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***Research paper***



# Formative Evaluation of an Educational Mobile Application: an Interactive MyQiraat Application

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**Abstract**

This research is concerned with deploying design pattern and formative evaluation for Qiraat mobile application using both Rapid Application Development (RAD) and User Experience (UX) methodologies. The ultimate aim of this research is to encourage ubiquitous teaching and learning of Qiraat through mobile devices. In this paper, continuous progress of MyQiraat design will be presented. The improvement of MyQiraat version design has been evaluated using high-fidelity and low-fidelity prototypes for MyQiraat version 1 and version 2 respectively. Results show that most participants realized the potential benefits of the application allowing a better understanding and encouragement of Qiraat learning among them. However, participants' feedback should be considered in the development of the prototype.

***Keywords***: *Continuous Design; Formative Evaluation Design; Mobile Application; Qiraat Learning.*

## 1. Introduction

Quran is the book revealed by Allah s.w.t as mankind guidance. As Muslims are required to read, studied and examined all the time, so that the Quran will truly guide our life. As we know, Qiraat (Quranic accent) has their own recitation style and variation with seven modes (Qiraat Saba'ah) such as Tajweed (pronunciations). An example of different pronunciation of Qiraat Saba'ah in text 'al-Sirat'as in Surat Al Fatehah. Some narrators of Qiraat i.e. Imam Qunbul read the words 'Sirat' and 'al-Sirat' with 'Sin' (ٱلسِّرَاطَ) while the remaining Imams (i.e. the readers), reads with 'Sad' (ٱلصِّرَٰطَ) excluding Imam Hamza, read with 'Zai' (ٱلزِّرَٰطَ) by 'Ishmam' (an indication or a mixture of two letters) [1-2].

It is very essential to recite the Quran (Qiraat) in an appropriate way for all Muslims such as in prayers. Quran is written in Arabic language and people who want to learn must possess basic knowledge of Arabic in order to read, memorize and understand the Quran. Reading the Holy Quran with Qiraat is quite different from reading the Arabic text [3]. In Qiraat, the tajweed rules are implied but not Arabic text. For example; types of nasalisation (called "ghunnah غنة"). For these reasons, learning how to recite properly is very important with the guidance of expert teacher because we can learn how the teacher recite the Quran with accurate pronunciations.

The learning process of studying Qiraat is not easy and challenging [4-5]. Traditionally, learning Qiraat using kitab (book) guided under a qualified teacher has been the practice until today [6-8]. The limitation of this method is that both students and lecturer should be present and spend more time together to comprehend the Qiraat learning [8-10].

The advent of technology is making a positive impact in the learning process [11-12]. This impact has shown in the increase usage of mobile technology in a variety of educational goals. It is the next generation of electronic learning that based on mobile devices [13] and can be carried everywhere to enable ubiquitous learning and accessing knowledge [14] such as learning of Qiraat through mobile devices.

This research is motivated from the previous version of MyQiraat [9-10]. MyQiraat addressed the issue of teaching and learning of Qiraat anywhere and anytime. It guides the user who wishes to learn Qiraat through an android-based mobile device. An evaluation was made, and the result shows positive feedback among users. However, more work needs to be done in order to get high acceptance among users [15]. Enhancement were made which includes introducing background colours to identify the narrator page, navigation and page transition. We consider this enhancement as part of the MyQiraat version 1.

In MyQiraat version 2, it was co-designed with the users to ensure high acceptance when the application is implemented in reality. In this version, the user interface is improved as well as more functionality were added such as navigation between imam page and highlighting different narrator page based on the text header.

This paper is structured as follows: Section 2 describes the related work. Section 3 provides the details of the design while Section 4 presents the formative evaluation of the design of MyQiraat version 1 and version 2. Finally, the conclusion and future work are given in Section 5.

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## 2. Related Work

The proper pronunciation of the Quran will take into consideration on the rules of Tajweed as well as Qiraat. For a first timer who wish to learn the Quran, he/she should understand letters used in the Quran, the ways to pronounce those letters and often practice before they can extant fluentness in recitation. Even there may be challenges encountered in learning the Qiraat, people are still encouraged to learn as much as they can, even a few verses from the Quran.

### 2.1. Difference Recitation of Qiraat

There are a few differences of Qiraat recitation based on the Qiraat Imam in term of pronunciations or Tajweed. For example, Imam Hafs verse count is recorded of 6236, while Imam Warsh composed 6214. Table 1 shows some differences of Qiraat types in terms of vowels and letter.

**Table 1:** The Differences of Qiraat

| Differences | Qiraat Types | Text |
|---|---|---|
| Dots/ Vowels | Imam Hafs | مٰلِك (Maaliki) |
| | Imam Warsh | مَلِك (Maliki) |
| Word/ Letter | Imam Bazzi | ٱلصِّرَٰطَ (al sirat) |
| | Imam Qunbul | ٱلسِّرَاطَ (al sirat) |
| | Imam Hamza | ٱلزِّرَٰطَ (al zirat) |

### 2.2. Existing Mobile Learning

A survey of the existing tools and techniques for mobile learning system relevant to Qiraat has been reviewed. Multimedia learning system (MMLS) is the medium to publish their teaching contents and assists instructors for the students [16]. It can produce various reports about students' performance. Verification is required in order to use the system. Publishing academic contents and producing students' performance reports may be useful in a web-based course environment. However, it has a limited content space for mobile devices.

GURU is a social network-based teaching and learning [17]. It aims for high school students. This application was built in android based where it focuses on the Malaysian Certificate of Education (SPM) and General Certificate of Secondary Education (GCSE) students. Students are able to communicate with their teachers on this application. Furthermore, they also can access to their school subjects like Mathematics, English, Biology, Science etc. Using social networks to share the subject content is potential to create a motivating environment in the study. We may consider to integrate with social networking in our future work.

Qiraat Asyara (العشر القراءات) Arab Android Apps consists of two parts; 1) listening and; 2) reading [18]. In listening part, this application provides the whole Quran readings (ten audios of different reciters). However, only juz Amma is available for the reading part. The user also can download the audio recitation by surah. In this study, it is aimed to provide the contents and audio of surah with recitation from the seven imams.

Qiraat Jazarine provides the holy Quran with audio playback and different translations such as in English and Malay language [19]. It also provides three different reciters audio namely Mishary Rashed Alafasy [20], Abdurrahmaan As-Sudais [21] and Abu Bakr Ash-Shaatree [22]. iPhone Islam Mushaf [23] features the concept of smart book by applying the multimedia technology in the content of the book. The user can bookmark on the page where they want to stop reading to continue later. This is a good feature that can be considered to be embedded in the next version of MyQiraat.

iQuran Lite [24] is available in iOS platform only. It uses the color code on Tajweed (pronunciations) with verse-by-verse translation and recitation. In this research, the color code will be applied on the text whenever imam reciting the Quran. Al Quran [25] application provides a searchable famous reciter of the Holy Quran together with the translations. It is available in both android and iOS platforms. In this research, we will apply the famous recitation audio based on the types of Qiraat.

It is believed that a proper design of Qiraat mobile application can contribute to effective and efficient in teaching and learning environment. Both teachers and learners require a proper tool to interact with each other in facilitating the teaching and learning [26]. However, this tool is not meant to substitute Qiraat teachers. It can potentially facilitate towards a better understanding of learning Qiraat. Additionally, it has potential participation impact over the lifelong Qiraat learning.

## 3. MyQiraat Design

This section presents the design of MyQiraat. The design was iterative with several modifications being done based on potential users' feedback. Figure 1 and Figure 2 show several screenshots of the earlier versions of MyQiraat (i.e. MyQiraat version 1).




**Fig. 1:** Initial designs of MyQiraat version 1 [10].

Figure 1 provides the initial platform for getting potential users' feedback. It starts from the verse page (see Figure 1(a) Verse page) where the user is given an option to select the verse. Following the verse selection, imam Hafs page will be displayed by default (see Figure 1(b) Hafs page) in the subsequent page. Audio can be played by clicking the text content in the line view. While playing the audio, a user can change directly to a different narrator. For example, if the user in the Hafs page (see Figure 1(b)), he/she can easily change to Qolun page by using the Qolun button at the bottom right of the screen. In the initial version of MyQiraat, it was also included an option for user to select "Imam". It shows the imam biography with the narrator's background. This design version has been evaluated and the result of this evaluation is presented in Section 4.




**Fig. 2:** Enhanced designs of MyQiraat version 1 (Abdul Roni, 2015).

Figure 2 shows several screenshots of the improved design based on the evaluation gathered from the initial prototype Mohd Bahrin [10]. Apart from the functionalities available in the initial design, the enhancement design has provided a friendly theme which combines several colours to highlight the narrator's page. For example, Imam Hafs is in blue background (see Figure 2(b)) and Imam Warsh is in the green background (see Figure 2(c)). Both initial Mohd Bahrin and enhanced Abdul Roni designs (also known as MyQiraat version 1) have provided motivational step for us to progress further [9-10].




**Fig. 3:** MyQiraat design version 2.

Figure 3 shows several screenshots of execution flow for MyQiraat version 2. The application starts from the Home page (see Figure 3(a)). From the Home page, the user will automatically be directed to the verse Al-Fatehah (see Figure 3(b) Qolun page). Apart from the functionalities available in MyQiraat version 1, new functionality was added where the user can select between the seven imams with their students (see the different in Figure 3(b) Qolun page and Figure 3(c) Warsh page) in the improvise version of the design (MyQiraat version 2). This version is able to change toward a different narrator and surah while playing the audio. For convenience, this version allowed to navigate between Imam and Surahs. For example, in Figure 3(b) Qolun page, the user can change directly to Imam Warsh page by clicking Warsh button at the bottom right of the screen. The user can also change the Surah by using the 'Next' and 'Back' arrow icons (see the next and back arrow buttons on the above in Figure 3(b) and (c)). This design also combines colours and texts at headers. These colours indicate the user in which narrator's page they are into. For example, Imam Qolun is in purple border page and Imam Warsh is in the green border page. This design was also being evaluated and the results of the evaluation are presented in Section 4.

## 4. Evaluation of MyQiraat

There were two evaluations carried out, i.e. formative evaluation for MyQiraat version 1 and version 2. The evaluation conducted mainly to get user feedback from the following elements: 1) contents of the application; 2) audio and texts; 3) the interface designs; and 4) general comments. This is to ensure high acceptance when the application is implemented in real.

### 4.1. Formative Evaluation for Myqiraat Version 1

1) Participants
Six participants were involved. Three participants have learned how to recite the Qiraat and the other two (they are first year students) who do not know at all in Qiraat recitation. A lecturer who was teaching the Qiraat subject is also involved in this evaluation.

2) Preparation
All participants were given a copy of the apk file which were installed on each mobile device. A script for the evaluator was used to walk through with the user on the basic functionalities of the application. Semi-structured questionnaire was used as well as a digital recorder to record/capture verbal feedbacks during the walk through.

3) During the evaluation session
The evaluation was done in two sessions. Firstly, participants were walked through with the evaluator screen by screen on the basic functionalities of the application. Secondly, the application was left in the participants' devices to allow them to freely test the application so that meaningful feedbacks may be gathered later. All participants provided their comments during the feedback session.

### 4.2. Formative Evaluation for Myqiraat Version 2

1) Participants
Twelve participants were involved in the evaluation, where five participants have the experience and knowledge of Qiraat recitation. Those five participants were students from the Faculty of Quranic and Sunnah Studies (FPQS), Universiti Sains Islam Malaysia (USIM) and the other five participants from different universities and have no experience in Qiraat recitation. Two lecturers who teach the Qiraat subject were also involved in the evaluation.

2) Preparation
All participants were given a paper-based prototype with a script for the evaluator to walk through the design flow. In order to capture feedbacks during the walk through and focus groups, a semi-structured questionnaire and a digital recorder to record verbal feedbacks during the evaluation sessions were used.

3) During the evaluation session
Participants were walked through with the paper-based design execution flows by the evaluator. Participants were allowed to ask questions or provide opinions during the walk through so that meaningful feedback can be gathered during the session. Focus groups were conducted with the participants to allow the evaluator to understand further the comments and feedback given during the walk through.

### 4.3. Results and Analysis

In this section, the result and analysis of both evaluations are presented. All verbal feedbacks gathered from both evaluations were transcribed and analysed. As mentioned earlier in this section, the evaluations were focused on four main themes. This includes the content of the application, audio and texts, the interface and layout design as well as general comments. Both evaluations were focused on the users' perspective. This is due to the goal of this application which is to get high acceptance among potential users. Implication for the proposed design were also analysed to identify the benefit of the MyQiraat mobile application. It is worth noting that MyQiraat version 1 was evaluated using the prototype on

mobile devices while MyQiraat version 2 was evaluated based on paper-prototype design.

#### 4.3.1. Theme 1: Content of Application

MyQiraat version 1

**Table 2:** Retrieving Content of the Surah (Czerepinski & Swayd, 2000).

| Questions | Answer | Participant Feedback |
|---|---|---|
| Question 1: Does this application show the correct way of reading of *imam Hafs* and *imam Qolun*? | Yes | 6 |
| | No | 0 |
| Question 2: Is the way of displaying the other mushaf in different page will benefit you? | Yes | 6 |
| | No | 0 |
| Question 3: Does this application helps you distinguish between the recitations of imams? | Yes | 2 |
| | No | 4 |

Table 2 shows the result of the participants' feedbacks. There are three questions related to the content of the Qiraat mobile application prototype. All the participants agreed that the Qiraat mobile application has the correct content and displaying both mushaf (reciter) was beneficial to them. The way of recitation and the writing method are correct as specified in the reference book.
One of the participants has highlighted that the content may be suitable for a beginner user who wish to learn Qiraat for the first time. We noted that the contents of the application should be expanded for advanced users.

MyQiraat version 2
There was no consensus from participants about the contents. A few participants expressed their view on the contents as below:

"the application [MyQiraat] content is very compact, where I can choose different Imams according to my preferences".
"please check the spelling and writing of Quran".
"Another suggestion for writing is to use rasm (writing) Uthmani for not confusing the other user".
"I think this application [MyQiraat] may add more surah". (Comment from the lecturer)

It is noted that the majority of the participants commented that the contents must be extensive enough in order for the application to be more attractive for them. Some participants suggested that the application should include the whole surahs in the Quran for the benefits of ummah who wish to learn Qiraat.

#### 4.3.2. Theme 2: Audio and Texts

MyQiraat version 1

**Table 3:** Audio and Text (Czerepinski & Swayd, 2000).

| Question | Answer | Participant Feedback |
|---|---|---|
| Question 4: Are you satisfied with the audio and text displayed? | Yes | 5 |
| | No | 1 |

Table 3 shows the result on audio and texts. One participant is not satisfied with the audio provided. However, other participants expressed that they impressed with the quality of the audio. The following are some of their comments:
"the font type and size chosen make it easy [or mostly satisfied] to read".
"the sound for recitation Qiraat is very clear. However, the audio should provide reciter by famous imam".
It was clear that the participants provided positive feedbacks on audio and texts. However, the recitation by famous imam should also be included in the future enhancement.
MyQiraat version 2
A majority of participants provide positive feedbacks where the images and texts are readable. At this stage, the audio part has not been evaluated until the real prototype is ready. Some participants gave their initial opinions and comments as below:
"the text is readable and looks professional".
"the text is readable and has the right size [or mostly satisfied]".
"The text is readable; however, the font is not clear. Maybe you can make the text a little bit sharper".
"Another suggestion for text is to use mushaf madinah". (Comments from the lecturer)
Overall, it was clear that the feedback is positive. It was noted that standard text must be used consistently from the Holy Quran script. One of the participants (a lecturer for Qiraat subject) provided an opinion on audio such as to include sound by famous reciter i.e. Imam Sheikh Abdul Rashid Al Suffi.

#### 4.3.3. Theme 3: The Interface Design

MyQiraat version 1
In general, the layout is acceptable, however the design need to be improved. One of the participants commented as follows:
"you should consider changing the background of the application layout ".
"the application should apply more colourful design theme".
It was noted in the participants' comments. In the improved design version, the developer and the users shall co-design the user interface to attract more user to use the application when it is implemented in real.
MyQiraat version 2
Some participants agreed that the user interface was very interesting and easy to follow. Some participants also highlighted some improvement that can be considered when developing the application.
"The interface is interesting and colourful. It is very intuitive and easy to navigate between the pages…. I can easily follow the learning of Qiraat".
"put some texts on the header of navigation [menu] page [i.e options] to alert user to know that page".
"The design should use white background and the color for words should be darker on the surah page to make it readable by colour-blind people".
"for highlighting the different Imam, the colour can be put on the frame page".
"the colour for navigation is not nice. Minimise the usage of the colour. Maybe put one or two colours only".
"Put something at the button between Qolun and Warsh such as icon or text (i.e Imams)".
"I think the combination of green and blue colours is not suitable, may be you can change to another colour".
"Maybe we can insert move cursor to the text line, follow by audio play".
"the design not crowded and I think it can be used by all ages".
"When the design of the application is good, the user who first time uses the technology will adapt easily because the design is user friendly".
"the design is simple and smart".
"The design is beautiful, nice and easy to understand".
Based on the participants' feedbacks, selecting the combinations of colour is very crucial on the screen reading for mobile devices. A high-quality interface design for Qiraat learning should be simple and comfortable to read, especially for colour-blind people. For example, it should enable a high contrast pairing such as black and white.

#### 4.3.4. Theme 4: General Comments

MyQiraat version 1
The general comments from participants with regard to the design decision are as follows:
"this application is user friendly. I can start to learn Qiraat anytime that I want".

"advanced contents should be included otherwise it is not relevant for senior students".

The participants highlighted that this application is user friendly and easy to use. It also can facilitate the ubiquitous learning of Qiraat as long as the application is in their mobile device. However, the participants have suggested adding more verse to make it relevant to senior students or advance users.

MyQiraat version 2

Participants highlighted several advantages of the application. This includes a better understanding as well as encouraging and motivating the participants in learning Qiraat. Perceptions from the participants on the designs are very positive to support the development of the real application. Some comments from the participants are as follows:

"when the design already applies to real application, it can be used by all users [who wish to learn Qiraat]".

"it's a good application".

"The application can act as user references [i.e. source of reference] for better understanding of Qiraat".

"Internet resources not necessarily correct unless the content already gets validated from the experts in Qiraat".

"It is a good design application to learn Qiraat, but hopefully more surah can be added from time to time rather than just surah Al-Fatehah and Al-Baqarah at the moment".

## 5. Conclusion

This paper reports the iterative design activities of MyQiraat mobile application. Each design iteration, a formative evaluation was conducted. This is to ensure high acceptability among potential users when the application is deployed in real environment. Comments and knowledge gained (i.e. formative evaluations) from the potential users are extremely valuable and will be used when the design is put into practice. For future works, the design will be revised to suit the suggested improvement for the development of the prototype application. The prototype of MyQiraat version 2 will be developed using Ionic Hybrid Framework mobile application tool [25-27]. It is a cross platform framework, whereby it supports various platforms such as Android, iOS and Windows mobile devices. Once the prototype is ready, a summative evaluation will be conducted to understand the value of the application among users who wish to learn Qiraat.

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## References

[1] Sulaiman, M.M, The seven famous qira'at and their implications on qur'anic exegesis, Doctoral Dissertation, (2011).

[2] Syarif, J. M., Qiraat Asyarah Mutawatir, Daral Sahabah Lithurath Bitanta. (2010).

[3] Elhadj, Y. O. M. (2010), E-Halagat: An e-learning system for teaching the holy Quran. Turkish Online Journal of Educational Technology, 9(1), 54-61.

[4] Ahmad Madni, Q. G., Gulzar-e-Tajweed-o-Qiraat, Fezan Madeena Qiraat Acedmi, (2015).

[5] Suyuti, & J. Din, Al-itqan fi ulum al-Quran, Beirut: Dar al-Fik, (2005).

[6] Czerepinski K.C. & Swayd A. R., "Tajweed rules of the Qur'an part one", (2000), http://d1.islamhouse.com/data/en/ih_books/single2/en_Tajweed_Rules_of_the_Quran_Part_01.pdf.

[7] Ibrahim, N. J., Idris, M. Y. I, Razak, Z., & Abdul Rahman, N. N., (2013), Automated tajweed checking rules engine for Quranic learning. Multicultural Education and Technology Journal, 7(4), 275-287.

[8] Muhammad, A., ul Qayyum, Z., Tanveer, S., Martinez-Enriquez, A., & Syed, A. Z., (2012), E-hafiz: Intelligent system to help Muslims in recitation and memorization of Quran. Life Science Journal, 9(1), 534-541.

[9] Abdul Roni, N. H., Enhancement of Qiraat mobile learning application: e-Qiraat, Bachelor's thesis, Universiti Sains Islam Malaysia, (2015).

[10] Mohd Bahrin, M. A., Qiraat Mobile learning, Bachelor thesis, Universiti Sains Islam Malaysia, (2014).

[11] Burnett, G. M., Wischgoll, T., Finomore, V., & Washington, C., "Initial design of a multimodal collaborative mobile application for real time decision making", Proceedings of the International Conference on Computer Graphics and Virtual Reality-World Congress in Computer Science, Computer Engineering and Applied Computing, (2012), pp. 1-6.

[12] Crearie, L., "Human Computer Interaction (HCI) factors in technology enhanced learning", Proceedings of the International Conference on Information Communication Technologies in Education, (2013), pp. 99-108.

[13] Naismith, L., Lonsdale, P., Vavoula, G. N., & Sharples, M., (2004). Mobile technologies and learning. https://lra.le.ac.uk/bitstream/2381/8132/4/%5b08%5dMobile_Review%5b1%5d.pdf.

[14] Adhoni, Z. A., Al Hamad, H., Siddiqi, A. A., Parvez, M., & Adhoni, Z. A., (2013), Cloud-based online portal and mobile friendly application for the Holy Qur'an. Life Science Journal, 10(12), 524-538.

[15] Ishak, S. F., Zaki, Z. M., Mohamad, K. A., Bahrin, M. A. M., Roni, N. H. A., & Musa, M. A., "MyQiraat: An interactive Qiraat mobile application", Proceedings of the 4th International Conference User Science and Engineering, (2016), pp. 35-39.

[16] Low, A. L. Y., Low, K. L. T., & Koo, V. C.,(2003), Multimedia learning systems: A future interactive educational tool. The Internet and Higher Education, 6(1), 25-40.

[17] "Guru App Ltd", (n.d), https://play.google.com/store/apps/details?id=guruapp.guruquiz_gcse_chemistry, last visit:01.12.2017

[18] "Qiraat Asyaara", (n.d.), https://play.google.com/store/apps/details?id=com.snapics.quran10

[19] "Qiraat Jazarine", (n.d.), https://play.google.com/store/apps/details?id=com.qiraat

[20] Assabile,"Biography of Mishary Rashed Alafasy", (n.d.a), http://www.assabile.com/mishary-rashid-alafasy-1/mishary-rashid-alafasy.htm

[21] Quran Central, "Biography of Abdur-Rahman As-Sudais", (n.d.), http://quran.muslimcentral.com/audio/abdur-rahman-as-sudais/

[22] Assabile, "Biography Abu Bakr Al-Shatri", (n.d.b) http://www.assabile.com/abu-bakr-al-shatri-34/abu-bakr-al-shatri.htm

[23] i4Islam, "iPhone Islam Mushaf", (n.d.) https://itunes.apple.com/us/app/iphoneislam-mushaf-mshf-ay/id328962407?mt=8

[24] Samed, S.,"Al Quran mobile application", (n.d.), https://itunes.apple.com/ca/app/alquran/id314099174?mt=8

[25] Ionic,"Ionic framework", (n.d.) http://ionicframework.com/

[26] Griffith, C., Mobile App Development with Ionic. Cross-Platform Apps with Ionic, Angular, and Cordova, O'Reilly Media Inc., (2017).

[27] Wilken, J., & Bradley, A., Ionic in action: Hybrid mobile apps with Ionic and AngularJS, Manning Publications, (2016).