Measuring User Experience of the Student-Centered e-Learning Environment

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Abstract

The aim of the current study is to develop an adapted version of User Experience Questionnaire (UEQ) and evaluate a learning management system. Although there is a growing interest on User Experience, there are still limited resources (i.e. measurement tools or questionnaires) available to measure user experience of any products, especially learning management systems. Two hundreds and thirteen computer science students participated and completed the adapted version of UEQ. In the study, the researchers used a learning management system named Student Centered e-Learning Environment (SCELE). Several types of learning materials are posted in SCELE such as audio files, simulations, PowerPoint slides, multimedia contents, and webpage links. Most of the lecturers use discussion forums in their courses to encourage students to participate in active learning setting. Staff and lecturers sometimes post academic-related announcements on the SCELE homepage. Two hundred thirteen students enrolled in Computer Science program were invited to evaluate the SCELE. This study will benefit UX practitioners, HCI educators, program and center of learning resources administrators, and learning management system developers. Findings of the present study may also be valuable for universities and high schools which are using computer-based learning environments.

Keywords: User experience; measurement; student-centered learning; learning management systems, online learning

INTRODUCTION

Research and development in the field of UX has been growing rapidly. The term User Experience (UX) is commonly used by researchers and practitioners in many fields, though the single definition of this term is not yet established. This lack of clarity can be understood by the fact that there are many subjects involved in UX and it is used to describe a wide range of topics. Regardless of the controversy, researchers agree that UX is a result of an interaction between the user, the system, and the context (Lallemand, Gronier, & Koenig, 2015).

Rogers, Sharp, and Preece (2012) stated that "There are many aspects of the user experience that can be considered and ways of taking them into account when designing interactive products. Of central importance are the usability, the functionality, the aesthetics, the content, the look and feel, and the sensual and emotional appeal" (p. 15). One of the widely accepted definitions of UX, as explained in usability.gov, is an aspect that focuses to understand the users' needs. It also includes the business objectives. The good UX promotes the high quality interaction between the users and the system (usability.gov). There are two approaches to study UX, qualitative and quantitative, both measurements have distinct benefits (Law, Schaik, & Roto, 2014).

Measurement is an important aspect in UX. It could give an insight into users' perception about specific aspects in the system (Thayer & Dugan, 2009). By performing measurement, researchers can formally formulate the needs of system development and improvement. It mainly focuses on choosing the best design, ensuring that the development is in right path, and making sure that it will fulfill the targeted users' needs (Vermeeren et. al., 2010). The methodology

suggested for user experience analysis consists of a mixture of different quantitative and qualitative methods, e.g., the use of interview, questionnaire, behavioral analysis, and expert evaluation (Bevan, 2014).

There are many kinds of user experience research frameworks in the market. A few are: Questionnaire for User Interaction Satisfaction (QUIS), The Standardized User Experience Percentile Rank Questionnaire (SUPR-Q), System Usability Scale (SUS), and Software Usability Measurement Inventory (SUMI). All of them have their own purposes for use as well as advantages and disadvantages.

QUIS is a proprietary framework that works well on general usability in a system (http://lap.umd.edu/quis/). It is similar to SUS in terms of generality. SUS is free and simple to use for measuring system's ease of use (http://www.usability.gov). On another side, its scoring method is quite difficult and the result is too general; thus, it cannot be used to conduct deep analysis. QUIS is leading SUS in the case of detailed validation support availability, and thus users can use the support to validate the questionnaire results accurately.

The two other frameworks, SUPR-Q and SUMI, are proprietary frameworks that give helpful tools to analyze the questionnaire result. SUMI can be used to measure the usability in a wide range of systems (http://sumi.ucc.ie/), while SUPR-Q is a more specific framework to be used for evaluating websites. SUPR-Q also provides the clients with a dataset of many other websites' score so that clients can compare their score to others (http://www.suprq.com/).

Compared to these four frameworks, User Experience Questionnaire (UEQ) provides exceptional advantages. The UEQ provides a comprehensive impression of user experience, ranging from classical usability aspects to user experience aspect. It also presents an analytical

tool to accurately interpret the result easily. The best of all, it is free to use without any fees (http://www.ueq-online.org/).

Although user experience measurements have been used to evaluate any products, there is still limited effort to evaluate learning management systems. Any evaluation effort to measure their usability are usually taken from students' perspectives. This issue is critical because the quality of learning management systems usage will affect students' learning performance while learning online. The purposes for this current study were: (1) to understand students' user experience while using a learning management system in Computer Science education; (2) to apply multi-methods approach in evaluating students' user experience; and (3) to provide recommendations for improving a learning management system. This study will not only benefit the learning management system developers, but also students in the future for better learning experiences in computer-based learning environments.

USER EXPERIENCE QUESTIONNAIRE

User Experience describes the subjective feelings of users towards products they use. Different users or user groups may have different impressions concerning the user experience of the same product. Thus, measuring user experience typically requires collecting feedback of a larger group of users. This can be done most efficiently with questionnaires, especially if such questionnaires are used as an online tool.

The main goal of the User Experience Questionnaire (UEQ) is to allow a fast and immediate measurement of user experience of interactive products (Laugwitz, Held, & Schrepp, 2008). UEQ has already been applied in a variety of research contexts, for example for the evaluation of business software (Rauschenberger, Hinderks, & Thomaschewski, 2011),

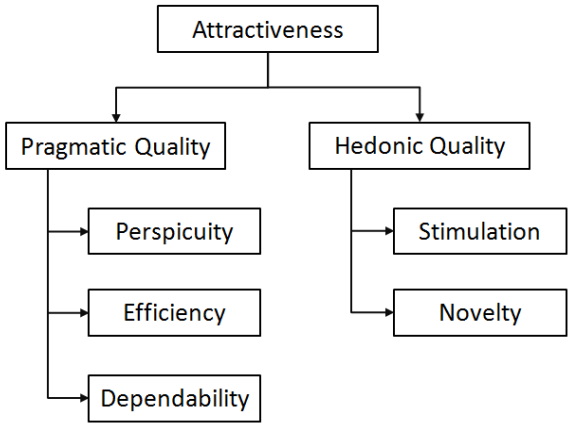
development tools (Wieschnowsky & Heiko Paulheim, 2011), web sites and web services (Hartmann, 2011), or social networks (Hartmann, 2011).

The user experience questionnaire contains six scales with 26 items in total:

1) **Attractiveness**: General impression towards the product. Do users like or dislike the product? This scale is a pure valence dimension. *Items: annoying / enjoyable, good / bad, unlikable / pleasing, unpleasant / pleasant, attractive / unattractive, friendly / unfriendly.*
2) **Efficiency**: Is it possible to use the product fast and efficiently? Does the user interface look organized*? Items: fast / slow, inefficient / efficient, impractical / practical, organized / cluttered.*
3) **Perspicuity**: Is it easy to understand how to use the product? Is it easy to get familiar with the product*? Items: not understandable / understandable, easy to learn / difficult to learn, complicated / easy, clear / confusing.*
4) **Dependability**: Does the user feel in control of the interaction? Is the interaction with the product secure and predicable? *Items: unpredictable / predictable, obstructive / supportive, secure / not secure, meets expectations / does not meet expectations.*
5) **Stimulation**: Is it interesting and exciting to use the product? Does the user feel motivated to further use the product? *Items: valuable / inferior, boring / exiting, not interesting / interesting, motivating / demotivating.*
6) **Novelty**: Is the design of the product innovative and creative? Does the product grab the attention of users? *Items: creative / dull, inventive / conventional, usual / leading edge, conservative / innovative.*

Perspicuity, *Efficiency* and *Dependability* are goal-oriented, pragmatic quality aspects. *Stimulation* and *Novelty* are non-goal oriented, hedonic quality aspects (Hassenzahl, 2001).

Attractiveness is a pure valence dimension. It is assumed that the users' impression concerning the *Attractiveness* scale forms from his or her impression concerning the other scales. Figure 1 shows the assumed scale structure of the UEQ.



Scale structure of the UEQ.

The items and scales of the UEQ were created by a data analytical approach. For the first step, a set of 229 potential items was built as a result of two brainstorming sessions with a larger group of usability experts. This set of potential items was reduced to 80 items by an expert evaluation with the same set of experts. Then the eighty raw-version items of the questionnaire were used in several studies focusing on the quality of interactive products, including, e. g., a statistics software package, cell phone address book, online-collaboration software, or business software. In total, the data of 153 participants were collected for the initial data set. Finally, the scales and the items representing each scale were extracted from the data by factor analysis (principal components, varimax rotation). The six factors of the UEQ were the results from this analysis (Laugwitz, Held, and Schrepp, 2006, 2008).

The reliability (i.e., the scales are consistent) and validity of the UEQ scales were investigated in several studies (in 11 usability tests with a total number of 144 participants and an online survey with 722 participants). A review of all available studies showed that reliability

(Cronbach's Alpha was used for an estimation of internal consistency) of the scales was sufficiently high. In addition, the results of several studies indicated a good construct validity of the scales (Laugwitz, Held, & Schrepp, 2008; Laugwitz, Schrepp, & Held, 2006; Laugwitz, Schubert, Ilmberger, Tamm, Held, & Schrepp, 2009). The items of the questionnaire are realized as a semantic differential, i.e. each item consists of a pair of terms with opposite meaning. An example is the following item:

easy to learn o o o o o o o *difficult to learn*

The items are scaled from -3 to +3. Thus, -3 represents the most negative answer, 0 a neutral answer, and +3 the most positive answer. Scale values above +1 indicate a positive impression of the users concerning this scale, values below -1 a negative impression. Due to well-known answer effects, like the avoidance of extremes, observed scales means are generally in the range of -2 to +2. More extreme values are rarely observed, so a value near +2 represents a very positive, near optimal, impression of participants.

In addition to this interpretation, a benchmark can be used to compare the results of a product measured with the UEQ to the results of other products. The first published benchmark (Schrepp, Olschner, & Schubert, 2013) data set for the UEQ contained data from 163 product evaluations. These evaluated products covered a wide range of applications. The benchmark contained complex business applications (98), development tools (4), web shops or services (37), social networks (3), mobile applications (13), and several other products (8). The questionnaire, together with information concerning its application, and an Excel-Tool for data analysis is available free of charge on www.ueq-online.org.

Table 1

The UX Questionnaire items (the English/original version)

	1	2	3	4	5	6	7		
annoying	○	○	○	○	○	○	○	enjoyable	1
not understandable	○	○	○	○	○	○	○	understandable	2
creative	○	○	○	○	○	○	○	dull	3
easy to learn	○	○	○	○	○	○	○	difficult to learn	4
valuable	○	○	○	○	○	○	○	inferior	5
boring	○	○	○	○	○	○	○	exciting	6
not interesting	○	○	○	○	○	○	○	interesting	7
unpredictable	○	○	○	○	○	○	○	predictable	8
fast	○	○	○	○	○	○	○	slow	9
inventive	○	○	○	○	○	○	○	conventional	10
obstructive	○	○	○	○	○	○	○	supportive	11
good	○	○	○	○	○	○	○	bad	12
complicated	○	○	○	○	○	○	○	easy	13
unlikable	○	○	○	○	○	○	○	pleasing	14
usual	○	○	○	○	○	○	○	leading edge	15
unpleasant	○	○	○	○	○	○	○	pleasant	16
secure	○	○	○	○	○	○	○	not secure	17
motivating	○	○	○	○	○	○	○	demotivating	18
meets expectations	○	○	○	○	○	○	○	does not meet expectations	19
inefficient	○	○	○	○	○	○	○	efficient	20
clear	○	○	○	○	○	○	○	confusing	21
impractical	○	○	○	○	○	○	○	practical	22
organized	○	○	○	○	○	○	○	cluttered	23
attractive	○	○	○	○	○	○	○	unattractive	24
friendly	○	○	○	○	○	○	○	unfriendly	25
conservative	○	○	○	○	○	○	○	innovative	26

Applying the UEQ does not require much effort. Usually 3-5 minutes (Schrepp, Olschner, & Schubert, 2013) is sufficient for a participant to read the instruction and to complete the questionnaire. Analyzing the data can be done quite efficiently with the provided Excel-sheet. Table 1 (see above) shows the English (original) version of the UEQ.

Development of Indonesian Version of the UEQ

For semantic differentials, like the UEQ, it is of course important that participants can read the items in their natural language. Thus, several language versions of the questionnaire were constructed and validated (for example, English, Spanish (Rauschenberger, Schrepp, Olschner, Thomaschewski, & Cota, 2012), Portuguese (Pérez Cota; Thomaschewski, Schrepp, Goncalves, Ramiro, 2014), etc.). These versions are freely available on www.ueq-online.org.

The adaptation process followed these guidelines: *First*, an Indonesian native speaker translates the items from English to an Indonesian draft version. *Second*, a second person that does not know the English version translates the Indonesian draft version back to English. If possible use an English native speaker, but that is not really crucial. Important is that the second person is not familiar with the English version and thus translates back independently. *Third*, if the translation from the Indonesian draft back to English produces the original English item, everything is OK and you can take the translation for the Indonesian final version. If not the two persons have to discuss where the discrepancy comes from and have to agree on a solution.

We describe in this paper the adaption of the UEQ to Indonesian language and its first usage to measure the user experience of SCELE. The Indonesian questionnaire version is freely available (i.e., can be downloaded and used from the website without any costs). Sample items of the questionnaire can be found on Table 2.

Table 2
The User Experience Questionnaire items (Indonesian version)

	1	2	3	4	5	6	7		
menyusahkan	○	○	○	○	○	○	○	menyenangkan	1
tak dapat dipahami	○	○	○	○	○	○	○	dapat dipahami	2
kreatif	○	○	○	○	○	○	○	monoton	3
mudah dipelajari	○	○	○	○	○	○	○	sulit dipelajari	4
bermanfaat	○	○	○	○	○	○	○	kurang bermanfaat	5
membosankan	○	○	○	○	○	○	○	mengasyikkan	6
tidak menarik	○	○	○	○	○	○	○	menarik	7
tak dapat diprediksi	○	○	○	○	○	○	○	dapat diprediksi	8
cepat	○	○	○	○	○	○	○	lambat	9
berdaya cipta	○	○	○	○	○	○	○	konvensional	10
menghalangi	○	○	○	○	○	○	○	mendukung	11
baik	○	○	○	○	○	○	○	buruk	12
rumit	○	○	○	○	○	○	○	sederhana	13
tidak disukai	○	○	○	○	○	○	○	menggembirakan	14
lazim	○	○	○	○	○	○	○	terdepan	15
tidak nyaman	○	○	○	○	○	○	○	nyaman	16
aman	○	○	○	○	○	○	○	tidak aman	17
memotivasi	○	○	○	○	○	○	○	tidak memotivasi	18
memenuhi ekspektasi	○	○	○	○	○	○	○	tidak memenuhi ekspektasi	19
tidak efisien	○	○	○	○	○	○	○	efisien	20
jelas	○	○	○	○	○	○	○	membingungkan	21
tidak praktis	○	○	○	○	○	○	○	praktis	22
terorganisasi	○	○	○	○	○	○	○	berantakan	23
atraktif	○	○	○	○	○	○	○	tidak atraktif	24
ramah pengguna	○	○	○	○	○	○	○	tidak ramah pengguna	25
konservatif	○	○	○	○	○	○	○	inovatif	26

MEASURING USER EXPERIENCE USING INDONESIAN VERSION OF UEQ

Participants and Context of the Study

In the present research, the authors used the Indonesian version of the UEQ to measure user experience of Student Centered E-Learning Environment (SCELE), a Moodle-based learning management system (LMS) (Hasibuan & Santoso, 2005). The SCELE is mainly used for getting learning materials from the instructors and to communicate effectively among students and also between students and instructor. The SCELE was designed to support student-centered learning paradigm where students have to construct knowledge actively. Furthermore, promoting social interaction in the online discussion forum is essential during the learning process with peers.

Two hundred thirteen Computer Science students at a university in Indonesia participated and completed the Indonesian UEQ. They were informed about the purposes and methods of the study. Participants have been using SCELE for years. Instructors use SCELE to facilitate teaching and learning activities outside the classroom. They can upload learning materials, post questions on discussion forums, and set up quizzes and assignments. Figure 1 shows the interface of SCELE. The current study uses the UEQ and open-ended questions to evaluate user experience of the students while using SCELE.

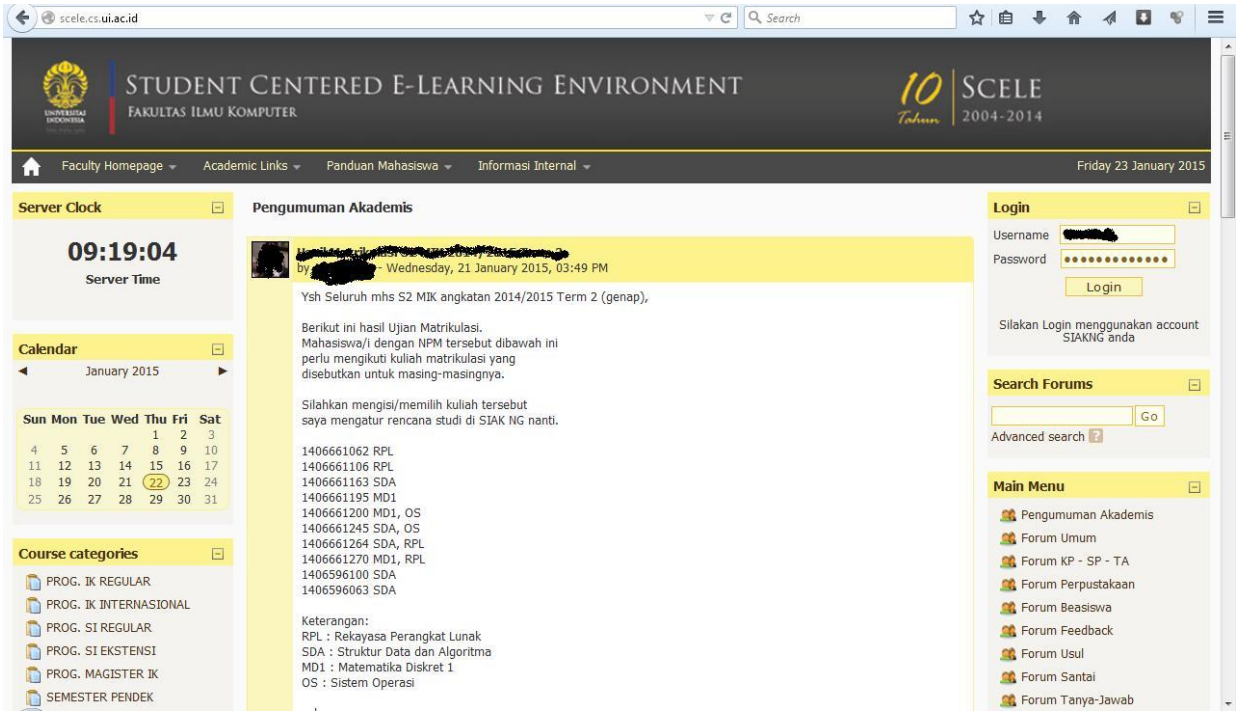


Figure 2. Interface of SCELE Homepage at Faculty of Computer Science Universitas Indonesia

Open-ended questions regarding SCELE usability were constructed and delivered to the students. In addition, semi-structured interview sessions were conducted and students' perceptions from Eight Golden Rules (Shneiderman, & Plaisant, 2010) were gathered to complement the findings from the UEQ.

Instrumentation

Reliability of the UEQ scales is typically high, i.e., the Cronbach-Alpha coefficient is typically greater than 0.7. Those scales were translated into Indonesian as follows: Daya Tarik, Kejelasan, Efisiensi, Ketepatan, Stimulasi, dan Kebaruan.

Data Collection Procedures and Analysis

Data collection included quantitative and qualitative data. The researcher gathered quantitative data from the online UEQ and open-ended questions related to students' perception about SCELE. Qualitative data were collected using interviews and expert judgment. The students

did not have to use a username and password to access the online questionnaire. The students were asked to reflect on SCELE before completing the UEQ. They could complete the questionnaire within 10-15 minutes. From data collection process, the UEQ was completed by 213 students and open-ended questions were completed by 99 students.

Analysis of the UEQ was conducted by calculating the means of the six scales. The UEQ does not produce an overall score for the user experience. Because the construction of the UEQ is by factor analysis (principal components, varimax rotation) (Laugwitz, Held, & Schrepp, 2008), it does not make sense to build such an overall score (for example, by calculating the mean over all scales) since this value cannot be interpreted properly.

In the standard interpretation, values between -0.8 and 0.8 represent a neural evaluation of the corresponding dimension, while values more than 0.8 represent a positive evaluation and values less than -0.8 represent a negative evaluation. The range of the scales is between +3 (*positive extreme*) and -3 (*negative extreme*). Due to typical answer tendencies in such questionnaires (people usually avoid the extreme answer categories), values between 1.5 and 2 already indicate a very good quality.

Findings

This section presents the findings of the evaluation of UEQ Indonesian Version. Findings from the UEQ showed that the scores for all scales describing a pragmatic quality aspect (Efficiency, Perspicuity, Dependability) are good, i.e., above 0.800 (see Figure 3). The scales describing hedonic quality (Stimulation and Originality), i.e., fun of use, show neutral evaluations.

The small ranges for the confidence intervals (bars in Figure 3) indicate that the measured scale means were quite accurate. Moreover, reliability of the UEQ scales is high. The Cronbach-

Alpha coefficients are 0.81 for *Attractiveness*, 0.78 for *Perspicuity*, 0.74 for *Efficiency*, 0.58 for *Dependability*, 0.64 for *Simulation* and 0.72 for *Originality*. Thus, these values indicate a sufficient scale consistency. Only the value for *Dependability* is a little bit weak, which can be due to the fact that this property does not play such an important role for the user experience of a learning platform or due to problems with the interpretation of the items in this scale.

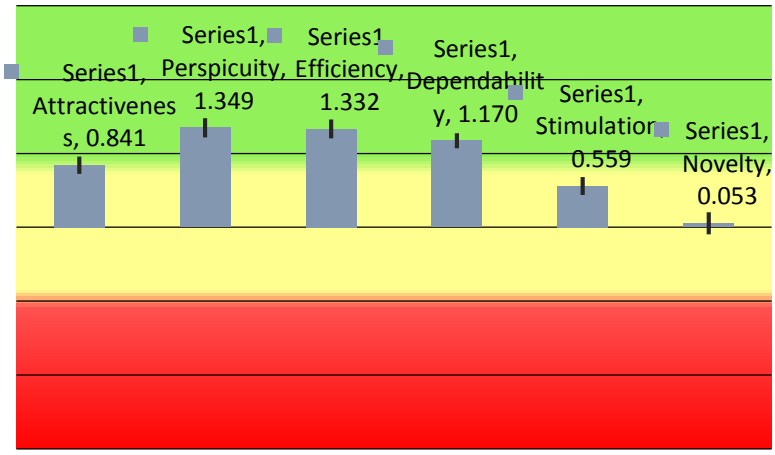


Figure 3. Graph of the six UEQ Scales

The students' responses to open-ended questions may explain the findings from the UEQ. The findings from questions answered by 99 students revealed four issues. *First*, regarding the benefits of using SCELE for learning, among 290 responses gathered, most respondents stated that SCELE helps them to assess learning materials (26%). They also stated that to gather/spread academic news/information is becoming an easier task (22%). SCELE can also facilitate online discussion forums (19%). To submit assignments is also becoming an easier task (15%). Thus, three of the four highest-rated benefits deal with points that make life easier or increase efficiency. This corresponds well to the data from the UEQ, where SCELE was positively perceived on the three pragmatic quality aspects. *Second*, regarding the challenges while using SCELE, it was revealed that among 189 responses, user willingness to access was the most challenging one

(15%). In addition, the other challenges were: there is no notification for new updates (13.2%), Internet connectivity (11.6%), and the user interface is quite boring/not quite user friendly (9.0%). The statement concerning the boring user interface corresponds to the neutral evaluation of the UEQ scales Stimulation and Novelty. *Third*, regarding the most important features of SCELE, 25% of 308 responses stated that discussion forum is the most important feature. The finding also reflects the pragmatic quality aspect of the UEQ. Instructors use discussion forums to facilitate communication among the students at any time and between instructor and class participants. The online discussion forum benefits the students in sharing and constructing their knowledge outside the classroom. *Fourth*, regarding the least important features of SCELE, 23% of 209 responses revealed that message (inbox) is the least important feature on SCELE. Detailed findings can be found on Tables 3 – 6 below.

Table 3
The Benefits of Using SCELE for Learning (n responses: 290)

Benefits	**Percentage**
To access/distribute learning materials is becoming an easy task	26.0 %
It can facilitate online discussion forum	19.0 %
To submit assignments is becoming an easy task	15.0 %
To gather/spread academic news/information is becoming an easy task	22.0 %
It provides organized repository for students to find previous version of learning materials and assignments	6.0 %
It serves as due date reminder	5.0 %
It encourages online class participation	1.0 %
It evaluates online class participation	0.7 %
It makes learning activity more easy	0.7 %
It can be considered as all-in-one media for learning activity	0.3 %
It is easy to maintain up-to-date-ness of material	0.3 %

Other advantages	4.5 %

Table 4

Challenges while Using SCELE (n responses: 189)

Challenges	**Percentage**
There is no notification for new updates	13.2 %
It is quite difficult to find courses	4.8 %
The user interface is quite boring/not quite user friendly	9.0 %
There is no challenge/difficulty	2.1 %
Discussion forums are unorganized	1.6 %
It is quite difficult to upload images to discussion forum	0.5 %
It is inefficient or slow to access information	5.3 %
User willingness to access	15.0 %
Internet connection	11.6 %
Mobile device compatibility	7.4 %
Site downtime when high access traffic	6.9 %
Limited post's edit time	5.3 %
Need user's learning effort and time	3.7 %
Compatibility across different browser (text editor, post format)	3.2 %
User's privacy	1.6 %
Content quality	1.0 %

Table 5

Most Important Features of SCELE (n responses: 308)

Most important features	**Percentage**
Discussion forum	25.0 %
Calendar	19.8 %
Assignment submission tool	21.4 %

Course page view	5.2 %
Download learning materials	14.9 %
Academic news	5.8 %
Course enrollment	3.2 %
Activity notification	1.9 %
Server clock	0.6 %
Search function	0.6 %
Message tool	0.6 %
Other features	0.6 %

Table 6

Least Important Features of SCELE (n responses: 209)

Least important features	**Percentage**
Message (inbox)	23.0 %
Grades	13.4 %
Everything is important	10 %
Automatic logout	2.4 %
Server clock	1.9 %
Profile	8.1 %
Non-academic forum	11.5 %
Online quiz	3.3 %
Enrollment key	2.9 %
Marking submission	2.4 %
Links to other resources	5.7 %
Notification	1.9 %
Recent activity	1.4 %
Other features	12.0 %

CONCLUSION

The User Experience and Human-Computer Interaction fields in Indonesia is currently growing. The current work is part of the efforts to support HCI development in the region and disseminate the significance of measurement in UX and HCI. The paper has described the adaptation process of the User Experience Questionnaire (UEQ) utilized in the Indonesian survey version. Other versions of the questionnaire have been available to use, such as, Spanish, Turkish, Portuguese, and Chinese. The UEQ can be used to measure user experience of interactive products, including web-based applications. It captures the pragmatic as well as the hedonic quality aspects of the interactive products. The questionnaire also allows user experience responses to be gathered from relatively large number of respondents.

The results of the study showed that the scales of the translated Indonesian version of the survey showed (with one exception) sufficient consistency. Although the translated version must also be proven in further studies with other types of products to get a more complete picture, the use of this version for practical product evaluations appears viable.

The results of validation revealed that, while the scores for all scales describing a pragmatic quality aspect were good, the scales describing hedonic quality showed neutral evaluations. The findings were also supported by students' answers to open-ended questions. Moreover, the measurement results provide additional insights into future development of the SCELE learning management system.

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