Measuring mobile applications user’s satisfaction: A closer look into the appropriate information systems user’s satisfaction

E Prastyo*, C W Budiyanto and R A Yuana
Informatics Education Department, Faculty of Teacher Training and Education, Sebelas Maret University, Surakarta, Indonesia

*ediprast@student.uns.ac.id

Abstract. The growth of mobile devices drives the use of the mobile app in every aspect of life. Mobile applications are known for their flexibility and speed and accounted for user experience and interactivity. The assessment over user satisfaction, however, remains an essential aspect for measuring the success of an information systems implementation. This paper aims to be a reference in measuring the level of user satisfaction pertinent to The End-User Computing Satisfaction (EUCS) model on mobile applications. A systematic literature review carried out to investigate the reports on the measurement of user satisfaction over mobile applications. The understanding over the justification to migrate into mobile applications perceived benefits of the mobile app over desktop/web application, and the cost and benefit of the mobile application drawn from papers published in SCOPUS, Web of Science, and DOAJ between 2010 up to early 2020. End-User Computing Satisfaction (EUCS) model has been displayed as a valid model for measuring user satisfaction with an integrated system. It’s can combined with other system success measurement models and can develop more variables as needed.

1. Introduction
The growth of mobile devices drives the development of mobile applications in various fields of life. The applications software developed pertinently to run on mobile devices such as smartphones, tablets and smartwatches. Mobile applications help ease users’ connectivity for their portability in comparison with desktop or laptop computers [1]. Ease of access is one of the considerations to migrate to mobile applications [2]. Regarding the embeddedness of mobile phone in modern daily life, user satisfaction is a primary consideration in developing mobile apps. Mobile applications designed without user satisfaction as the primary concern will be abandoned, even damaging the company’s brand and potentially decreasing the company’s revenue [3]. User satisfaction is an essential component of measuring the success of an application system [4]. User satisfaction is an essential factor that affects the continual use of services of mobile apps [4] and effectiveness [5]. Therefore measuring the end-user satisfaction level with mobile applications is very important to understand user’s needs and identify important factors that can use to improve mobile application services and increase the business value [6].

A model to measure the level of user satisfaction is essential to ensure systems adoption success. End-User Computing Satisfaction (EUCS) is the most popular model for measuring user satisfaction.
The main concern is the overall affective evaluation that an end-user has about the experience with the application system [7]. Despite the promising benefits of EUCS in user satisfaction measurement, literature is lacking on the evidence of the use of EUCS in a specific application. It is expected that future empirical results from research provide support for the EUCS model and their robustness as a valid computational measurement to measure user satisfaction. This paper aims to be a reference in measuring the level of user satisfaction pertinent to The End-User Computing Satisfaction (EUCS) model on mobile applications.

2. Research methods
The method used in this study is a systematic literature review. A systematic literature review is a well-know research method which conducted with systematic and strict standards [8,9]. It begins by determining the purpose of the literature review, making protocol documents that contain procedures to be followed if more than one reviewer, searching for literature, extracting data systematically from the collected research, and then writing the results of the review [9]. This research elicited thirty-three most relevant articles. The articles were aggregated from 2010 to 2020 with Scopus, Science Direct, DOAJ, and Research Gate as data sources. The research uses appropriate keywords such as mobile applications, user satisfaction, EUCS model. The literature used in this research classified in the chart below.

![Data Sources](image1.png)

**Figure 1.** Data sources.

![Year of Published Articles](image2.png)

**Figure 2.** Year of published articles.

Based on the collected data in the chart above, most of the articles published beyond 2017 as the most recent publication. The literature review carries out by making a metric of authors, year of publication, the title of the research, data sources, objectives, results, and conclusions. It is systematically to help streamline the review.

3. Results

3.1. The advantages of using a mobile application
Smartphones have become an essential part of everyday life. Smartphone, as part of everyday life, develops the behaviour and skills needed for a successful life and work in modern times [10]. A variety of mobile applications in smartphones provide a range of offer features and sophistication. It makes the application opportunities for moving in the future endless [11].
Consideration over human connectivity and social utilities are the prime reasons for using mobile applications [2]. Mobile apps provide easy accessibility, speed, availability, and low cost [12]. In developing mobile applications using the hybrid mobile method, the development of mobile software has become more productive. Hybrid mobile apps are considered adequate because of multiplatform. The use of applications moves smoothly and quickly and can integrate with other devices such as cameras [13].

Mobile applications benefit the user for better access to educational material, increased knowledge and confidence [14]. A research conducted by Bustillo [12], for example, indicated that the use of the mobile application is confidently listening foreign language. Learning by utilizing mobile apps is increasingly popular. After all, it is accepted as an effective technique because its main strength is that it can be used anytime and anywhere [15]. The main benefit that makes m-learning so accessible today is encouraging anywhere - anytime study habits [10]. Besides, application users engaged in m-learning increase student interest and motivation [16].

People are getting more and more engaged in a banking application, such as mobile banking services. The mobile app offers the required information quickly and accurately as well as the ease of interaction, thereby increasing satisfaction for users of mobile banking services and having service to those services [17]. The use of the application supports patients in taking an active role in their health management in collaboration with health professionals. The use of cellular health applications can positively influence communication and relationships between patients and service providers, facilitating reciprocal relationship-centred health services [18]. In a business environment, companies recommend launching mobile applications to communicate with their customers [3].

3.2. The Importance of understanding user satisfaction

User satisfaction plays an important role to measure the level of success of an application [19]. At the basic level, user satisfaction is related to the user's form and perception. At the next level, user satisfaction is not only associated with shapes and attitudes but also about functions and experiences while using the application [20]. Various factors influence the level of comfort. Interface quality [19] [4], system quality, information quality, support resources and compatibility influence the level of user satisfaction [21]. In research conducted by Seraj [22], information clarity, responsiveness and accuracy of data are factors that influence user satisfaction.

Improving system performance and availability are crucial for satisfaction. Some features should be more user friendly or user-friendly if possible, such as font size [23]. The ease and clarity of objectives increase the use of mobile applications [24]. Applications that support user needs [25] and provide positive user experiences [26] will provide user comfort. It will encourage increased user satisfaction [27].

In some literature explains that the slow response causes user dissatisfaction, so it requires a long time, excessive workload [28], slow system, unavailability of feedback mechanism [23], poor system integration, and inaccurate data [29]. Besides, excessive use of security control systems is considered a complex problem that can reduce system productivity [30], and mismatches between costs incurred with facilities and services provided by an application can provide a poor user experience [31].

3.3. Measurement of user satisfaction using the end-user computing satisfaction model

End-User Computing Satisfaction or known as the EUCS model, is one of the system success measurement models that focuses on measuring the level of user satisfaction. Doll and Torkzadeh first developed the EUCS model in 1988. The EUCS model built with five dimensions of measurement, namely, content, accuracy, format, convenience, and timeliness [32]. Until now, the EUCS model is still relied on by researchers to measure system user satisfaction in various fields. The measurement of user satisfaction of the EUCS model is widely applied to school or university information systems [33] [34], learning management systems, government websites [35], e-commerce [36] and banking services [37]. In the health sector, the EUCS model is used to measure the quality of hospital services [38], health information systems [39], and nursing learning systems.
EUCS is a valid predictor of user satisfaction with an integrated system. But that requires longitudinal studies and much more precision in model specifications [40]. Research conducted by Aggelidis [7] about the satisfaction of hospital information system users. Empirical results from his research provide support for the EUCS model (incorporate new factors) and increase the generalization of EUCS instruments and their robustness as valid measures of computational satisfaction in measuring system success. Although the psychometric nature of EUCS appears to be stable across all studies and user groups, it should not consider as the final chapter in the validation and refinement of this scale. Continued efforts must make to validate and expand the instrument [7].

Besides, research conducted by Pauluzzo [41], shows that in the primary literature has provided evidence that EUCS is a second-order construct explained by five first-order factors (content, accuracy, ease of use, timeliness, and format). The findings also provide evidence about the psychometric stability of the EUCS tool. The EUCS model has been validating and tested, allowing scholars to use or combine it with other Information System acceptance models with confidence [41]. They can try to develop and excite user satisfaction in measuring the success of the system in terms of dimensions and more variables [37].

4. Discussion
Smartphones have become an essential part of everyday life. A variety of mobile applications in smartphones offer a range of features and sophistication. Mobile applications provide easy accessibility, speed, availability and low cost. Furthermore, mobile application development using the hybrid mobile method is where mobile apps are more effective because of the multiplatform capability and can integrate with other devices. The development of mobile applications is inseparable from the satisfaction of mobile application users. User satisfaction plays a vital role to measure the success of mobile applications developed. Mobile apps that can meet the needs of users and provide a pleasant user experience will provide user comfort. It will encourage increased user satisfaction.

Conversely, a slow system, the unavailability of feedback mechanisms, poor system integration, and data inaccuracies are the cause of dissatisfaction, and ultimately the user will not use mobile applications again. Besides, excessive use of security systems considered to reduce system productivity, and the mismatch between costs incurred with the facilities and services provided can provide a bad experience for users. Measuring the level of user satisfaction is needed to determine the opinion of application users towards the application used. Application developers can use this information to evaluate and make improvements to the app. End-User Computing Satisfaction or known as the EUCS model, is one of the system success measurement models that focuses on measuring the level of user satisfaction. The EUCS model has shown to be a valid predictor of user satisfaction with an integrated system. Research conducted by Aggelidis [7] provides support for the EUCS model by increasing the generalization of the EUCS model instrument to its robustness as a valid measure of computational satisfaction in measuring system success. Continued efforts must make to validate and expand the tool. The EUCS model has been verified and tested, which allows researchers to use or combine it with other IS acceptance models. They can try to develop different measurement dimensions and more variables. Moreover, apart from the capability of EUCS to predict level of systems’ user satisfaction, literature seems over-explored its adoption to measure web-based and desktop applications. Few research focused on the effectiveness of EUCS to measure mobile applications user’s satisfaction. Among 30% papers reviewed, only one paper investigated user perception over mobile apps’s access speed, graphical user interface, and data reliability [42].

5. Conclusion
End-User Computing Satisfaction (EUCS) model is a measurement tool for measure user satisfaction of various systems such as information systems, learning management, and mobile applications. The EUCS model, with its five dimensions of measurement, content, accuracy, format, convenience, and timeliness, has been displayed as a valid model for measuring user satisfaction with an integrated system. The EUCS model has validated and tested, which allows researchers to use the EUCS model
as a measure of user satisfaction. They can combine it with other system success measurement models, develop different measurement dimensions, such as security or others and they can develop more variables as needed.

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