



Modelling Subjective Measurements for Usability Evaluation of M-banking Application Interface

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Abstract: Usability of mobile applications has become an important element of success in the market, be its context applications, financial applications or otherwise, but the central issue is the interface of such application. The aim is to ensure that the applications are usable and satisfying users. Studies on how to measure the usability of m-banking application are very limited and much less in the area of m-commerce application itself. Most of the usability measurement are carried out in lab test or field test and mainly focused on objective measurement. The objective of this paper is to provide subjective measurements that will determine the user satisfaction of m-banking application. The SLR and QUIM were used to propose the subjective measurements for evaluating the usability of m-banking application. Therefore, to ensure that the developed subjective measurement are reliable and useful, the usability study was conducted with twenty four participants. Five sample of m-banking applications were used to validate the subjective measurements. The result shows that the developed subjective measurements are useful and will determine user satisfaction for m-banking application.

Keywords: M-banking application, usability evaluation, Subjective metrics, Usability study, QUIM

I. Introduction

Positioning m-banking services rapidly with richness, effective and efficient interface will permit a bank to advance the attainment and retain customers as many of them will rush to activate the application in their various mobile devices [15]. M-banking services provide lots of conveniences to the customers. Customers considered that convenience, security and the ability to save time and energy during banking transactions and services are important values and of course, it will keep a good relationship with their banks [29]. The demand of m-banking application and its usability evaluation method is rapidly increasing across the globe due to their advantages and usefulness in both industry and customers. Though, many banks do not offer m-banking application while those that offer have limited functionalities and it is assumed that their interfaces are still insufficient and not user friendly [29], [10], [21].

The usability of mobile applications has become an important element of success in the market, be its context applications, financial applications or otherwise, but the central issue is the interface of such application. Many m-banking applications are suffering from usability problems such navigation system, login technique, information presentation, icons design and inadequate functionalities [21], [29]. This will continue to affect the deployment of the application in many countries. Literatures revealed that approach on interface usability evaluation of m-banking application has not been addressed substantially [29], [26], [29]. Interface usability issue from the customers' side, and of course financial fraud have also slowed down the deployment of such technology in some countries [22]. Therefore, based on predetermined statements, there are needs for an appropriate study that will be addressed these issue in order to bridge the existing gap towards the usability of m-banking application. However, the objective this paper is to design a subjective metrics for evaluating the usability of m-banking application interface.

Literature on how to measure usability of m-banking application are very limited and much less in the area of m-commerce application itself. Most of the traditional usability metrics have been designed specifically for desktop applications, as such some metrics may not be directly applicable to most of the mobile applications due to many reasons such as screen size, memory capacity, speed and input method. Therefore, there are needs for dynamic and appropriate usability measurements for m-banking application mentioned by [15].

II. Usability Evaluation in M-banking Application

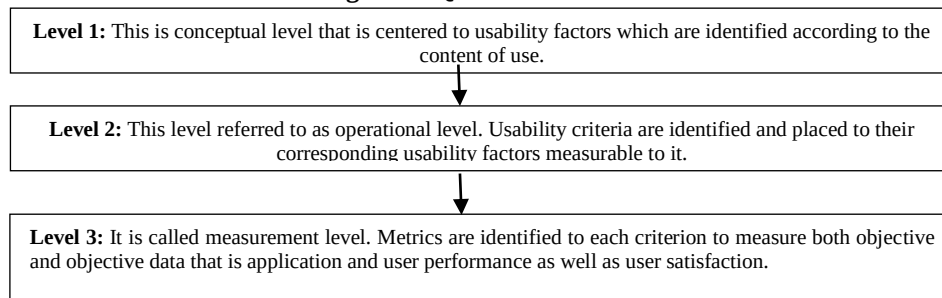
As mentioned earlier, literature on usability measurements of m-banking application are very limited. However, few usability measurements were used in m-banking application evaluation and its related area; for instance in the study conducted by [24] on the comparative usability study of tag-based interface for m-banking used three usability factors which are in line with ISO usability standard; these include effectiveness, efficiency and satisfaction. [32] on their study on Chinese m-banking services evaluation uses convenience and safety to determine interface quality. [18] produce context, content community, customization, connection and commerce as the criteria for customer interface design for m-commerce. Meanwhile, in the study conducted by [13] on the impact of usability of mobile website context on mobile commerce presented efficiency, flexibility and errors as

the usability measurement. Navigation, presentation, task support, learnability and customisation were used by [28] in their study on the criteria for accessing the usability of enterprise resource planning (ERP). Most of the usability measurements used were originated from ISO usability standard measurements and that of [23] respectively. Moreover, many studies failed to provides comprehensive descriptions of criteria and metrics been used.

III. QUIM Model

The Quality in Use Integrated Measurement (QUIM) is a consolidated model designed specifically for effective usability measurement practice [27]. It builds the usability measurement into factors, and further broken it into criteria, finally into specific metrics. The QUIM model provides a reliable basis and origin for usability factors, criteria, and metrics specifically for research and educational purposes. By using QUIM it is quite possible to establish independent usability evaluation models for mobile applications [27]. The QUIM consists of two recognizable extra points; that is data and data collection methods. The data are the basics of usability metrics, which means that the measures are combined in the function that defined the metrics. QUIM also supports multi-views of the relationship from usability factors to criteria then to metrics. This is to say, it has three explicit levels, as described in Figure 1 below.

Figure 1: QUIM levels



The QUIM model provides consistency and offers fair guidance on how to select particular metrics given broader goals of usability [11], [27], [30], [31]. It incorporates most of the quality usability measurements for evaluating functional application products [2]. [6] developed a model for usability measurements and classification of Multifunction Teller Machine (MTM) through the application of QUIM model. Many usability studies highlighted the impact of QUIM usability measurements in testing the functional software and mobile applications [7], [11], [19], [20]. The QUIM model appears to be a enormous contribution and evidently exposed more the meaning of the usability construct and its implications on how to measure usability [5], [7], [13].

IV. Methodology

Selecting an appropriate methodology for a research depends on the objectives and the area of the study. Therefore, selecting the correct methods for a particular research topic needs a good and careful understanding of each methodology since there is no given approach to it [12]. Similarly, certain factors needs to be taken into consideration when selecting a research method such as research topic, length of time given to the research, available resources and of course the nature of the research environment [3]. Therefore, the Systematic Literature Review (SLR) was used for generating appropriate usability measurements for evaluating the usability of m-banking application interface.

The SLR is an approach mainly used to recapitulate the existing evidence regarding treatment of data that can be used to summarize the empirical evidence of the benefits and limitation of a particular method [17]. The SLR is mainly on search strategy that can easily detect relevant literature [17]. Moreover, it specifies how information is to be obtained from the primary study and the quality criteria that will be used to evaluate each of the primary study.

In order to achieve the objectives of this paper, five (5) highest HCI journals and three (3) conference proceedings have been selected from 2010 ahead and this method of selection has a basis from [8], [27]. Therefore, relevant papers were downloaded and reviewed in order to generate appropriate usability measurement for evaluating the usability of m-banking application. A number of usability measurements were identified and sorted out according to relevancy to banking functionalities.

V. Results/Discussions

This paper employed SLR in order to generate appropriate usability measurement for evaluating the usability of m-banking application interface. Therefore, five usability factors and fourteen criteria have been identified. Each criterion has been placed to its corresponding usability factor and the placement was based on the relationship between them. The criteria that are more appropriate to m-banking application functionalities are

given careful consideration in the selection to maintain originality and consistency level. Table 1 described the generated usability factors and their corresponding criteria.

Table 1: Placement of criteria to their corresponding usability factors

Criteria	Usability factor				
	Efficiency	Effectiveness	Trustfulness	Learnability	User satisfaction
Compatibility	✓				
Loading time	✓				
Operability	✓				
Accuracy		✓			
Presentation		✓			
Navigation		✓			
Privacy			✓		
Reliability			✓		
Simplicity				✓	
Familiarity				✓	
Consistency				✓	
Content					✓
Structured task					✓
User guide					✓

VI. Designing the Subjective Metrics

The subjective metrics are regarded as preference metrics which measure the actual user satisfaction about the existing application. The subjective metrics requires fully functional application. Therefore to create substantial subjective metrics, the defined metrics from GQM [4], [16], [27] and other usability studies such as [9]; were critically analysed and employed with little modifications to suit this study. These models provides consistency and offered fairly guidance on how to select particular metrics given broader goals of usability [11], [27], [30], [31]. Besides the consistency of the models, it also categorized the relationship among criteria and metrics. Moreover, these models allow a researcher to manually create a usability testing plan by selecting the desired metrics based on the application to be tested in the specified context of use. Therefore, a total of twenty nine (29) subjective metrics have been designed. However, the designed subjective metrics were placed to their corresponding criteria accordingly. Table 2 describes usability measurements for subjective evaluation of m-banking application.

Table 2: Representation of Subjective model and its components

Usability Factors	Criteria	Subjective Metrics
EFFICIENCY	Compatibility	Loading the application with this device Performance speed
	Accuracy	Satisfaction with task performed
EFFECTIVENESS	Presentation	Satisfaction with menu buttons presentation Satisfaction with information organisation Satisfaction with graphic presentation Satisfaction with output format
	Navigation	Satisfaction with navigation structure Satisfaction with menu items provided
	Privacy	Satisfaction with user ID/password style & format Satisfaction with authentication techniques Satisfaction with access denial support
TRUSTFULNESS	Reliability	Satisfaction with session timeout if idle
	Simplicity	Easy to select task in the interface Easy to use and learn the application
LEARNABILITY	Familiarity	Satisfaction with menu buttons Satisfaction with the contents of the application Satisfaction with pages style and format
	Consistency	Satisfaction with output display Satisfaction with overall interface layout
	Content	Satisfaction with logical presentation of task Satisfaction with transaction task provided Satisfaction with update request
USER SATISFACTION	Structured task	Satisfaction with content design and format Satisfaction with logical design of menu buttons Satisfaction with application style and format
	User guide	Satisfaction with help menu provided Satisfaction with alert message if error occurred Easy to make error(s) correction

The Table 2 above represent a complete subjective model for evaluating the usability of m-banking application interface. Metrics are categorized according to specific criteria, whereas criteria are placed to their corresponding usability factors. The placement of each criterion are based on QUIM model [27] which described the relationship between the usability factors and the criteria.

VII. Usability Study

To validate the proposed subjective model, the usability study was conducted. Therefore, in order to ensure that the proposed model can be used for evaluating the usability of m-banking application, twenty four (24) Participants that are using m-banking application were recruited. Similarly, five (5) m-banking applications platforms such as CIMB Clicks, GTbank mobile, m2u mobile, Firsonie and Zenith bank mobile were used to validate the model. The scenario is to determine the applicability of the proposed model to different m-banking application.

In validating the proposed model, each of the participant was given a questionnaire to answer. The questionnaire was built based on the designed sets of subjective metrics. The participants completed the questionnaires and sorted out according to m-banking application. The SPSS version 24 was used for the analysis of the collected subjective data. However, the result indicated that all the twenty nine (29) subjective metrics are valid and have the capability of collecting data and yield a significant results.

The result of subjective data has been achieved from the questionnaire that contained subjective metrics. The questionnaire consists of 29 subjective measures based on the proposed usability measurement. In this regard, data presented in this section described overall results from the completed post usability test questionnaire during usability experiment session based on the five m-banking application. Therefore, the Figure 1 below presents the result from m2u mobile application. Please refer to Appendix 1 for representation of alphabets level for metrics.

Figure 1. Metrics scores for m2u mobile

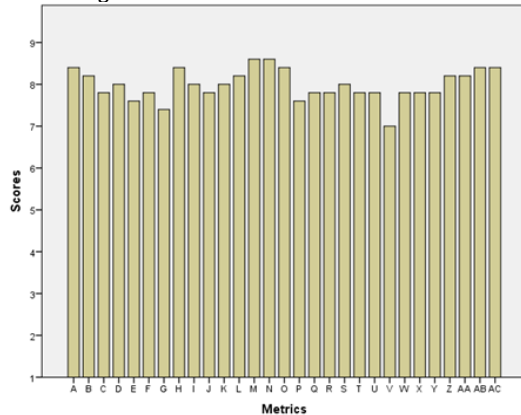
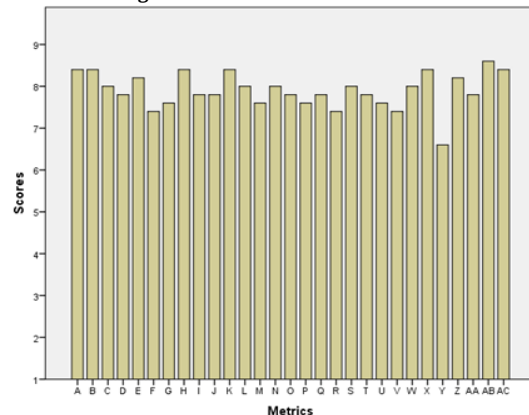


Figure 2. Metrics scores for CIMB Clicks



The twenty nine subjective metrics are measured to examine the participants' opinions of the application. As indicated above, it shows participants are very satisfied with m2u application with average satisfaction level is more than 7 out of 9 point Likert scale. The metric "V" has the lowest as it reached satisfaction level 7.2 out of 9 point Likert scale.

In Figure 2, the metric "Y" (satisfied with alert message provided if error occurred) did not reach average satisfactory level since it laid within 6.8 whereas all the twenty eight metrics are more than average satisfaction level of 7 out of 9 Likert scale. Therefore, this shows that participant's satisfaction level is weak with regard to metric Y. That means the CIMB Clicks application need to be improved with an alert message in case an error occurred when a user conducting a transaction.

Figure 3. Metrics scores for GTbank mobile

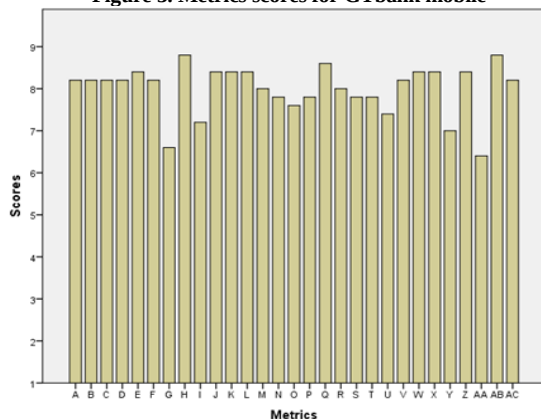
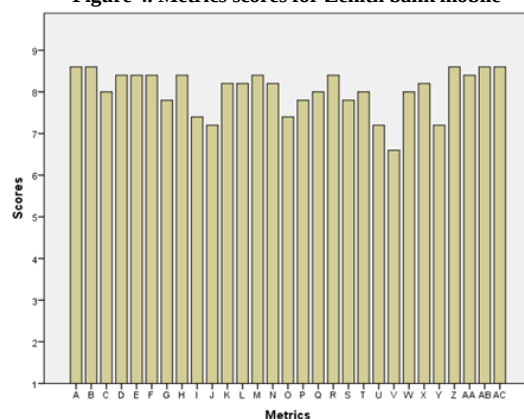
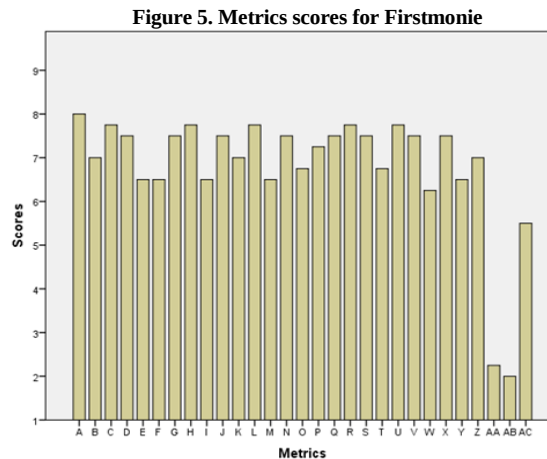


Figure 4. Metrics scores for Zenith bank mobile



The result in Figure 3 indicate that metrics “G” and “AA” did not reach the average satisfaction level of the Likert scale. The metrics “G” represents “Easy to make correction while performing a task”, and metric “AA” stands for “Access denial support”. Therefore, since these two metrics did not reach average satisfaction level 7 out of 9 of Likert scale, therefore this clear indicate that the satisfaction level of the participants is weak as they found it difficult to correct a mistake while performing a task. Moreover, it can be concluded that the application needs an improvement for those aspects. However, the remaining twenty seven metrics have reached more than average satisfaction level of 7 out 9 Likert scale. This indicates that participants were satisfied with other aspects of the application.

The result in Figure 4 indicate that the use of help menu provided in the application was not much easier by the participants. The participants’ satisfaction level is weak, since the metric “V” (Easy to use help menu provided) did not reach average satisfactory level, it laid within 6.8 of Likert scale. All the twenty eight metrics are more than average satisfaction level of 7 out of 9 Likert scale. Therefore, the participants were happy with the application.



Based on the result obtained Figure 5, it shows that a number of usability problems were identified such as; (1) “Difficulty in performing task in the interface” and the “Use of menu buttons” as indicated in metrics “E” and “F”. (2) Content of the application, menu item provided and interface layout as revealed in the metrics “I”, “M” and “W”. (3) The satisfaction level of metrics “O”, “T”, “X”, and “AC” are below average satisfaction level of 7 out of 9 Likert scale. However, the satisfaction level of metrics “AA” and “AB” are too low and those indicate that participants were completely not happy with “Access denial support” and “Session timeout support if idle” for the Firstmonie application. Generally, the average satisfaction level for the Firstmonie application was very low considering that many metrics are below the average satisfaction level of 7 out of 9 Likert scale.

Therefore, based on comparison, the results from the five individual m-banking applications indicates that all the twenty nine subjective metrics are measurable to their corresponding criteria via the usability factors.

VIII. Conclusion

The proposed model has been validated through the usability study using five sample of m-banking application platforms. The designed subjective metrics has proven the capability of collecting data, analyse and provides accurate and consistent results. The SLR and QUIM model were used to develop the model. Moreover, due to advancement in mobile technology, the design subjective metrics in the proposed model needs to be updated in future. The usability measurements for any mobile applications have to be dynamic due to mobility in nature and technological improvement [3].

References

- [1] Abubakar, HI, Nor Lailly, H. & Hussain, A. (2015). Verification Process of Usability Evaluation Model for M-banking Application. A paper presented at the 17th International Conference on Mathematical and Computational Methods in Science and Engineering. WSEAS Transactions on Computers.
- [2] Alonso-Ríos, D., Vázquez-García, A., Mosqueira-Rey, E., & Moret-Bonillo, V. (2009). Usability: a critical analysis and a taxonomy. *International Journal of Human-Computer Interaction*, 26(1), 53-74.
- [3] Baharuddin, R., Singh, D., & Razali, R. (2013). Usability Dimensions for Mobile Applications-A Review. *Research Journal of Applied Sciences*, 5(6), p2225-2231.
- [4] Basili, V. R. (1992). Software modeling and measurement: the Goal/Question/Metric paradigm University of Maryland at College Park.
- [5] Becker, J., Niehaves, B., & Pfeiffer, D. (2008). Ontological Evaluation of Conceptual Models. *Scandinavian Journal of Information Systems*, 20(2), 4.
- [6] Braz, C., Seffah, A., & M'Raihi, D. (2007). Designing a trade-off between usability and security: a metrics based-model. *Human-Computer Interaction-INTERACT 2007* (pp. 114-126): Springer.

- [7] Buchanan, S., & Salako, A. (2009). Evaluating the usability IT and IT, usefulness of a digital library. *Library Review*, 58(9), 638-651.
- [8] Coursaris, C. K., & Kim, D. J. (2011). A meta-analytical review of empirical mobile usability studies. *Journal of Usability Studies*, 6(3), 117-171.
- [9] Dubey, S. K., & Rana, A. (2010). Assessment of usability metrics for object-oriented software system. *ACM SIGSOFT Software Engineering Notes*, 35(6), 1-4.
- [10] Emmanuel, E. A., & Nsung-Nza, M. H. (2012). *Mobile Commerce Interaction Techniques for African Rural Economy Development: A Case Study for Dwesa*. The Polytechnic of Namibia, Namibia.
- [11] Fernandez, A., Insfran, E., & Abrahão, S. (2009). Integrating a usability model into model-driven web development processes: Springer. ISSI Research Group, Valencia, Spain.
- [12] Galliers, R. (1992). *Information systems research: Issues, methods and practical guidelines*: Blackwell Scientific: Bentley University.
- [13] Hornbæk, K., & Law, E. L.-C. (2007). Meta-analysis of correlations among usability measures. Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems.
- [14] Hussain, A., & Kutar, M. (2009). *Usability Metric Framework for Mobile Phone Application*. PGNet, ISBN, 978-971.
- [15] Hussain, A., HI Abubakar & Nor Laili, H. (2014). Evaluating Mobile banking application: Usability dimensions and measurements. Paper presented at International Conference on Information Technology and Multimedia (ICIMU).
- [16] Hussain, A., Kutar, M., Mutalib, A. A., & Kamal, F. M. (2011). Modeling Subjective Metrics for Mobile Evaluation: www.researchgate.net/publication/235958889.
- [17] Kitchenham, B. (2004). *Procedures for performing systematic reviews*. Keele, UK, Keele University, 33, 2004.
- [18] Lee, Y. E., & Benbasat, I. (2004). A framework for the study of customer interface design for mobile commerce. *International Journal of Electronic Commerce*, 8(3), 79-102.
- [19] Lim, C., Song, H.-D., & Lee, Y. (2012). Improving the usability of the user interface for a digital textbook platform for elementary-school students. *Educational Technology Research and Development*, 60(1), 159-173.
- [20] Ma, X., Yan, B., Chen, G., Zhang, C., Huang, K., & Drury, J. (2012). A Toolkit for Usability Testing of Mobile Applications. *Mobile Computing, Applications, and Services*, 226-245.
- [21] Merdenyan, B., Kocyigit, O., Bidar, R., Cikrikcili, O., & Salman, Y. B. (2014). Icon and User Interface Design for Mobile Banking Applications. *International Journal of Advances in Computer Science and its Applications-IJCSIA*, Vol 4: Issue 2, 54-59.
- [22] Monye, S., Ansah, E., & Orakwue, E. (2010). Easy to declare, difficult to Implement: the disconnect between the aspirations of the Paris Declaration and donor practice in Nigeria. *Development policy review*, 28(6), 749-770.
- [23] Nielsen, J. (1994). Heuristic evaluation. *Usability inspection methods*, 24, 413.
- [24] Ravendran, R., MacColl, I., & Docherty, M. (2012a). A comparative usability study of a tag-based interface in the mobile banking context. Paper presented at the Proceedings of the 13th International Conference of the NZ Chapter of the ACM's Special Interest Group on Human-Computer Interaction.
- [25] Ravendran, R., MacColl, I., & Docherty, M. (2012b). Tag-based interaction in online and mobile banking: A preliminary study of the effect on usability. Paper presented at the Proceedings of the 10th asia pacific conference on Computer human interaction.
- [26] Ravendran, R., MacColl, I., & Docherty, M. (2012c). Usability Evaluation of a Tag-Based Interface. *Journal of Usability Studies*, 7(4), 143-160.
- [27] Seffah, A., Donyaee, M., Kline, R. B., & Padda, H. K. (2006). Usability measurement and metrics: A consolidated model. *Software Quality Journal*, 14(2), 159-178.
- [28] Singh, A., & Wesson, J. (2009). Evaluation criteria for assessing the usability of ERP system. Paper presented at the Proceedings of the 2009 annual research conference of the South African Institute of Computer Scientists and Information Technologists.
- [29] Trudel, M., Boeck, H., Bastonnais, M., Rabec, C., & Bergeron, M.-J. (2011). Nature and Interactivity of Mobile Banking Applications: A Typology Based on the Canadian-American Industry. Paper presented at the Tenth International Conference on Mobile Business (ICMB).
- [30] Wagner, S., & Deissenboeck, F. (2007). An integrated approach to quality modelling. Paper presented at the Fifth International Workshop on Software Quality, WoSQ'07: ICSE Workshops 2007.
- [31] Winter, S., Wagner, S., & Deissenboeck, F. (2008). A comprehensive model of usability Engineering interactive systems (pp. 106-122). Book Chapter, Springer.
- [32] Zhuo, Q., & Li, Y. (2010). Chinese Mobile Banking Service Evaluation Based on AHP Method. Paper presented at the International Conference on E-Product E-Service and E-Entertainment (ICEEE).