User experience measurement of adaptive online module system using user experience questionnaire

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Abstract. Traditionally, research in Human-Computer Interaction (HCI) kept focusing on system usability. Nowadays, user experience is also taken into consideration, complementing system usability, as important aspects of the system. Adaptive Online Module System is an adaptive e-learning system that automatically adjusts its behavior according to the student’s learning style. User Experience Questionnaire (UEQ) Indonesian version is selected in this study to assess the user experience of Adaptive Online Module System. Most results of the Adaptive Online Module System user experience measurement are positive. In the grouped result, adaptive online module system has positive scores in Attractiveness, Pragmatic Quality and Hedonic Quality. On all six scales of UEQ result (Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation and Novelty). Adaptive Online Module System has a positive benchmark. The benchmark results are ranging from above average to excellent. Adaptive Online Module System also has a positive result and sufficient consistency in all of six scales except novelty scale.

1. Introduction

Traditionally, research on Human-Computer Interaction (HCI) kept the focus of system usability. Nowadays, user experience is also taken into consideration, complementing system usability, as important aspects in the system [1]. The rise of website and smartphone is considered the reason behind the increasing importance of user experience [2-3]. International Organisation for Standardization (ISO) also responds to the development in the area. At first, ISO releases the definition of usability in ISO 9241-11. Later, after the realization of the importance of user experience, ISO also releases the definition of user experience in ISO 9241-210.

User experience is an important factor in creating an attachment between product, system or service with the user. Therefore, the attachment may result in sustainable usage [4]. While the definitive user experience dimensions yet to determine, the evaluation must be able to assess different elements of user experience [5]. Some research in user experience measurement is conducted in several case studies, for instance, in task-oriented software [6], handmade marketplace [7], and mobile augmented reality [8]. In this study, user experience measurement of an e-learning system is proposed.

Adaptive Online Module System is an adaptive e-learning system. The works are based on the study of learning styles by Felder and Silverman. Felder-Silverman Learning Styles Model (FSLSM) classifies students according to the following dimensions, sensing / intuitive, visual/verbal, active/reflective and sequential or global [9]. First, the user of Adaptive Online Module System requires to fill the questionnaire to determine their learning style. Next, Adaptive Online Module System saves the student learning style under their account. Every time the student access Adaptive Online Module System, the system automatically adjusts its behavior according to the student’s learning style.
System, it automatically adjusts its behavior according to the student’s learning style. The changing behavior includes a navigation system, type of materials and features [10].

Conducting scientific user experience evaluation on Adaptive Online Module System requires user experience measurement tools. The user experience measurement tools commonly available in the form of a set of questionnaires and the analysis tool. The available tools are ranging from speech-oriented assessment tools, such as Subjective Assessment of Speech System Interfaces (SASSI) and Speech User Interface Service Quality (SUISQ), to graphical user interface-oriented assessment tools, such as Software Usability Measurement Inventory (SUMI) and Questionnaire for User Interaction Satisfaction (QUIS). However, tools that assess non-specific systems also available, such as System Usability Scale (SUS) and User Experience Questionnaire (UEQ) [5,11]. UEQ is selected in this study to assess the user experience of Adaptive Online Module System.

2. User experience

Nowadays, user experience is considered to determine the success of a technology. User experience in ISO 9241-210 is defined as people's perceptions and responses resulting from the use and/or anticipated use of a product, system, or service. It is arguably dominant for a short period at the introduction of the new technology. However, after the initial period, the whole experience is determined by a mix of user experience and system usability. System usability it stated in ISO 9241-11 is system, product or service that can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use. At the stage, user experience no longer the dominant factor to maintain the user in using the technology [3]. While user experience no longer the dominant factor, it still has its importance. Human as a technology consumer has an emotional side that affects their judgment of certain technology. Mixed with the usability of the system, the emotional experience determines the user’s decision in using the technology. User experience helps in providing the emotional experience in human technology interaction [12].

Due to the importance of the user experience, combined with the system usability, it is understandable that user experience should be included in the designing of product, system or service. The implementation is choosing the best design alternatives to ensure that software development is meeting user needs [13]. The elements of user experience are as important as other technical related issues in technology design. Certainly, designing and implementing technology that includes user experience elements isn’t enough. Further evaluation is needed after the introduction of the technology. Evaluation through user experience measurement is important since the user is the one to judge the technology. The evaluation result may have a big impact on the next development of the technology [14].

Considering its importance, objective measurement of user experience is needed. By measuring user experience will provide additional ideas of user perceptions about the specific attributes of a system [15]. However, no definitive standard of user experience elements needed to measure. One suggestion is to divide the elements into 3 categories. The categories are user-centered elements, user interface-focused elements and content-related elements [4]. Another research pointed out that user experience must focus on the concerned technology, the user and the context of use. In the research, the user experience is spanned before, during and after using the technology. It involves the users’ emotions, preferences, perceptions, physical and psychological responses, behaviors and accomplishments [16].

In UEQ, the elements of user experience are divided into 3 categories, such as the attractiveness of the technology, ergonomic quality, and hedonic quality. The attractiveness of technology is an average of direct attractiveness of the technology with the quality of the technology in relevant aspects. The ergonomic quality focus on the ability of technology to complete its task. A technology considered has good ergonomic quality when it completes its task effectively and efficiently. On the other hand, the hedonic quality focus on technology’s qualities other than its ability to complete its task. Examples of the hedonic quality of technology are the originality or the beauty of the visual design [11].

In 2005, fifteen usability experts participate in two brainstorming sessions to determine terms that can be used to describe user experience. Originally, they produce 229 terms. Further work from seven
usability experts reduce the numbers of the terms onto 80 terms. The terms are in the form of adjective words. The team creates questionnaire items by adding antonym of the corresponding word and gives a 7-point Likert scale. Next, six experiments were held using the questionnaire with 80 items. The experiments achieve 153 complete datasets. After another process, the number of items is further reduced to 26 items. The final questionnaire represents 6 factors/scales, i.e. attractiveness, perspicuity, dependability, efficiency, novelty, and stimulation. The result is called User Experience Questionnaire (UEQ). Furthermore, an analysis tool is added to validate the result [17].

Since UEQ created in German, it is logical for the original UEQ to available in Germany. However, the maker of the original UEQ also provides its English translation. Due to the increasing concern in user experience, people's awareness about UEQ is also increasing. Some research is conducted in order to translate UEQ into other languages. Thus, now UEQ also available in Spanish [18], Portuguese [19], Indonesian [20] and Estonian [21].

3. Methods
The research begins with data collection. The participants, which are students, are asked to fill the questionnaires. The system under assessment is Adaptive Online Module System, an e-learning platform that adapts to its user learning style. Students assess Adaptive Online Module System as part of their learning process. The number of participants in this study is 30 students.

The questionnaire in this study has two main parts, namely user profile and UEQ itself. In this study, the standard UEQ is used, nothing changed from the original, which means it has all six scales and twenty-six items. However, it used the Indonesian version of UEQ. Thus, the scales being used are attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. Figure 1 shows the standard questionnaire instrument from UEQ in Indonesian and English.

![Figure 1. Standard questionnaire instrument of UEQ in Indonesian and English](image_url)

Students are given access to an online system in which they must enter their profile first. Next, students were asked to assess their user experience in Adaptive Online Module System. To get valid
and reliable answers, participants were given an explanation of how to understand the standard questionnaire because items were arranged in pairs with the opposite meaning.

After the participant finished filling the questionnaire, the questionnaire data is collected. The data becomes an input for the UEQ analysis tool. The analysis tool is a straightforward Excel file. The tool generates UEQ scales result, consistency of the measurement and benchmark of the technology.

4. Results and discussion
UEQ produces results in the form of numbers for each scale. No single value is produced from UEQ. Since UEQ works by analyzing each factor separately, producing a single value result is improbable. Table 1 shows the result of the experiments.

| Scale       | Value |
|-------------|-------|
| attractiveness | 1.828 |
| perspicuity   | 1.858 |
| efficiency    | 1.650 |
| dependability | 1.517 |
| stimulation   | 1.175 |
| novelty       | 0.75  |

The results in table 1 are produced by calculating the average point of the corresponding scale. The minimum value for each UEQ item is -3 and the maximum value is 3. The most negative result is -3, the most positive result is 3 and the neutral result is 0. Due to the tendency of participants to not choose an extreme value (3 or -3) the average value usually is in the range of -2 to 2. The results in table 1 confirmed the assumption.

Generally, if the result of a scale is between -0.8 and 0.8, it means the user experience for the corresponding scale is neutral. If the result is bigger than 0.8 then the user experience for the corresponding scale is positive while if the result is less than -0.8 then the user experience for the corresponding scale is negative [17]. Five scales in the UEQ result reach a score higher than 0.8, i.e. attractiveness (1.828), perspicuity (1.858), efficiency (1.650), dependability (1.517) and stimulation (1.175). The result may be interpreted that the user experience of Adaptive Online Module System is positive in those 5 scales. However, the scale of novelty has a value of 0.775 which is between -0.8 and 0.8. It means the user experience of Adaptive Online Module System is neutral in novelty scale.

The result of the UEQ can also be grouped into 3 attractiveness, pragmatic quality and hedonic quality. Pragmatic Quality is calculated by averaging the result of perspicuity, efficiency, and dependability. Hedonic quality is calculated by averaging the result of stimulation and novelty. Figure 2 shows the grouped UEQ result of Adaptive Online Module System.

![Figure 2. The grouped UEQ result for adaptive online module system](image-url)
participants. The result of hedonic quality is 0.98 which means Adaptive Online Module System is also perceived has positive in hedonic quality by the participants.

Table 2. The Cronbach Alpha coefficient of UEQ result for adaptive online module system

| Scale         | Cronbach Alpha |
|---------------|----------------|
| attractiveness| 0.9            |
| perspicuity   | 0.74           |
| efficiency    | 0.67           |
| dependability | 0.67           |
| stimulation   | 0.91           |
| novelty       | 0.56           |

Table 2 shows the Cronbach Alpha value for each scale. Cronbach Alpha is used to show the consistency of the UEQ. If the value of Cronbach Alpha of a scale is less than 0.7 then the scale has a low consistency value while the if the value is bigger or equal than 0.7 then the scale has a high consistency value [21]. The Cronbach Alpha coefficient in UEQ result for Adaptive Online Module System shows that 5 scales, i.e. attractiveness, perspicuity, efficiency, dependability, and stimulation have sufficient consistency. Only the Kebaruan scale has a lower consistency value.

The last information generated by the UEQ analysis tool is the benchmark. Benchmark shows the level of user experience of the evaluated technology compared with the level of user experience of other technologies. Only 5 categories of benchmark introduced in the UEQ analysis tool. Those categories are [17] (1) Excellent: the evaluated technology has the best 10% value in the scale compared to other technologies, (2) Good: the evaluated technology has a better value in the scale compared to 75% of other technologies and only worse compared to 10% of other technologies, (3) Above Average: the evaluated technology has a better value in the scale compared to 50% of other technologies and worse compared to 25% of other technologies, (4) Below Average: the evaluated technology has a better value in the scale compared to 25% of other technologies and worse compared to 50% of other technologies, (5) Bad: the evaluated technology has the worst 25% value in the scale compared to other technologies.

Figure 3. Benchmark UEQ result for adaptive online module system

Figure 3 shows that the benchmark of the Adaptive Online Module System UEQ result. No scales have a bad or below-average category in the benchmark. Three scales, attractiveness, perspicuity, and efficiency, are considered excellent in the benchmark. The dependability scale has good results in the benchmark. While two remaining scales, stimulation and novelty, have above average results in the benchmark.

5. Conclusion
Adaptive Online Module System is an e-learning system that has the ability to adapt to the student’s learning styles. The study is conducted to measure the user experience of Adaptive Online Module
System. The chosen measurement tool is User Experience Questionnaire (UEQ) Indonesian version. Most results of the Adaptive Online Module System user experience measurement are positive. In the grouped result, Adaptive Online Module System has positive scores in attractiveness, pragmatic quality dan hedonic quality. It means Adaptive Online Module System is considered attractive, able to complete its task and even has additional quality according to its users. The UEQ result is presented on six scales, attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. On all six scales, Adaptive Online Module System has positive benchmarks. The benchmark results are ranging from above average to excellent. Adaptive Online Module System also has a positive result and sufficient consistency in all of the six scales except novelty scale. A lower score in the novelty aspects of Adaptive Online Module System is perhaps caused by the adaptability nature of Adaptive Online Module System. Adaptive Online Module System novelty lies in its ability to adapt. However, users have no knowledge that the system adapts to their learning styles. In that respect, the users didn’t experience the novelty of the system.

Acknowledgments
Researchers would like to thank to the Ministry of Research and Technology - Higher Education (KEMENRISTEK-DIKTI) which provide fund for this research.

References
[1] Saket B, Endert A and Stasko J 2016 Proc. of the Sixth Work. on Beyond Tie and Err. on Nov. Eval. Meth. for Vis. 2016 133
[2] Castaneda J A, Munoz-Leiva F and Luque T 2007 Inf. Manag. 44 384
[3] Karapanos E, Zimmerman J, Folizzi J and Martens J B 2009 Proc. of the SIGCHI Conf. on Hum. Fact. in Comput. Syst. 2009 729
[4] Dirin A, Laine T H and Nieminen M 2017 Cogn. Technol. Work 19 303
[5] Kocaballi A B, Laranjo L and Coiera E 2018 Proc. of the 32nd Int. BCS Hum. Comput. Interact. Conf. 2018 1
[6] Isleifsdottir J and Larusdottir M 2008 Proc. of the Int. Work. on Meaningful Meas.: Val. Useful User Exp. Meas. (VUUM) 8 97
[7] Nursalhah R K, Santoso H B and Isal R Y K 2018 Int. Conf. on User Sci. and Eng. 2018 207
[8] Irshad S, Ramblí D R A, Nazri N I A M, Rohkmah S and Omar Y 2018 Int. Conf. on User Sci. and Eng. 866 349
[9] Felder R M and Spurlin J 2005 Int. J. Eng. Educ. 21 103
[10] Hidayat A and Utomo V G 2016 Int. Conf. on Inf. and Comput. (Mataram) 2016 94
[11] Laugwitz B, Held T and Schrepp M 2008 Const. and Eval. of a User Exp. Ques. 2008 63
[12] Jokinen J P P 2015 Int. J. Hum.-Comput. Stud. 76 67
[13] Vermeeren A P, Law E L C, Roto V, Obrist M, Hoonhout J and Väänänen K 2010 Proc. of the 6th Nordic Conf. on Hum.-Comput. Interact. 6 521
[14] Sharp H, Preece J and Rogers Y 2019 Interaction Design: Beyond Human-Computer Interaction, 5th Edition (England:Wiley)
[15] Thayer A and Dugan T E 2009 Proc. in the Int. Prof. Comm. Conf. (IPCC) 2009 1
[16] Bakiu E and Guzman E 2017 IEEE 25th Int. Req. Eng. Conf. Workshops (REW) 2017 192
[17] Schrepp M, Hinders A and Thomaschewski J 2017 Int. J. Interact. Multimed. Artif. Intell. 4 40
[18] Rauschenberger M, Schrepp M, Cota M P, Olschner S and Thomaschewski J 2013 Int. J. Artif. Intell. Interact. Multimed. 2 39
[19] Cota M P, Thomaschewski M and Gonçalves R 2014 Proc. Comput. Sci. 27 491
[20] Santoso H B, Schrepp M, Isal R Y K, Utomo A Y and Priyogi B 2016 J. Educ. Online 13 1
[21] Kadastik J, Artla T and Schrepp M 2018 Conf. Rural Env. Educ. 11 281