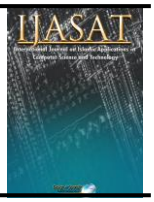


A Game-Based Learning Quran Reading Application: A Performance Evaluation of the Special Needs Children

Fatima Jannat[a], Unaizah Obaidellah[b*]

[ab]Department of Artificial Intelligence, Faculty of Computer Science and Information Technology, Universiti Malaya, Malaysia
unaizah@um.edu.my*

Abstract

Parents and instructors often search for a well systematic and coherent learning method for their special needs students so that they can adopt the method quicker. The learning method for Special Need Children is not always the same as the normal students, especially in case of learning a second language like Arabic where it requires more attention and diversity in the learning materials. We theorize that understanding the core difficulties and challenges of different types of special needs children during language e-learning would facilitate the process of designing personalized learning methods via computer applications. To support our theory, we developed a desktop-based application incorporating an adaptable method like gamification with multiple modules and analyzed the accuracy and time attributes from the collected actual target group's data. The proposed application could identify where the students frequently make mistakes during learning using the application. It is also observed that most of the students quickly embraced the proposed game-modules resulting in a positive effect in their Arabic language learning.

***Keywords*:** gamification, Quran reading, telawa, special needs children, performance evaluation.

1. Introduction

Religious education is an important component for personal development of an individual. This supports several functions in life that spans across moral, spiritual, social and cultural aspects which helps to understand individuals, groups and communities. In Islam, the significance of education is highly emphasized. One of the aims of the Islamic education is to provide teachings of Quran, the major holy book for Muslims which forms one of the pillars of faith in Islam, containing various parables, commands, and lessons for Muslims to learn and act on. The al-Quran is traditionally recited in Classical Arabic. Hence, comprehending the Quran in its original form remains a norm across Muslims regardless of whether they are native speakers of the Arabic language. The Quran is divided into several hierarchical levels, from chapters to verses to word and to letter levels. All levels (i.e. chapters, verse, and word) are composed of varying lengths.

In the Muslim conception of religious education, recitation and memorisation of the Quran occupies a central role. Learning reading the Quran involves several stages which commonly begin with reading the basics, recitation, tajweed, memorization and understanding (via translation) of its scripts. These steps are potentially easier for normal and mentally-abled individuals. However, mastering these steps is demanding for special needs individuals who are challenged by mental and/or physical abilities. Furthermore, assisting the special needs children (SNC) in this type of informal education is an added challenge. Therefore, understanding the capability and ways to improve this ability of every individual in this teaching is critical.

In this modern technological era, use of technology such as mobile devices especially in education have democratize access to knowledge from the traditional practice. Many educational applications including those used to learn reading the Quran now adopt learning psychology and gamification principles to maximise the learning experience. However, there is still scarce work in the assessment of special needs children in this respect. In other words, it is yet unknown to what extent special needs children of different types perform when interacting with a gamified learning Quran Reading application. Gamification is considered a potential factor in learning to create an informative, exciting, educational, and entertaining content due to its interactivity. During learning, these features are keys to motivate and engage the special needs children who are known to have short attention span.

The proposed research is a preliminary attempt to answer this gap by evaluating how well different types of special needs children perform when interacting with a learning Quran Reading application (called ***Let's Tilawah***) that was developed using the gamification principles. In this context, performance refers to the amount of time and score accuracy invested by the user on a specific module of the app. The system consists of four types of modules; each records these metrics as an individual performs different activities in the respective module. Several types of special needs students such as those with autism, slow learner, and Down Syndrome were recruited in this assessment. However, it is worth noting that at this point, this work serves as a case study given that only a few students represent each group due to scarcity of respondents for each type of disability at the time the study took place.

The contribution of this work is its methodological approach in analysing data associated with the performance of the special needs children towards an automatic progress monitoring of their learning development. As a result, teachers and parents will be able to examine the learning performance of their student/child without relying intensely on manual recording and observation of the child's learning progress. The proposed method is applicable regardless of the type of subject matter and could be extended to healthy/normal development population (both adults and children).

The aim of the research is threefold. All of which seeks to evaluate the Quran reading app that was developed by the authors. First, the work attempts to identify the difference in terms of performance (i.e. speed and accuracy) of four types of modules of the app. Secondly, the evaluation investigates whether differences of their performance exist across different types of development categories (i.e. disabilities). Finally, the work identifies the percentage of errors produced at the lowest level of the content learned in a specific chapter (Surah) of the Quran. This characterizes whether there is an effect of improved learning that can be observed at the lowest level unit of content (letter level). With respect to the objectives, the following are research questions for the proposed work:

1. Is there any difference between the four (4) modules? Did the students (all) perform better in any of them (modules)? And if so, which module showed the highest and lowest performance?
2. Across different types of disabilities (SNC categories), did their overall performance differ in time and accuracy?
3. What is the percentage of errors for each letter in surah Al-Ikhlas? And which letters received the highest and least number of mistakes?

2. Literature Review

2.1 Gamification in Language Learning

This subsection will discuss about related works in the field of language learning where gamification has been used as a pedagogical strategy. The research work of Figueroa (2015) presented a brief overview of the usage of gamification tools and methods in case of the second language learning. It showed how some of the popular second language learning applications like: *Duolingo, Class Dojo, Edmodo, Zondle, Socrative, Brainscape* used gamification as motivational theory. An online based game prototype has been developed for the Arabic elementary language learners in the work of Sahrir and Alias (2012) with an objective to understand the perceptions of Arabic language learning though online games. The authors designed and developed a framework for Arabic language online game using the results and findings of total 113 students' survey. In Hamizul and Rahimi (2015), a conceptual method for Arabic language learning online game is developed combining various game elements, pedagogy components and ARCS (Attention, Relevance, Confidence, Satisfaction) model. One of the limitations of this study is that no such game prototype has been developed to support the proposed method. Zhou et al (2017) developed a story-telling based game name **ADVENTURE** for Chinese students to practice learning English language. Users need to map the appropriate word to define a story image and they can rehearse the narratives in this app. Hence, these types of practice enhance the users' vocabulary and reading skills.

2.2 Gamification for Special Need Children

Many research works have contributed to the field of education using gamification for special need children. Gooch et al (2016) used a very popular gamification platform named *classDojo* for examining motivation among the students with Dyslexia. The authors conducted a case study approach among the teachers and students to comprehend the influence of gamification. At the end of analysis, Gooch et al (2016) suggested three important practices: "1) providing students with badges for overcoming personally meaningful challenges 2) giving students the agency to identify their own weaknesses through a process of negotiation with their teacher, 3) self-reflection and monitoring of their improvements."

A game based educational application is developed in Cruz and Palaoag (2019) for the exceptional learners with an acceptability ratio of 4.55from the users. A major limitation of this research work is lack of analysis on influence of gamification among the exceptional learners. Another application name *LexiPal* is developed in Saputra and Risqi (2015) with different game elements like story/theme, achievements/badges, rewards, levels, clear goals, points and feedback for dyslexia students. Forty dyslexic children were tested using qualitative and quantitative methods with and without *LexiPal*. Result from this research work shows that, 92.5% students could keep their interest while using the application and 100% of them felt happy learning with gamification method. The authors also mentioned the probable reason behind losing attentiveness of this special category students were tiredness or hunger.

A good number of researches like Hussain et al., (2014), Hanafi, Hendrawan, and Hakim (2019), Ahmad et al. (2019) used game elements to develop applications for hearing impaired students with the objective of learning reading the Quran. The authors in Ahmad et al. (2019) developed their application *mAR-Quran* with augmented reality and feedback features where users can arrange these sequences of verses during Quran Memorization.

mFakih (Hussain et al., 2014) is a mobile/tablet app based model to teach deaf students al-Quran using Fakih (Mohd, Jomhari and Abdull Zubi, 2012) techniques which uses coloured and numbered techniques to represent each Arabic letter. A prototype of the proposed model has been implemented in this work. One of the limitations of this work is that there were no model or application evaluation through collecting data from the targeted users. The study on MUD and ALI (2021) also stated *Fakih* as a popular medium of learning reading al-Quran for the disable young students. This document analysis-based study also mentioned two more popular techniques; Abahataal-Jabari, a rhythm based Quran reading learning method and skin sensitivity, a touch based Quran reading learning method for the blind visually impaired children.

The research work in Senan et al. (2017) used takrir or repetition method and proposed a mobile application named *iHafaz* for the autistic children. The proposed application presented total two modules; 1) Hafaz or Memorize and 2) Latihan or Exercise. Result found from this study shows that 84.5% users (teachers and students) approved takrir as an effective method and 72.4% respondents found the *iHafaz* application a productive tool for memorizing al-Quran for special need students.

2.3 Summary

The review from the previous work implies that method like *gamification* and incorporation of game elements in a language learning process can make the learning more interesting, fun and attention-focused especially for the special need children. The review also shows the importance to include e-learning methods along with conventional methods for learning reading al-Quran for the SNC students.

From the summary, it can be concluded that even though a good number of studies have been carried out focusing on learning reading al-Quran, very few of them developed a real-life application using gamification method and tested on targeted users like special need children. Considering the need of a suitable, easy-to-use and enjoyable learning Quran reading application for the special need students, this research work proposes a practice-based gamification application with total five different modules (one learning module and four exercise modules) and tested with proper target users.

3. Proposed Work

3.1 Proposed Game

After assessing the related literature on language learning strategies using gamification methods for both special needs children and normal children, this paper proposes an educational game named *"Let's Tilawah"*. Figure 1 shows the workflow of the proposed game. The game starts with an animated storyline with sound effect which increases the curiosity about the game among the children. As the proposed game tracks every player's score, each player needs to create an account for playing the game using the sign up and login screen. The login screen leads to a menu screen where the player can choose their preferred module option to play. The players go to a *Surah Map* screen after choosing to play a module from a choice of four. The UI of the game has been designed with an *Island-Adventure* theme. Players can choose any particular Surah (chapter of Quran) and play further.

This game has been designed in such way that the users can learn to recognise the letters of a surah in Top-Down approach. There is a total of five modules among which one is learning

module (Recognize Letters) and other four are exercise/game module (Match Letters, Arrange Letters, Find Letters and Select letters).

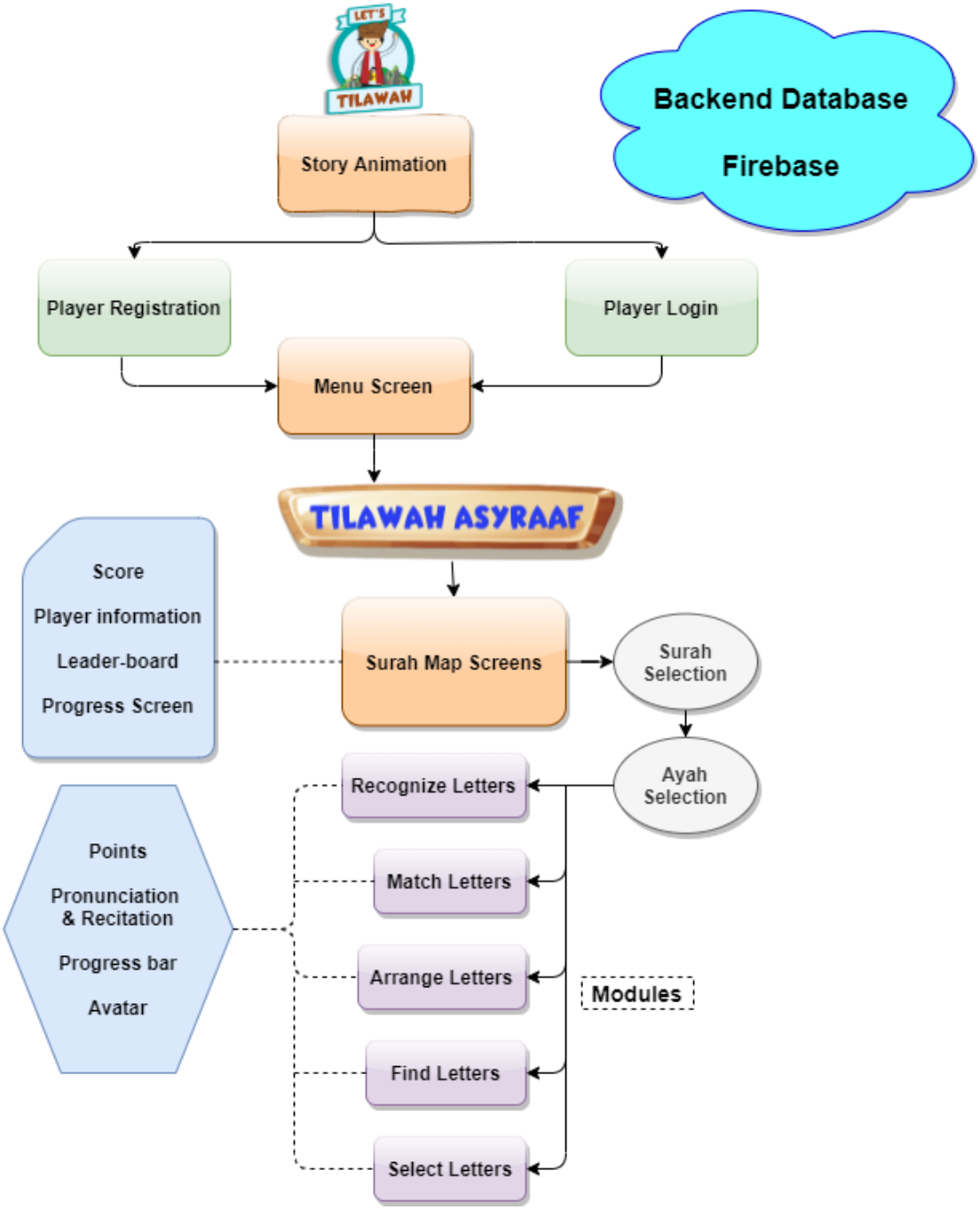


Figure 1: Work-flow of Proposed Game

3.1.1 Recognize Letters (Module-1)

Any user can learn all forms of an Arabic alphabet from this module. In Arabic language, one alphabet may have different forms (styles) at the start, middle or end of a word. Hence, it is important for the students to learn how a letter is represented in different positions. *Recognize letters* module helps a student to learn before starting the game modules.

3.1.2 Match Letters (Module-2)

Match letters is a simple click-based challenge module in which students get to choose the correct option to match with a letter. In this game module, one at time, a word from an ayah appears on the screen and a colored marker indicates which letter from that word a player needs to match. A player gets full score if he/she can match it correctly in the first go. Otherwise for every incorrect answer, one point is deducted.

3.1.3 Arrange Letters (Module-3)

Arrange Letters is a drag-drop based game module where students choose the option and drag it to the correct position. This dragging challenge has an increased difficulty level for the children. One of the aims of adding this dragging functionality is to examine how special need children can easily cope with this difficulty.

3.1.4 Find Letters (Module-4)

*Find letter*s is also a click-based challenge model where a student has to choose the correct answer from fourteen options. Having more options to choose when answering the question increases the difficulty of this module for the SNC students.

3.1.5 Select Letters (Module-5)

Among the Arabic letters, there are many letters whose structure is similar to each other with very small differences. The objective of this *Select Letters* module is to make the students practice the similar letters. The students need to choose the correct option from a range of similar looking letters in this module.

3.2 Development of the game

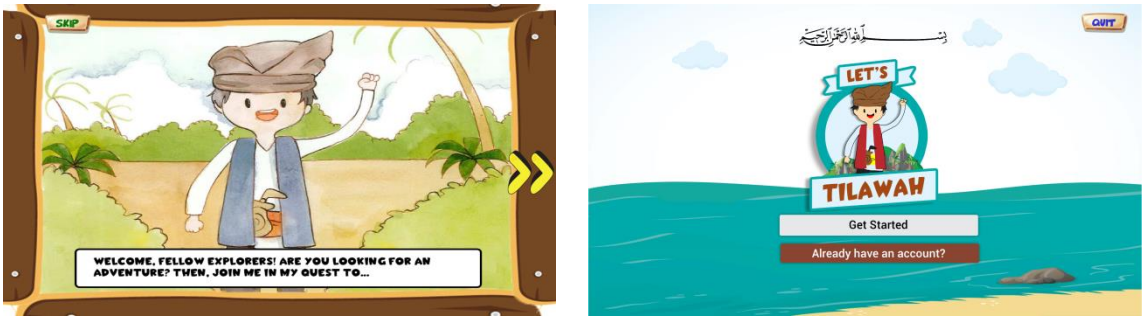
This section gives an overview of the developed game to support the proposed work's objective. During the implementation of the user interfaces, the following aspects were included keeping the targeted users in mind:

- The game is developed following the gamification elements (game mechanics) like Score, Levels, Rating, Animal Avatar (Badge), Rewards (Fruits), Quiz (module-based), Leader-board Progress (Game and Ayah level), Animation Character (Khaleel et al. 2016).
- The images, icons and symbols of the proposed game are designed maintaining the semiotic interface design framework (Islam and Bouwman, 2016).
- Clear and explainable English voice instructions are included in a enjoyable manner which is appropriate and interesting for the children.

The game was developed in Unity, a cross-platform game engine using C# object-oriented language. Firebase back-end, a platform developed by Google, has been used for storing all the users' real time data, record and authentication. This real time feature lets the users to observe their updated leader-board instantly. The game is developed particularly for tablet or PC screens. After the implementation, the application has been tested at the development level by three software developers and two game designers before starting the eventual interactive experiments with the children. This is important to verify that the app works in a correct flow.

Figure 2 shows the snippets of the welcome screen with an animated character's storyline. This kind of storyline shown at the beginning of the app helps the children to develop more attention and enjoyment (FU and Yu, 2006). This is emphasized by Wijaya and Helmi (2018) on how an animated character can offer suitable representations of diverse concepts. The

storyline of this game is demonstrated as an island treasure hunting adventure where the children can earn more rewards the more they play the game.



(a) (b)

Figure 2: Starting Screens with animated story-line

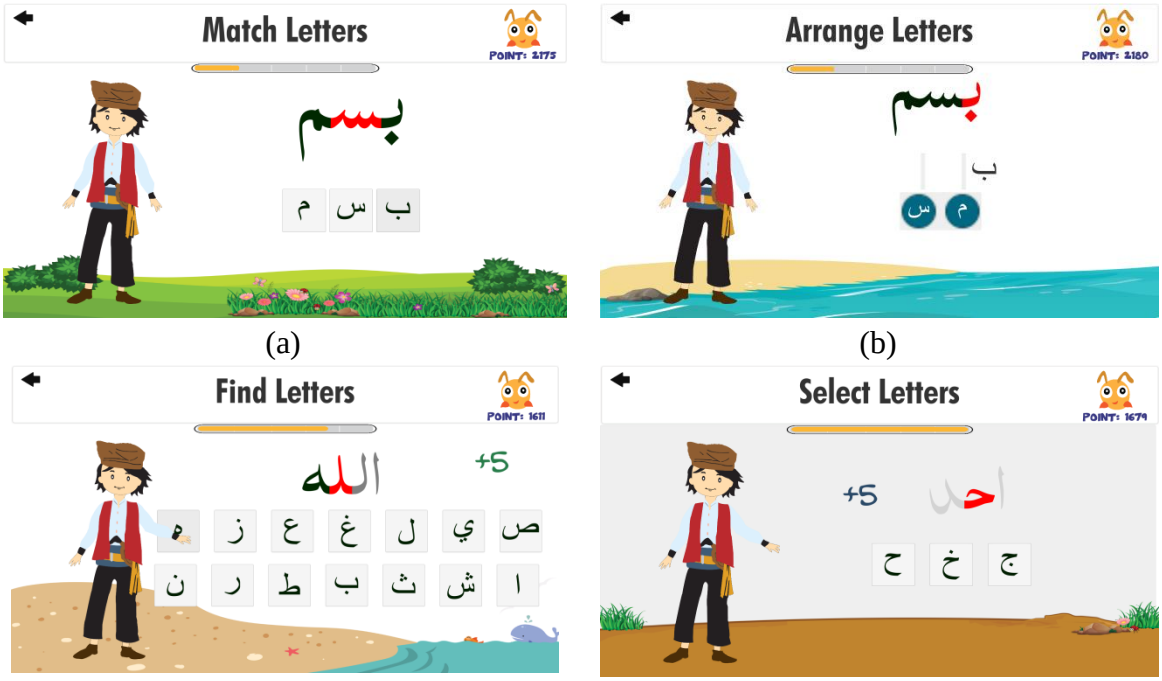
The main Surah selection screen is designed with an island concept [Figure 3 (a)] where a total four islands hold all the surahs from the last chapter of the holy Quran. The children can choose any surah to play from this interface and track their surah rating and rewards. After selecting a particular surah, a player gets to choose an ayah from the Ayah Screen [Figure 3 (b)] and any of the five modules (One learning module - Recognize Letters and four game modules - Match, Arrange, Find, and Select letters) from the Module selection screen [Figure 3 (c)].

(a)

(b) (c)

Figure 3: Interface of Surah, Ayah and Module selection screens

Figure 4 shows the interface of the four game modules screens. The players can observe their progress while playing a module from the progress bar. They can also instantly observe their updated score. Each module is associated with the default animated character which gives different vocal updates when a player answers a question correctly or incorrectly.

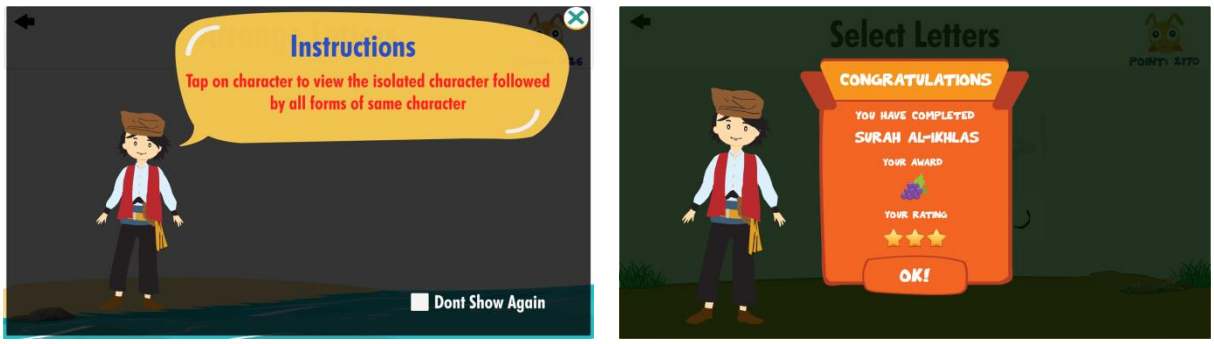


(a) (b)

(c) (d)

Figure 4: Four game modules- (a) Match Letters, (b) Arrange Letters, (c) Find Letters, and (d) Select Letters

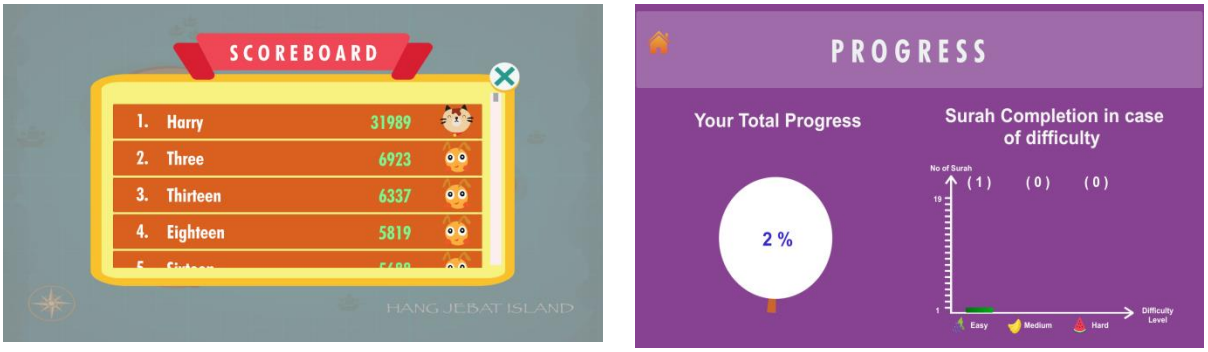
Animations in a game can have different types of functionalities such as Directional, Transitional, and Instructional (Wijaya and Helmi, 2018; Berney and Bétrancourt, 2016). Instructional animations [Figure 5 (a)] is used in this game to make the players, especially who are first timer, understand how each game modules are needed to be played. Again, transitional animations are used upon completing playing a full surah and during the award notification phase [Figure 5 (b)].



(a) (b)

Figure 5: Usage of animations for different purposes

Performance measurement features such as scoreboard and progress graphs [Figure 6] are presented in this game so that parents and teacher can understand and track the performance of a particular child. Additionally, features such as scoreboard also motivate the children to play more while aiming to gain higher positions.



(a) (b)

Figure 6: Performance measuring feature screens (a) Scoreboard (b) Progress

4. Data collection and Analysis

4.1 Data Collection

4.1.1 Participant

Ten special needs students of three types of disability (i.e. autism, Down syndrome, and slow learner) participated in the study. These students were recruited from a special needs school that specializes in teaching these students Quran lessons. Majority of these children were considered beginners in learning the Arabic alphabets who have learned for approximately several months before the study took place. There were 3 female and 7 male students. Although their age range were between 9 to 14 years old, their knowledge and skills/ability in performing the required tasks for this study very considered somewhat similar given that all were at an almost similar performance level as confirmed by their teachers.

It is assumed that majority of these students have acquired sufficient preliminary knowledge from their previous lessons in the traditional classroom setting. Therefore, the focus of this study is to evaluate the level of adaptability/performance of these students in identifying the Arabic letters with respect to the use of the Let's Tilawah modules developed as an effect of gamification techniques.

4.1.2 Material

The Let's Tilawah application consists of four game modules each associated with different types of challenges, namely 1) Match Letter (Module 1); 2) Arrange letter (Module 2); 3) Find letter (Module 3); and 4) Select letter (Module 4) (details given in Proposed Work)
For the purpose of this data collection, Surah Al-Ikhlas was used as the students were most familiar with this surah during their previous learning sessions in a normal classroom exercise. Additionally, a relatively short surah as this would maintain the attention of these children who are known to suffer shorter attention span.

4.1.3 Procedure / task

The students were asked to complete a full cycle of the game modules (4 models) for the Surah Al-Ikhlas (4 ayahs), which consists of 16 tasks. There were told that they will be playing a series of games, and all indicated interest to participate on a voluntary basis prior to the session. Each student completed a single session individually that lasted approximately 5 minutes. Only one student who seemed very less focused did not complete the full session and only played two and half ayahs

.

To assist interaction while playing the game, the students played on a touch screen tablet while being observed by the experimenter. All participants were given a chance to familiarise themselves with the tablet device used for data collection although these students were pre-identified to be familiar with common tablet usage prior to the experiment. They were allowed to explore and play with a different test surah for 2 minutes before the experiment begins. All students understood the task instructions and performed according to the expectation of the experiment when playing the game.

4.2 Result Analysis

This subsection describes the analysis of the collected data from the target group. This study followed the statistical data analysis method to inspect the outcome. Among all the special need students, 87.5% successfully completed playing all the game modules of all ayahs of the Surah Al-Ikhlas. The effectiveness of this game can be measured from the performance accuracy and completeness (Frøkjær, Hertzum and Hornbæk, 2000) of the game modules by time (M = 958.275, SD = 646.46) and surah ratings (M = 2.6925, SD = 0.4744). Only 12.5% SNC (mainly of the Autistic category) could not complete all the game modules of all ayahs due to a remarkable less focus and attention. Further data analysis is conducted using only data from those students those completed all the game modules.

Module based performance (accuracy): This part of paper shows the result of the students' accuracy performance across all four game modules. The graph in Figure 7 is shown from data calculated from the ratings gained by each student while playing each Module of all four Ayahs of Surah Al-Ikhlas. Result shows that the students did best in Module-2 (Match Letter) with 97.83% highest accuracy while Module-4 (Find Letter) recorded the lowest accuracy with 93.93%.

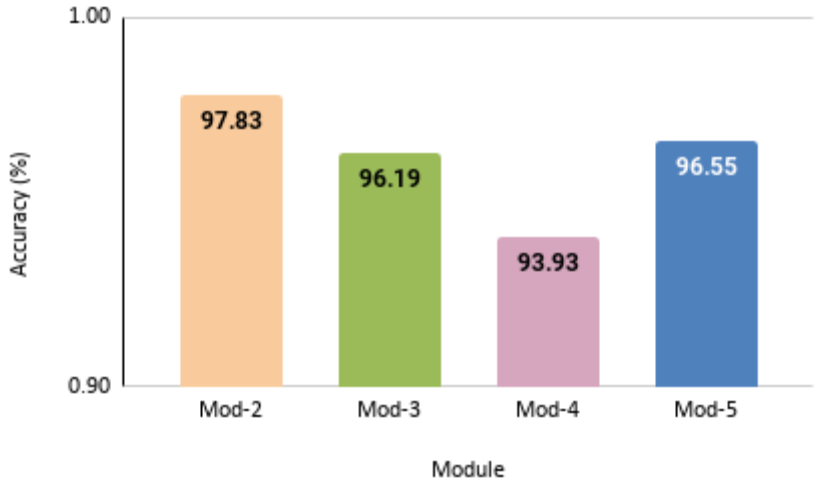


Figure 7: Accuracy based performance

5.

Table 1 shows that all the students' average rating for Module-2, Module-3, Module-4, and Module-5 are 2.946, 2.886, 2.818, and 2.896 respectively. Here, it can be observed that Module-4 has the most standard deviation of 0.2465 with minimum rating 2.2 and maximum rating 3. This suggests that the differences of performance accuracy among the students are less consistent for Module-4. Hence, the results also imply that Module-2, Module-3 and Module-5 are more consistent across the students regardless of their disability category.

Table 1: Results of study on accuracy per module

Variable	Module	Mean	Std. Dev.	Min	Max
Accuracy (rating out of 3)	Mod-2	2.946	.0999	2.7	3
	Mod-3	2.886	.1268	2.5	3
	Mod-4	2.818	.2465	2.2	3
	Mod-5	2.896	.1478	2.5	3

Performance (accuracy & time) of different special need student categories: A descriptive analysis is performed to identify which category of special need student performed well with this proposed game. In this research, there were three categories of special need students who participated in the data collection; 1) Autistic; 2) Down Syndrome; and 3) Slow learner. Result in Table 2 shows that even though Slow learner students took more time (M = 1276.5, SD = 465.98) they performed best among all other categories in terms of accuracy (M = 2.95, SD = .07).

Table 2: Results of performance study on SNC category

Variable	Category	Mean	Std. Dev.	Min	Max
Accuracy	Autism	2.85	.058	2.8	2.9
	Down Synd.	2.7	0	2.7	2.7
	Slow Learner	2.95	.07	2.9	3
Time (s)	Autism	567.55	229.8	353.5	840
	Down Synd.	2230	0	2230	2230
	Slow Learner	1276.5	465.98	947	1606

Completion time based performance: Completion time based on performance is evaluated at two levels; 1) Analysis of average time taken for each alphabet in each ayah of surah Al-Ikhlas, 2) Analysis of average time taken for playing each module of each ayah of the surah Al-Ikhlas.

The first evaluation examined how much average time each student took to play one alphabet (haraf) in each ayah. All the game modules are designed as alphabet-based game meaning that a player obtains points after solving different challenges of a single alphabet. Figure 8 shows the players time progression of the alphabet in each ayah. The players spent most time (3.63 sec) to play an alphabet in the first ayah of surah Al-Ikhlas. This gradually decreases over time as they played more ayah, indicating improved performance and familiarity.

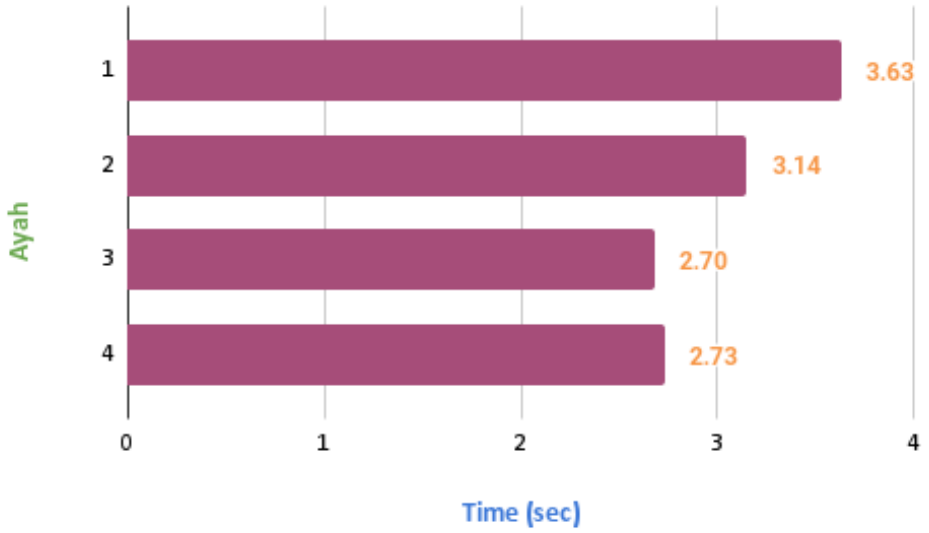


Figure 8: Per Alphabet Time (sec) vs. Ayah Graph

The second evaluation analyses the average completion time for each student in playing each module of each ayah. It can be observed from Figure 9 that Module-4 needed more time than any other modules. A one-way Anova test among the completion time of each module found significant difference where the p value of Module-4 with Module-2, Module-3 and Module-5 are p = 0.0041, p= 0.012 and p = 0.00109 respectively. This result confirms that Module 4 is significantly different from the other modules. Another observation noticed from Figure 9 is that the curves for all modules generally show a gradual decline from the first ayah to the last ayah.

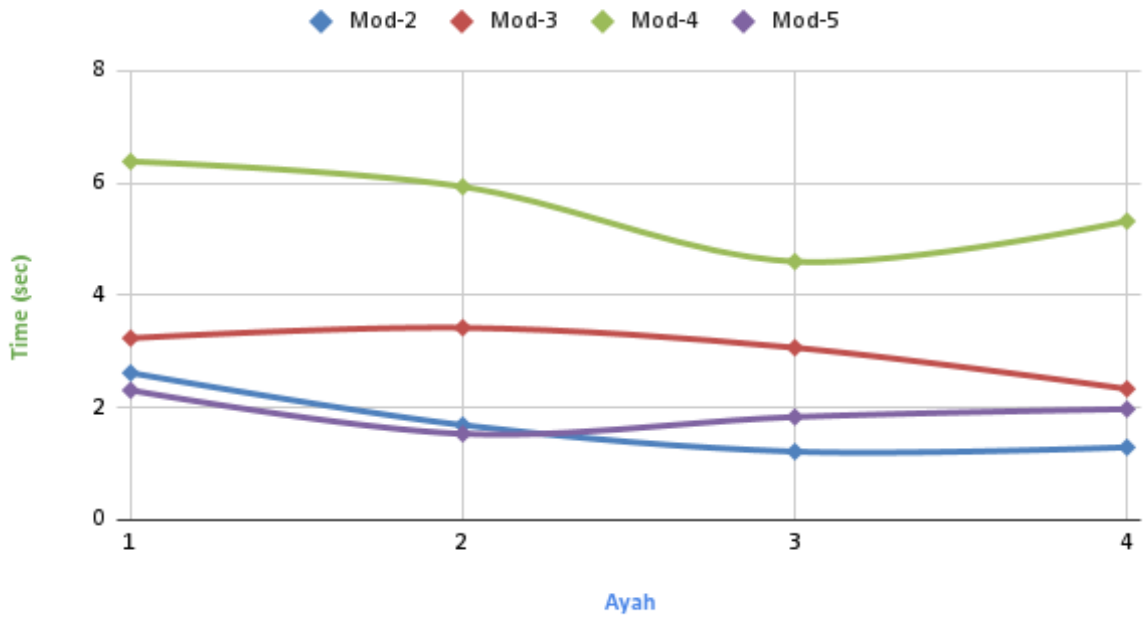


Figure 9: Time, Module and Ayah Graph

Alphabet recognition result analysis for Surah Al-Iklhas: In this part, an analysis is performed on all unique alphabets of surah Al-Ikhlas. There is a total of 13 unique letters in surah Ikhlas (ا , ل, د, ه, ح, و, ك, م, ق, ي, ص, ف, ن) . The goal of this analysis is to find among these 13 alphabets which of them were frequently answered incorrectly in a particular game module by the special need students. From Figure 10, the alphabet Kof (ق) has the highest percentage (75%) of wrong estimation for Module-5. It implies that in Module-5, 75% students choose the Kof (ق) alphabet incorrectly. Again, Ha (ه) (small) appeared a total of 4 times in the whole surah in two different styles. Furthermore, 66.67% students made mistakes in case of Ha (ه) in Module-4. Additionally, it can be noticed that, in Module-2 (Match letters) students made the least number of mistakes.

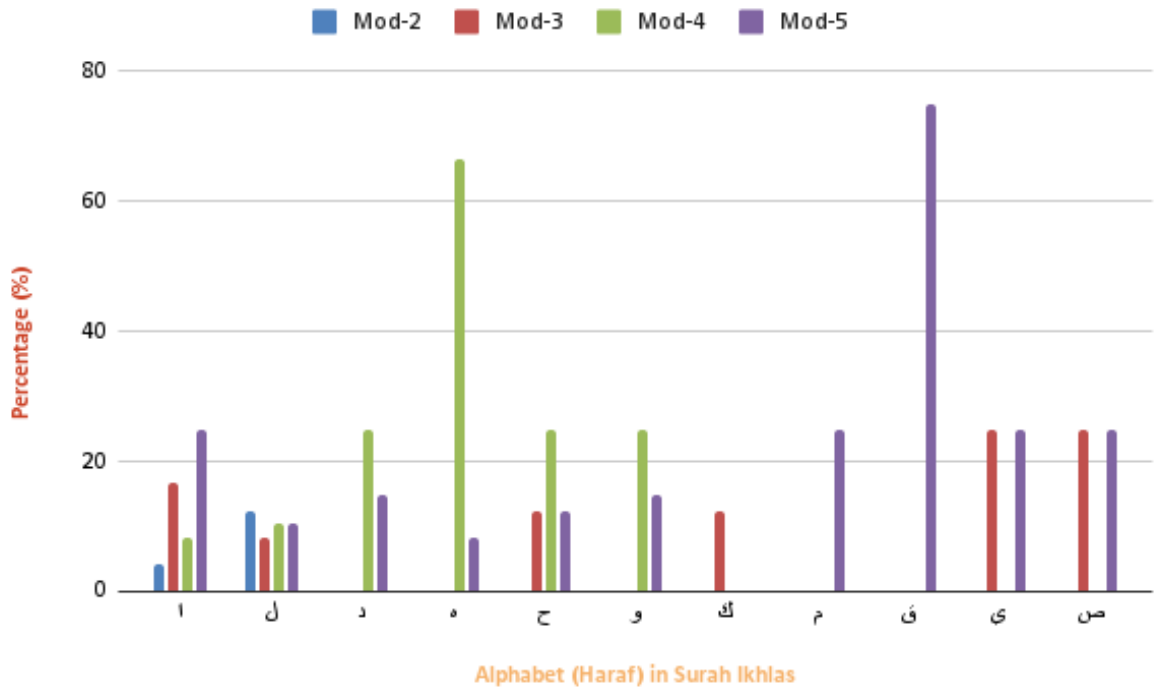


Figure 10: Percentage of making mistakes of each alphabet (of surah Ikhlas) in each module

5. Discussion

This section discusses the overall summary of the proposed work and describes the results with respect to the research questions mentioned in the Introduction chapter. The proposed game has been developed in such way that it is easy and comfortable to use for the special need children. The game modules were designed in a manner that enables any children to quickly familiarise themselves even when several of the modules were more difficult. Upon data analysis, this work examined how each module can contribute to the Arabic learning process of the SNC students.

The analysis from the subsection “Module based performance (accuracy)” and “Completion time-based performance” answer the first research question and finds the differences among the four game modules. Result shows that Module-2 (Match Letters) was most straightforward, easiest, showed high-scoring and is the least time-consuming module to all the SNC students. The likely reason is that this module is designed with a simple click-based functionality and with lesser options to choose. On the other hand, Module-4 (Find Letters) is found significantly different than the others in terms of completion timing and SNC students

did more mistakes in this module than any other module. The SNC students got more confused with the availability of fourteen options in this module which took longer time for them to decide the correct answer. Again, often the students became restless to understand all the options and just clicked any option randomly which eventually made their score lower for this module. Another observation can be found from Figure 7 and Figure 9 that Module-3 (Arrange Letter) has the second lowest accuracy and the second highest completion time among all the modules. This module has a dragging functionality which made it harder to play for the special need student especially when they are playing for the first time. However, from the graph in Figure 9, we can also understand that the students eventually got familiar with the dragging functionality and took lesser time gradually from Ayah-1 to Ayah-4. One of the interesting facts that can be found form the result analysis is that even though Module-5 (Find Letters) has similar looking letter options to choose, most of the SNC student could identify the correct answer correctly and took less completion time. From Figure 8, it can also be observed that the more ayahs a student played the more the average time decreased gradually. Each student took lesser time for Ayah-4 than Ayah-1 of surah Al-Ikhlas. This implies that students got more comfortable with the game and learnt about the application faster for its easy UI and less complex features.

This research work also tries to find the differences of performance in contrast to timing and accuracy across SNC students of different categories (Autistic, Down Syndrome, and Slow learner). The result shows that Slow Learner students has higher accuracy rate than other type of students, but they took longer average time. It can be observed that nature of the disability could make an impact on their performance and timing. As for the Autistic students, they were more impatient to finish a task which affected their performance too. On the hand, the Down syndrome category students took most time with least performance when completing a task. Slow growth rate and lower IQ which are the two main characteristics of Down syndrome children can be the reason behind their lower performance and the reflection of these behaviours can be seen on this data analysis. However, the performance analysis of different types of SNC students' needs further testing and validation with more participants.

Figure 10 analyses how often the students answered a particular letter from surah Al-Ikhlas incorrectly. This analysis answers the third research question and shows that in Module-2 Lum (ل) had highest mistake rate (10.42%), in Module-3 Yaa (ي) and Soyad (ص) had highest mistake rate (25%), in Module-4 Haa (ه) had highest mistake rate (66.67%) and in Module-5 Kof (ق) had highest mistake rate (75%). The characteristic and structure of a letter, the appearance number of a letter in the entire surah, the order of appearance of a letter in an ayah and the structure of a game module are important factors that may influence the mistake rate. As for example, Kof (ق) is the very first letter of surah Ikhlas and it appeared only once in the entire surah. On the other hand, in Module-5 the students need to choose the correct option from very similar looking letters and the letter Faa (ف), Yaa (ي), Nun (ن) are similar to (ق). All this parameter can influence the students to make most mistakes for the letter (ق) in Module-5. Again, the letter Haa (ه) has appeared in surah Ikhlas in total two forms (final and isolated). In Module-3, due to confusion with too many options, most students made mistake with this letter.

The proposed method can provide suggestions for other studies on learning development for the special need children and how they can adopt e-learning more in religious studies like Arabic language. The outcome can also help the instructors to understand what types of game modules are appropriate for the SNC students and how gamification can be incorporated in the learning process.

6. Conclusion and Future Work

In this research work, an Arabic learning gamification application has been developed for the special need children. To understand the effectiveness of this kind of learning application, few empirical user studies have been done by collecting data from the target users. The result showed that overall most of special need children became accustomed with the application rapidly where they could learn and practice the game modules of the application successfully on their own. The different types of game modules with different structure and difficulty make the learning process challenging and interesting for the SNC students. Data analysis implies that the students could easily learn from their past mistakes and eventually took lesser time to complete the tasks. The analysis also showed how differently the SNC students behave according to their disability category. This type of analysis can contribute to the field of special need children research. Additionally, this research provided a method to understand the tendency of doing mistakes for any Arabic letters in a certain surah by the SNC students. This research work leads to the belief that making a letter mistake for a particular student not only depend on lack of letter-knowledge but also it can happen due to characteristic and structure of a letter, the appearance number of a letter in the entire surah, the order of appearance of a letter in an ayah and the structure or difficulty of a game module. This outcome or type of analysis can be used as part of adaptive learning systems and exercise, or lessons can be adjusted according to individual learning progress.

One of the limitations of this research work is on the limited number of SNC students adopted in the study. Only three categories of SNC students took part in the data analysis process. Another limitation is the analysis has been conducted only for surah Al-Ikhlas and this surah has only 13 unique Arabic letters among the 28 letters. In future, it is our plan to enrich the participant number during data collection including more SNC categories like dyslexia, ADHD (Attention Deficit Hyperactivity Disorder), bi-polar. A long period term testing is also included in the future plan to understand more about the real impact of this gamified application on SNC students learning method. It is also planned to compare the SNC students' result with the normal students' data and include more surah so that all the Arabic letters can be examined. This will help to understand more about the differences between the two categories students.

References

Ahmad, H., Zainuddin, N. M. M., Yusoff, R. C. M., Azmi, N. F. M., & Hassan, W. A. W. (2019). Augmented reality model to aid Al-Quran memorization for hearing impaired students. In Intelligent and Interactive Computing (pp. 447-457). Springer, Singapore.

Berney, S., & Bétrancourt, M. (2016). Does animation enhance learning? A meta-analysis. Computers & Education, 101, 150-167.

Cruz, C. S. D., & Palaoag, T. D. (2019, March). An empirical study of gamified learning application engagement to exceptional learners. In Proceedings of the 8th International Conference on Informatics, Environment, Energy and Applications (pp. 263-267).

Flores, J. F. F. (2015). Using gamification to enhance second language learning. Digital Education Review, (27), 32-54.

Fu, F., & Yu, S. C. (2006, July). The Games in e Learning Improve the performance. In 2006 7th International Conference on Information Technology Based Higher Education and Training (pp. 732-738). IEEE.

Frøkjær, E., Hertzum, M., & Hornbæk, K. (2000, April). Measuring usability: are effectiveness, efficiency, and satisfaction really correlated?. In Proceedings of the SIGCHI conference on Human Factors in Computing Systems (pp. 345-352).

Gooch, D., Vasalou, A., Benton, L., & Khaled, R. (2016, May). Using gamification to motivate students with dyslexia. In Proceedings of the 2016 CHI Conference on human factors in computing systems (pp. 969-980).

Hamizul, M., & Rahimi, N. M. (2015). Design and development of Arabic online games–a conceptual paper. Procedia-Social and Behavioral Sciences, 174, 1428-1433.

Hanafi, Y., Hendrawan, H. J., & Hakim, I. N. (2019). QUR'ANI: Assistive Technology Based on Android to Recite Qur'an for the Hearing Impaired Children. In 2nd International Conference of Learning Innovation–SciTePress (Vol. 1, pp. 47-56).

Hussain, A., Jomhari, N., Mohmad Kamal, F., & Mohamad, N. (2014). mFakih: modelling mobile learning game to recite Quran for deaf children. International Journal on Islamic Applications in Computer Science And Technology, 2(2), 8-15.

Khaleel, F. L., Tengku Wook, T. S. M., & Ismail, A. (2016). Gamification elements for learning applications. International Journal on Advanced Science, Engineering and Information Technology, 6(6), 868-874.

Malone, T. W., & Lepper, M. R. (2021). Making learning fun: A taxonomy of intrinsic motivations for learning. In Aptitude, learning, and instruction (pp. 223-254). Routledge.

Mohd Daud, N. A., Jomhari, N., & Abdull Zubi, N. I. (2012). FAKIH: A method to teach deaf people 'reading' Quran.

MUD, S. C., & ALI, M. M. (2021). LEARNING AL-QURAN FOR CHILDREN WITH DISABILITIES. Jurnal Hadhari, 13(1), 135-146.

Sahrir, M. S., & Alias, N. A. (2011). A study on Malaysian Language Learners' perception towards learning arabic via online games. GEMA Online Journal of Language Studies, 11(3).

Sahrir, M. S., Yahaya, M. F., & Nasir, M. S. (2013). EZ-Arabic for children: A virtual learning resource tool for Malaysian primary schools. Procedia-social and behavioral sciences, 90, 396-404.

Saputra, M. R. U., & Risqi, M. (2015). LexiPal: Design, implementation and evaluation of gamification on learning application for dyslexia. International Journal of Computer Applications, 131(7), 37-43.

Senan, N., Ab Aziz, W. A. W., Othman, M. F., & Suparjoh, S. (2017). Embedding repetition (Takrir) technique in developing Al-Quran memorizing mobile application for autism children. In MATEC Web of Conferences (Vol. 135, p. 00076). EDP Sciences.

Wijaya, H., & Abbas, R. A. (2018). Animation effectiveness for E-learning with progressive web APP approach: A narrative review. International Journal of Engineering and Technology (UAE), 7(4), 112-120.

Zhou, L., Yu, J., Liao, C. A., & Shi, Y. (2017, July). Learning as adventure: An app designed with gamification elements to facilitate language learning. In International Conference on HCI in Business, Government, and Organizations (pp. 266-275). Springer, Cham.

Biodata

	**Fatima Jannat** completed her Masters in Computer Science from Faculty of Computer Science & Information Technology at University of Malaya. She worked as a graduate research assistant in the same faculty for multiple years. She completed her BSc degree in Computer Science & Engineering and worked as a university lecture for one and half year in Bangaldesh. She has multiple research articles published in IEEE conference proceedings and one book chapter in Springer. She also has experience of working as a software engineer for almost three years. Her research interest includes application of computer science in Islamic education, HCI, education related software development, information security, and artificial intelligence.
	**Unaizah Obaidellah** received her PhD in Cognitive Science from the University of Sussex in 2012. She is currently a Senior Lecturer in the Department of Artificial Intelligence, Faculty of Computer Science and Information Technology, University of Malaya. Her research interests are in the field of computing education, artificial intelligence, and learning applications for the special needs children with an emphasis on studies related to cognitive processes during learning and problem-solving.