access and gain the results of information quickly.
NHE 9	Help User Recognize, Diagnose, and Recover from Errors.	Each message of error should be as express and precise as possible.
NHE 10	Help and Documentation.	Documentation should be well organized, written, and concise in human language.

Table 2. E-Commerce Website Features.

ECWID	System Function	Description
ECW001	Manage User Account	Both buyers and sellers can register an account. They also can update their account.
ECW002	Searching Product	Buyers can search for the textbook or reference book they want to buy.
ECW003	Product Information	Buyers can look into the details of the textbook-like its description, author, and price.
ECW004	Add to Cart	Buyers can add the books they want to the cart and they can purchase them.
ECW005	Delivery by Postage	Buyers will be able to insert the detailed address for postage delivery of the textbook.
ECW006	Manage Product and Stock	The seller can add new products and update the products and stock.
ECW007	Validate Seller Account	Admin can approve the seller account if the account is valid. For validation, sellers have to upload their SSM certification and identification card picture.

2.2 Mapping between the e-commerce system features with the heuristic evaluation.

The mapping process was conducted by comparing both aspects of NHE and ECW. All aspects of the heuristics standards were applied in the system's design. An evaluator was selected to assess the user interface as the main user of this system. A storyboard was designed for this process. Then, the representative was given a set of questions about the system's functions and design. After that, the evaluator is required to test the system and answer the question given. A brief description of each heuristic has been added to help the

evaluator while evaluating the e-commerce website. The answer to the question was recorded for the use of analysis. As depicted in Table 3 below, the mapping process was based on adapting and organizing the usability heuristics for user interface design standards. In addition, we have added a detailed description of each heuristic to apply the heuristics in the development of e-commerce marketplace. The results were examined to validate the set of heuristics with the overall design using the prototype. Moreover, the result will identify the strengths and weaknesses of the e-commerce website.

Table 3. Mapping Table of NHE and E-Commerce Features

Question	Nielsen's Heuristics Evaluation	E-Commerce Features
1. While you were testing this website, do you get any notification when you did any activity? (For example, when you try to add a textbook to the cart)	NHE 1	EC001 EC004 EC005 EC007
2. Are you familiar with the features in this website?	NHE 2	EC002 EC003 EC004 EC006
3. Does this website contain an undo button or a trash bin button when you want to change something?	NHE 3	EC001 EC004 EC006
4. Is the layout of the website consistent?	NHE 4	EC002 EC003
5. Does the website notify you when you make a mistake? (For example, leave the blank area when making a registration account)	NHE 5	EC001 EC003 EC006
6. When the mistake happens, did the notification explain where the mistake is?	NHE 6	EC001 EC004 EC007
7. Do you recognize the navigation and button on the website and know what it is doing?	NHE 7	EC002 EC005
8. Does the navigation of the website is efficient and flexible to use? (For example, different navigation will display for only that required page)	NHE 8	EC006 EC004
9. Does the design of a website look minimalist to you?	NHE 9	EC002 EC003
10. Does the website give you help and documentation about the website?	NHE 6	EC003

3. Results and Discussions

University Textbook Marketplace (UniText) is an online marketplace for students to purchase textbooks and various sellers (publishers) to sell them. Every semester, students at Universiti Teknologi Mara (UiTM) are required to purchase a textbook and reference book for each subject. Currently, the process of purchasing textbooks is being done manually. Therefore, there are problems such as dependency on a single supplier, stock storage space requirements and no mechanism to compare textbook prices among other publishers or suppliers. Due to the problems with the existing system, a new University Textbook Marketplace (UniText) is proposed. UniText is an online marketplace for students to purchase textbooks directly from publishers or sellers. By having an online marketplace, buyers and sellers can easily do sales

transactions without involving any middleman. It will eliminate the role of the middleman, especially the involvement of lecturers. This system also provides a variety of sellers in which buyers can choose the best price for a textbook. At the same time, UniText acts as a marketing tool for sellers and focuses on their niche market. Figure 1 below is the use case diagram of the UniText. There are three actors (Buyer, Admin and Seller) with seven use cases.

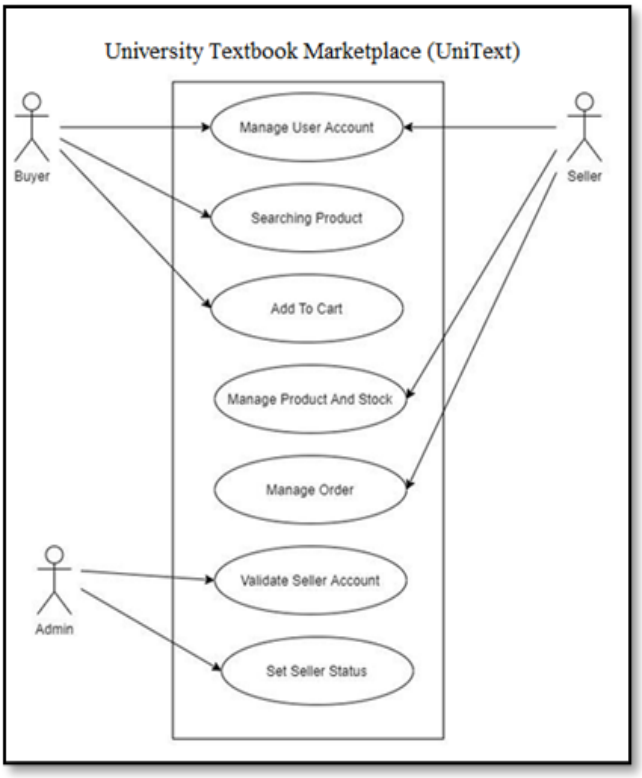

Figure 1. Use Case Diagram for University Textbook Marketplace (UniText)

For the first evaluation phase, the evaluators will test the UniText prototype with specific elements to evaluate. Firstly, a thorough explanation was given about the system. It includes what the system is, what it can do, the functionalities, and the details of the design. Then, the respondent was given the chance to explore and try the functionality of the system by himself. At the same time, a list of questions was given based while exploring the sessions earlier. The UniText prototype was evaluated and examined for its usability. The evaluator has to test and review the system interface. Based on the result, we have mapped and applied the ten Nielsen's Heuristics Evaluation (NHE) with all the e-commerce system features. The mapping process was useful in solving usability issues and came up with better designs. Figure 2 and Figure 3 show the new system interface.

Figure 2. Home Page

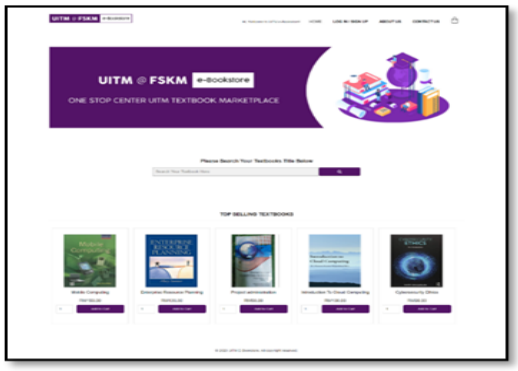

Figure 3. Menu Page

For the second evaluation phase, to validate the findings, the heuristics evaluation and usability testing were conducted. The evaluator tests the website by answering the question and recording problems encountered. This validation process was done with the real user of the system. Thirty-two respondents participated in this validation process. All of the respondents' answers were recorded. The result of the evaluation has been recorded and analysed. Figure 4 below is the result of the validation process. We also conducted a debriefing session to assemble the evaluators' findings and establish a complete list of problems.

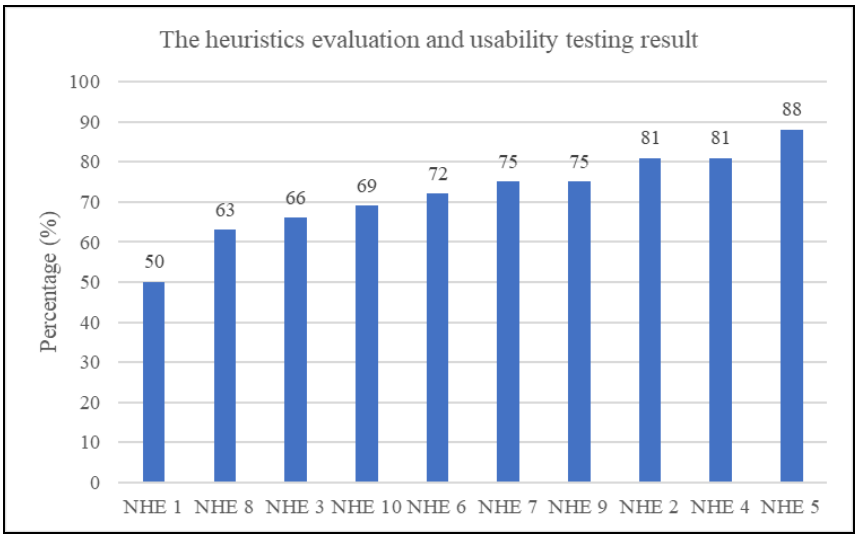

Figure 4: UniText prototype system interface evaluation result

The results were examined to validate the set of heuristics with the overall design using the prototype. Overall, the user testing uncovered many issues with the UniText prototype website design. The main issue that has the lowest value was the visibility of system status (NH1), followed by Aesthetic and Minimalist Design (NHE 8) and User Control and Freedom (NHE 3). The improvement step to be taken is to enhance the system status and feedback for all interactions made. Among the good features agreed by the respondents are the Match Between System and The Real World (NH2), Consistency and Standards (NH4), and Error Prevention (NH5). New and existing guidelines or checklists are adapted and consolidated, as shown in Table 4.

Table 4. The ranking of UniText heuristics features

Rank (Lowest to highest)	Nielsen's Heuristics Evaluation	Percentage
1	NHE 1	50%
2	NHE 8	63%
3	NHE 3	66%
4	NHE 10	69%
5	NHE 6	72%
6	NHE 7	75%
7	NHE 9	75%
8	NHE 2	81%
9	NHE 4	81%
10	NHE 5	88%

4. Conclusion

This paper presents the heuristic evaluation for an e-commerce system called UniText. UniText is a platform for buying and selling new and used textbooks and reference books. This system will eliminate the long process of purchasing textbooks for university students. The Nielsen's Heuristics Evaluation (NHE) for user interface design is used as a guideline to help to improve the system's design. Each heuristic element was examined whether they are met or violated and then defined the user problems. Based on the validation result, it is shown that the design of UniText with e-commerce marketplace features matches the Nielsen heuristics standard. The result of this research act as a guideline to perform usability evaluation of e-commerce marketplace applications. However, there are a few limitations that have been identified in this study. The first one is this study only involves one representative from each user (lecturer and student). More user testing to be conducted to highlight specific issues can only be revealed. The involvement of bigger participants will provide better-quality outcomes for the study. Further refinements to the project are to involve usability specialists participating in the development.

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7. Author Contribution

Author1 in charge of the article's composition. Author2 prepared the project background and conduct the experiment. Author3 wrote the research methodology and performed fieldwork. Author4 prepared the literature review and article authoring. Author5 prepared the project

background and conduct the experiment. Author6 conducted the statistical analysis and interpreted the results.

8. Conflict of Interest

The authors have no conflicts of interest to declare.

References

Akrajindanon, R., Anupong Avirutha, Treepala, N., & Mcafee, A. (2017). The Elements of Marketing Mix Affecting The Repurchase Electronic Marketplace (E-Marketplace) In Thailand. http://dspace.spu.ac.th/bitstream/123456789/5977/1/1_SPUCON2017_(Dr.%20Ravipa%20Akrajindanon).pdf

Asher, M. (2017). The history of user interfaces–and where they are heading. Available at https://www.cmo.com/features/articles/2017/7/20/a-brief-history-of-ui-and-whats-coming.html#gs.tcqMwFIo.

Csontos, B., & Heckl, I. (2021). Accessibility, usability, and security evaluation of Hungarian government websites. *Universal Access in the Information Society*, 20(1), 139-156.

Díaz, J., Rusu, C., & Collazos, C. A. (2017). Experimental validation of a set of cultural-oriented usability heuristics: e-Commerce websites evaluation. *Computer Standards & Interfaces,* 50, 160-178.

Fernandez, A., Abrahão, S., & Insfran, E. (2012). A systematic review on the effectiveness of web usability evaluation methods.

Hairuddin, H., Seman, S. A. A., & Mozie, N. M. (2019). Customers' satisfaction on the Quality of E-commerce. *Advances in Business Research International Journal*, 5(3), 1-10.

Hamid, S., Bawany, N. Z., & Zahoor, K. (2020, October). Assessing ecommerce websites: Usability and accessibility study. In *2020 International Conference on Advanced Computer Science and Information Systems (ICACSIS)* (pp. 199-204). IEEE.

Haruna, S. A. H., Olufemi, A. R., & Kehinde, B. O. (2020). Neuro-fuzzy data mining system for identifying e-commerce related threats. *Malaysian Journal of Computing (MJoC)*, 5(2), 537-552.

Hasan, L., Morris, A., & Probets, S. (2012). A comparison of usability evaluation methods for evaluating e-commerce websites. *Behaviour & Information Technology*, 31(7), 707-737.

Hassan, S., Zambri, S., Kasiran, M. K., Mahli, M. T., Abd Ghani, N. F., & Muhammad, M. (2012). Conformance of Malaysia e-commerce blogs with quality content theories. *Journal of Internet and e-Business Studies*, 2012, 1.

Ilbahar, E., & Cebi, S. (2017). Classification of design parameters for E-commerce websites: A novel fuzzy Kano approach. *Telematics and Informatics*, 34(8), 1814-1825.

Janom, N., & Zakaria, M. S. (2010). B2B E-Commerce Progression using Stage model in Malaysian SME. *In The Proceeding of International Research Symposium in Service Management 'Service Imperatives in the New Economy*.

Janom, N., Zakaria, M. S., Arshad, N. H., Salleh, S. S., & Aris, S. R. S. The Development of Multiperspective of Business to Business E-commerce Maturity Application. *Insights into Economics and Management*, 95.

Jimenez, C., Lozada, P., & Rosas, P. (2016, September). Usability heuristics: A systematic review. *In 2016 IEEE 11th Colombian Computing Conference (CCC)* (pp. 1-8). IEEE.

Kambil, A., & Van Heck, E. (2002). Making Markets, How Firms Can Design and Profit from Online Auctions and Exchanges.

Koe W. L., & Afiqah Sakir, N. (2020). The Motivation to Adopt E-commerce Among Malaysian Entrepreneurs. Organizations and Markets in Emerging Economies, 11(1), 189-202.

Lamprecht, E. (2017). The Difference Between UX and UI Design-A Layman's Guide. Career Foundry.

Langmajer, M. (2020, February 22). 10 usability heuristics every designer should know. Available at https://uxdesign.cc/10-usability-heuristics-every-designer-should-know-129b9779ac53

Nielsen, J., & Molich, R. (1990, March). Heuristic evaluation of user interfaces. *In Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 249-256).

Paz, F., Paz, F. A., Villanueva, D., & Pow-Sang, J. A. (2015, April). Heuristic evaluation as a complement to usability testing: a case study in web domain. *In 2015 12th international conference on information technology-new generations* (pp. 546-551). IEEE.

Schön, E. M., Thomaschewski, J., & Bader, F. (2017). Heuristics considering UX and quality criteria for heuristics. Wigand, R. T. (1997). *Electronic commerce: Definition, theory, and context. The information society*, 13(1), 1-16.

Zucker, L. G. (1986). Production of trust: Institutional sources of economic structure, 1840–1920. *Research in organizational behavior.*