Evaluating an e-Learning Platform at Graduate School Based on User Experience Evaluation Technique

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Abstract. This study was aimed to evaluate the e-learning platform in a graduate school by using User Experience Questionnaire (UEQ). The data were collected from 65 respondents and analyzed using an excel data analysis tool. The results indicate that all six scales of the instrument are consistent except the novelty scale. Also, the calculated means of the scales are slightly positive as all values are greater than 0.8 compared to the UEQ benchmark. Although the respondents show a little positive impression with the platform, all scales means are below average category except efficiency scale which is above average as compared to the benchmark. This indicates that the platform needs more improvement in all aspects of user experience for it to be at least in a good category. The findings discussed in this paper are valuable for all academic stakeholders in various educational institutions which implement interactive e-learning systems as well as practitioners of user experience and developers of e-learning systems.

1. Introduction

1.1. Study background
The rapid advancement of science and technology, especially information and communication technology (ICT), is a fact which cannot be denied. The existence of ICT makes human life easier than some decades ago. The development of ICT covers various fields of life, one of which is the educational aspect [1–5]. Along with time, ICT increasingly shows its glory in education industry. The development of ICT encourages various educational institutions to use e-learning systems to increase the effectiveness and flexibility of learning.

Although many research results show that the effectiveness of learning using an e-learning system tends to be the same when compared to conventional or classical learning, but the benefits that can be obtained by e-learning are in terms of its flexibility [6,7]. Flexibility is the key word in e-learning systems. Students become very flexible in choosing the time and place of study because they do not have to come somewhere at a certain time. On the other hand, lecturers can update their learning material anytime and from anywhere. In terms of content, learning materials can be made very flexible starting from text-based lecture materials to learning materials that are loaded with multimedia components. However, the quality of learning with e-learning is also very flexible or varied, which can be worse or better than conventional learning systems. Through e-learning, learning materials can be
accessed anytime and from anywhere, besides that material that can be enriched with various learning resources including multimedia can be quickly updated by the instructor [7]. The use of e-learning can also save time and money, other benefits is that of its interactivity and user friendly.

The implementation of e-learning systems that exist today is very varied, but all of it is based on a principle that e-learning is intended as a means to distribute learning material via electronic media or the Internet so that students can access it anytime from all corners of the world. The important factor of learning by e-learning is the creation of a flexible and distributed learning environment [8]. So, to get a good and interactive e-learning system a good design is needed too.

In Yogyakarta State University (YSU), e-learning has been implemented through e-learning platform called Be-smart. Be-smart is an interactive electronic learning media accessed through the internet aimed for communication, interaction, and engagement between YSU students and lecturers. The platform was developed in 2006 by one of the lecturers of the Informatics Engineering at the Faculty of Engineering based on Modular Object-Oriented Dynamic Learning Environment (MOODLE), a world-famous software package that is used for the development of internet electronic learning media. Moodle uses the principle of social constructionist pedagogy, which is the best way to learn according to the student’s own perspective. Moodle was developed based on the Learning Management System (LMS), an online education database management system. The reason to build be-smart is to facilitate the relationship between lecturers and students in teaching and learning activities and to follow the development of learning technology [7].

Despite the benefits of any e-learning platform provides, there is still a need for its evaluation during and after its development for it to be sustainable in the future. This is because there are still few users using the e-learning platform at YSU beyond expectation since the introduction of the said platform. Evaluation is one of the important steps in the process of developing an e-learning system. Evaluation process is intended to determine the quality of e-learning. To know the quality of a learning system how good it is, there is a need to know the criteria [6]. Web-based learning products such as e-learning are unique compared to other products, so the evaluation criteria for determining quality are of course different.

So, this study is aimed to evaluate an e-learning system based on user experience questionnaire (UEQ) approach. Eventually, the goal of this study is: (1) to apply and support the reliability of UEQ especially an Indonesian version, when evaluating e-learning platforms; (2) to understand user experience of both lecturers and students while using e-learning platform; (3) to give suggestions on where to improve the e-learning platform. Specifically, this study presents the UX results of both lecturers and students contrary to previous studies which involved only students’ perception towards e-learning systems.

1.2. Review on user experience evaluation (UXE)
Evaluating user experience (UX) is tricky since there are many dimensions in UX. High quality of UX, is a key competitive factor of any system development. It is a subjective physical and emotional feeling of the user that builds up when a user interacts with the e-learning platform. To improve the UX of the e-learning platform, it requires a strategic evaluation approach where conventional methods are not adequate for UX evaluation [9].

User experience evaluation (UXE) using user experience questionnaire (UEQ) is the popular evaluation technique used in web-based products evaluation. UXE is a collection of tools and methods utilized to discover how an individual is impressed and perceives a software product, service, or system before, during, and after interacting with it. It is vital to evaluate user experience as user experience is context-dependent, subjective, and dynamic over time. Since UX happens in every step of the process when users use an e-learning platform, it is crucial to have good UX for the sustainability of the platform [10,11].

The UEQ approach gathers feedback from e-learning system users using questionnaire items which allow a respondent to have enough time to think and fill the questionnaires. The scales in UEQ are designed purposely to handle the comprehensive user experience impression [12,13]. The format of
the UEQ supports users’ immediate responses, expressing their impressions, feelings, and attitude towards the e-learning system before, during, and after its use. UEQ makes users to answer questions promptly and spontaneously, so making inquiries with in-depth material and avoid abstract statements about products or system. The selection of UEQ questions is very simple and can be answered as soon as possible by the user. UEQ uses six relevant scales or components namely efficiency, dependability, perspicuity (transparency), novelty, stimulation, and attractiveness. Also, there is a total of twenty-six items for measuring UX [9,12,14]. So, this method is simple which does not need respondents to think for a long time to answer the questionnaire.

Despite various studies have implemented UEQ to evaluate different web-based systems, but, most of them focused on consumer products other than e-learning systems such as e-commerce mobile application platform [15], re-design of the User Interface of mobile smartphone applications [16], design process of mobile phones [17], and many others such as [18–22]. Few studies have focused their evaluation on LMS such as that of Edmodo e-Learning system by [23] and another by [24], but, they lack to include the lecturers’ perception of those LMS.

Thus, in this study, User experience evaluation (UXE) approach is used to evaluate the e-learning platform specifically involving both students and lecturers’ UX contrary to previous studies which involved only students’ UX. In this evaluation approach, specific methods and tools are utilized to reveal how users perceive the said e-learning platform. The rationale of using this evaluation method is because it pertains almost all aspects of user experience (UX) including hedonic, ergonomics (pragmatic), and aesthetics (attractiveness). This study will be beneficial to all stakeholders of e-learning system in the whole institution including developers for better improvement of the platform, benefiting both lecturers and students for better learning engagement and interaction. Moreover, the study contributes to theoretical knowledge of UX especially when evaluating e-learning systems using Indonesian version of UEQ providing valuable insights and directions for future research in the same discipline of UX.

2. Methodology

A quantitative methodological approach is used in this current study and the UEQ (Indonesian version) was used to collect responses from users of the e-learning platform at Yogyakarta State University especially in a graduate school.

2.1. Instrument and data collection

This study implemented the Indonesian version of UEQ as most of the participants are native Indonesians. This was to make sure that the items (questions) of the questionnaire are understood and made clearer than using the English version. This version of the questionnaire was first developed and used in the study conducted in Indonesia to measure UX of the learning management system [24]. This version of the questionnaire was derived from the English version. UEQ is enriched with additional tools which make it reliable, fast, and simple to use when measuring UX of interactive and engaging systems or products. The questionnaire is available in more than twenty-two languages [12].

UEQ consists of six scales with twenty-six items reflecting the basic components (scales). The validation of the scales and the consistency of scales (reliability) was done in previous conducted studies [9,13,25]. The six scales of UEQ contain extensive aspects of user experience impression including attractiveness, and both UX aspects (stimulation and novelty) and traditional usability features (dependability, efficiency, and perspicuity). That is to say, the questionnaire has three main quality features namely hedonic, attractiveness, and pragmatic quality features [10]. This can be seen in the Figure 1 below.
Below is the explanation of the six scales of UEQ questionnaire and their corresponding items [12,25]:

1) **Attractiveness**: This scale is completely valence dimension of a user. It is the overall impression of users towards e-learning system. Do users like or dislike the system? Items: attractive/unattractive, unlikable /pleasing, unpleasant /pleasant, friendly /unfriendly, good /bad, annoying /enjoyable.

2) **Dependability**: Do users feel in control of the interaction with the system? Is a system predictable and secure? Items: secure / not secure, unpredictable / predictable, meets expectations / does not meet expectations, obstructive / supportive.

3) **Efficiency**: Does the system allow users to carry out their tasks without needing a lot of effort? Is the reaction of the system fast enough? Items: inefficient / efficient, fast / slow, organized / cluttered, impractical / practical.

4) **Perspicuity**: Is a system clear, easy to learn, understand and simple to get familiar with and use it? Items: clear / confusing, not understandable / understandable, complicated /easy, easy to learn /difficult to learn.

5) **Novelty**: Is the design of the system creative and innovative? Is it interesting to users and catches their attention? Items: conservative /innovative, creative /dull, usual /leading edge, inventive /conventional.

6) **Stimulation**: Do users feel motivated and excited to use the system? Is there enjoyment and fun to use it? Items: motivating /demotivating, valuable /inferior, boring /exciting, not interesting /interesting.

All versions of UEQ of several languages like English are available for free to download and use for evaluation needs of various software products [12]. In this study, the questionnaire was formulated and transformed to google form and distributed through online via emails and WhatsApp groups. So, the link of the google form was shared to various users (students and lecturers) of the be-smart e-learning platform. The questionnaire was accompanied with a little introduction of the UEQ and the example was given on how to fill and what is the interpretation of the particular response. All available versions (Languages) of UEQ questionnaire are available on www.ueq-online.org, and have been created and validated in various studies [10,11,24].

The Table 1 and 2 below are an Indonesian (used in this study) and English version of UEQ questionnaire items.
| Table 1. Indonesian version of UEQ questionnaire [24]. |
|------------------------------------------------------|
| menyesahan  | 0 | 0 | 0 | 0 | 0 | 0 | menyenangkan |
| tak dapat dipahami | 0 | 0 | 0 | 0 | 0 | 0 | dapat dipahami |
| kreatif | 0 | 0 | 0 | 0 | 0 | 0 | monoton |
| mudah dipelajari | 0 | 0 | 0 | 0 | 0 | 0 | sulit dipelajari |
| bermanfaat | 0 | 0 | 0 | 0 | 0 | 0 | kurang bermanfaat |
| membosankan | 0 | 0 | 0 | 0 | 0 | 0 | mengasalkan |
| tidak menarik | 0 | 0 | 0 | 0 | 0 | 0 | menarik |
| tak dapat diprediksi | 0 | 0 | 0 | 0 | 0 | 0 | dapat diprediksi |
| cepat | 0 | 0 | 0 | 0 | 0 | 0 | lambat |
| berdaya cipta | 0 | 0 | 0 | 0 | 0 | 0 | konvensional |
| menghargai | 0 | 0 | 0 | 0 | 0 | 0 | mendukung |
| baik | 0 | 0 | 0 | 0 | 0 | 0 | buruk |
| rumit | 0 | 0 | 0 | 0 | 0 | 0 | sederhana |
| tidak disukai | 0 | 0 | 0 | 0 | 0 | 0 | menggembirakan |
| lazim | 0 | 0 | 0 | 0 | 0 | 0 | terdepan |
| tidak nyaman | 0 | 0 | 0 | 0 | 0 | 0 | nyaman |
| aman | 0 | 0 | 0 | 0 | 0 | 0 | tidak aman |
| memotivasi | 0 | 0 | 0 | 0 | 0 | 0 | tidak memotivasi |
| memenuhi ekspektasi | 0 | 0 | 0 | 0 | 0 | 0 | tidak memenuhi ekspektasi |
| tidak efisien | 0 | 0 | 0 | 0 | 0 | 0 | efisien |
| jelas | 0 | 0 | 0 | 0 | 0 | 0 | membingungkan |
| tidak praktis | 0 | 0 | 0 | 0 | 0 | 0 | praktis |
| terorganisasi | 0 | 0 | 0 | 0 | 0 | 0 | berantakan |
| atraktif | 0 | 0 | 0 | 0 | 0 | 0 | tidak atraktif |
| ramah pengguna | 0 | 0 | 0 | 0 | 0 | 0 | tidak ramah pengguna |
| konservatif | 0 | 0 | 0 | 0 | 0 | 0 | inovatif |

| Table 2. English version of UEQ [25] |
|-------------------------------------|
| annoying | 0 | 0 | 0 | 0 | 0 | 0 | enjoyable |
| not understandable | 0 | 0 | 0 | 0 | 0 | 0 | understandable |
| creative | 0 | 0 | 0 | 0 | 0 | 0 | dull |
| easy to learn | 0 | 0 | 0 | 0 | 0 | 0 | difficult to learn |
| valuable | 0 | 0 | 0 | 0 | 0 | 0 | inferior |
| boring | 0 | 0 | 0 | 0 | 0 | 0 | exciting |
| not interesting | 0 | 0 | 0 | 0 | 0 | 0 | interesting |
| unpredictable | 0 | 0 | 0 | 0 | 0 | 0 | predictable |
| fast | 0 | 0 | 0 | 0 | 0 | 0 | slow |
| inventive | 0 | 0 | 0 | 0 | 0 | 0 | conventional |
| obstructive | 0 | 0 | 0 | 0 | 0 | 0 | supportive |
| good | 0 | 0 | 0 | 0 | 0 | 0 | bad |
| complicated | 0 | 0 | 0 | 0 | 0 | 0 | easy |
| unlikable | 0 | 0 | 0 | 0 | 0 | 0 | pleasing |
| usual | 0 | 0 | 0 | 0 | 0 | 0 | leading edge |
| unpleasant | 0 | 0 | 0 | 0 | 0 | 0 | pleasant |
| secure | 0 | 0 | 0 | 0 | 0 | 0 | not secure |
| motivating | 0 | 0 | 0 | 0 | 0 | 0 | demotivating |
| meets expectations | 0 | 0 | 0 | 0 | 0 | 0 | does not meet expectations |
| inefficient | 0 | 0 | 0 | 0 | 0 | 0 | efficient |
| clear | 0 | 0 | 0 | 0 | 0 | 0 | confusing |
| impractical | 0 | 0 | 0 | 0 | 0 | 0 | practical |
| organized | 0 | 0 | 0 | 0 | 0 | 0 | cluttered |
| attractive | 0 | 0 | 0 | 0 | 0 | 0 | unattractive |
| friendly | 0 | 0 | 0 | 0 | 0 | 0 | unfriendly |
| conservative | 0 | 0 | 0 | 0 | 0 | 0 | innovative |
2.2. Participants and context of the study
The google form was shared to different departments of postgraduate program at Yogyakarta State University (YSU), Indonesia. So, data was collected from students and lecturers for those who ever interacted with Be-smart before. Data collection was done within a week on December of 2019 and a total of sixty-five (65) respondents filled out the questionnaire. Data cleaning was done using the data analysis tool to remove suspicious responses. Six respondents were detected as suspicious and were removed remaining with fifty-nine (59) respondents. In this specific kind of UX analysis, there is no constrained minimum sample of respondents. The sample of collected data is sufficient for stable and reliable results in this kind of data analysis as indicated by [13,14] Therefore, using the UEQ approach, the responses of instructors and students were used to evaluate the platform as will be discussed in the following sections.

2.3. Data analysis method
The UEQ questionnaire has its own specific tool for data analysis. The data analysis tool is an excel sheet and are both available on the website (www.ueq-online.org), free to download and use. The tool is well established for statistical analysis of scales and items of UEQ. It can calculate the reliability of UEQ by calculating a coefficient alpha (Cronbach's alpha). Also, it can calculate other statistical measurements of items and scales such as calculating means and standard deviation [9,12]. So, in this study, the excel tool was used to analyze the collected responses and calculated the needed statistical measurements for the interpretation of the findings based on the theoretical and practical background of the UEQ evaluation approach supported by the related studies as explained above [12,14].

3. Results and discussion
The findings of this study are divided into three parts namely overall results of both students and lecturers, results from students only, and results from lecturers only. These findings were obtained by interpreting the results from the MS excel tool which does all the necessary statistical analyses. The raw data collected from all respondents were entered in the excel tool for various statistical calculations, most importantly the alpha coefficient (Cronbach's Alpha) for checking the reliability of UEQ scales. Also, the excel tool comes with the part of benchmark to compare the results with it to see if the findings have reached the minimum required values. Moreover, from the data analysis tool, results can be depicted in the form of graphical visualization.

3.1. The Cronbach's Alpha confirmation
The Table 3 below shows the results of Alpha coefficient values of the scales from the three groups. From Table 3, for the overall UX results of both students and lecturers, the calculated values of Cronbach's Alpha of all UEQ scales generally show the satisfactory values (the Alpha values are equal or higher than 0.7) with the exception of novelty scale which has the value less than 0.7.

| UEQ scale     | Cronbach’s Alpha value |
|---------------|------------------------|
|               | All respondents | Students only | Lecturers only |
| Attractiveness| 0.87          | 0.86         | 0.91           |
| Perspicuity   | 0.8           | 0.79         | 0.86           |
| Efficiency    | 0.79          | 0.8          | 0.74           |
| Dependability | 0.8           | 0.79         | 0.82           |
| Stimulation   | 0.84          | 0.85         | 0.9            |
| Novelty       | 0.66          | 0.72         | 0.46           |

The results from students only respondents, the Alpha values as it can be seen above, are all higher than 0.7 indicating that the items of all six UEQ scales are consistency from the responses of students.
While, on the other hand, from the responses of lecturers only, the Alpha value of novelty scale is much less than 0.7 which may be resulted from a small sample of lecturers’ respondents as only ten (10) potential lecturers responded to the questionnaire.

3.2. Interpretation of the results based on the UEQ benchmark

After the confirmation of the Alpha coefficient, the interpretation of the study results can be proceeded as follows. The next step is to compare the values of the results from every UEQ scale with that of the benchmark provided in the excel tool. This comparison is the key and primary indicator of knowing if the system or product evaluated has enough UX of its users for the system to be treated as worth and successful. So, the relative weaknesses and strengths of the evaluated system can be known and concluded by comparing and referring to the values in the benchmark.

The benchmark was developed through evaluation studies of hundreds of systems and products such as web systems, mobile applications, development tools, and many more mature technological products which are well designed and developed. There are five (5) categories in the benchmark dataset to classify the results of an evaluated system, these categories are bad, below average, above average, good, and excellent as indicated in the Table 3 below. The main aim of the benchmark is to help practitioners of UX with easy interpretation of the scale results during systems evaluations using UEQ. It is vital to mention that the overall expectations of UX grow as time goes on. Thus, the UEQ scales of the system to be evaluated should at least be in the ‘Good’ category as the benchmark comprises data from well potential systems and products. The Table 4 below illustrates the mean values of six UEQ scales of the benchmark dataset for comparing with values of any evaluated interactive system.

| Table 4. Benchmark Intervals for the UEQ scales[25] . |
|----------------|----------------|----------------|----------------|----------------|----------------|
|                | Att. | Eff. | Per. | Dep. | Stim. | Nov. |
| Excellent      | ≥ 1.75 | ≥ 1.78 | ≥ 1.9 | ≥ 1.65 | ≥ 1.55 | ≥ 1.4 |
| Good           | ≥ 1.52 | ≥ 1.47 | ≥ 1.56 | ≥ 1.48 | ≥ 1.31 | ≥ 1.05 |
| Above average  | < 1.75 | < 1.78 | < 1.9 | < 1.65 | < 1.55 | < 1.4 |
| Below average  | ≥ 1.17 | ≥ 0.98 | ≥ 1.08 | ≥ 1.14 | ≥ 0.99 | ≥ 0.71 |
| Overall        | < 1.52 | < 1.47 | < 1.56 | < 1.48 | < 1.31 | < 1.05 |
| Bad            | < 0.7 | < 0.54 | < 0.64 | < 0.78 | < 0.5 | < 0.3 |

The Table 5 below illustrates the means of scales from the results of students, lecturers, and the overall results. Also, Figure 2 illustrates the graph visualization of the overall results. Finally, the Figure 3 shows the graph of overall results with the error bars of 5% confidence interval.

| Table 5. The UEQ scales means results. |
|----------------|----------------|----------------|----------------|
| Scale          | Means          | Overall | Students only | Lecturers only |
| Attractiveness | 0.89 | 0.89 | 0.90 |
| Perspicuity    | 0.98 | 0.98 | 0.98 |
| Efficiency     | 1.03 | 1.05 | 0.95 |
| Dependability  | 0.92 | 0.86 | 1.18 |
| Stimulation    | 0.81 | 0.72 | 1.23 |
| Novelty        | 0.44 | 0.41 | 0.55 |
Thus, from the results shown in Table 3 above, the overall results (all respondents) show that all scales except the novelty scale, have high internal consistency, that is, the Cronbach’s Alpha is equal or higher than 0.7. The results from students indicate that all UEQ scales were consistent as all Alpha coefficients are above 0.7. Moreover, analysis results from lecturers show a slight difference whereby the novelty scale is below 0.7 which makes sense as the e-learning platform is no longer new to them. Generally, it can be said that the overall values of Alpha coefficient are satisfactory as all scales have values higher than 0.7 except for the novelty scale. So, this means that the Indonesian version of UEQ questionnaire used in this study shows enough reliability for the interpretation of the found results. This indicates that the scales of UEQ in this study are sufficiently consistent. From Table 5 above, we can see that the means of scales from the responses of lecturers only, dependability and stimulation scales are in above average category while other scales are within below average category in reference to the UEQ benchmark as illustrated in the table 4 above. Also, the results from students’ responses indicate that only efficiency scale mean is in above average category while the rest of the scales are within below average category. Moreover, the overall results from both students and lecturers as shown in both Table 5 and Figure 2 above, indicate that efficiency scale is the
only one which has mean value above average while other scales means are within below average compared to the benchmark intervals. From Figure 3 above, the graph shows the error bars representing the 5% confidence intervals of the means of scales. So far, the widths of the error bars are not too wide indicating that there is an agreement between respondents on respective scales despite the number of respondents is not quite big. This is because the width of the error bars depends on the number of respondents and the agreement level between them. That is, the higher the number of participants the smaller is the width of the error bars, and the higher the level of agreement between individuals, the smaller will be the width of the error bars.

4. Conclusion, limitations, and future work
This study aimed at examining the user experience of the e-learning platform called Be-smart at Yogyakarta State University, especially in the graduate school. The evaluation of the e-learning platform was done using user experience questionnaire (UEQ), an Indonesian version. Generally, the overall responses show that there is a little positive user experience impression of the e-learning platform as all values are above 0.8. Clearly, there is a higher impression in pragmatic dimensions (efficiency, perspicuity, and dependability) than in other dimensions of attractiveness and hedonic quality (novelty and stimulation). Though, from the results discussed above, it can be concluded that the overall ratings (the scales means) of the e-learning platform are still low as most of them are below average compared to the values in the UEQ benchmark. This means that, as recommendation from the researchers of this study, the platform needs a lot of improvement in all aspects of UX, that is, attractiveness, hedonic, and pragmatic. But, most importantly, the pragmatic improvement is of much importance as the platform is there to make easy access of information, learning materials, and communication between students and lecturers or students themselves more smoothly. So, the findings of this current study are important to be taken into consideration as they give a starting point to the platform developers on which areas to improve.

This study has its limitations. The first limitation is about the number of participants as only 65 participants responded to the questionnaire. So, for better and more reliable findings, future studies should involve many participants to evaluate the e-learning platform. Also, the study was conducted in graduate school, we recommend future studies to include other students and lecturers from different faculties in undergraduate level. Despite the limitations of this study, we can still know and predict efficiently the areas of improvement in e-learning platform. This is because the UEQ questionnaire approach is an efficient and an easy quantitative method to collect and analyze data of participants ranging from very small to large number of respondents. Also, it is normally possible to make concrete guess on the strengths and weaknesses of the evaluated interactive e-learning system since the UEQ questionnaire has various scales which describe well different quality dimensions of the interactive system like e-learning platform evaluated in this study.

Finally, in the future, it will be much better to add qualitative methods in the study together with UEQ evaluation method to make deep inquiries of user experience of the users by interviewing some of the respondents especially lecturers. This is because lecturers voluntarily use the platform compared to students who are forced to use the e-learning platform if the lecturers would want them to do so.

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