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Quran Memorization Technologies and Methods: Literature Review

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***Abstract*— The application of the Qur'an for the memorizers in adding and maintaining their memorization continues to grow in number. No less than 200 digital Qur'an applications are available on mobile application providers. In addition, publications on the topic of the digital Qur'an in the last ten years have also increased. Through these applications and publications, it is an opportunity to find patterns and knowledge about current topics and features. Through this knowledge, it is hoped that it can be a recommendation for a better form of digital Al-Qur'an application system, especially providing features that affect increasing the ease and quality of memorizing the Qur'an. This paper aims to explore the application of the Qur'an specifically for memorizing and papers on the topic to provide these recommendations. The method used to get the paper using PRISMA. While the applications being reviewed are taken from the AppStore. As a result, 31 papers were reviewed and 12 main applications regarding the Qur'an for memorization were obtained. Through the answers to each research question, it can be used by subsequent researchers as well as by system developers in developing Al-Qur'an products for better memorization of tense.**

Keywords*— *quran memorization; quran digital; memorizing method; PRISMA; literature review

1 INTRODUCTION

Today, the interest of the Muslim community in memorizing the Qur'an has increased sharply [1]. This is indicated by the increasing number of new institutions that open education for memorizing the Qur'an. These institutions have various forms, such as Islamic boarding schools, tahfiz houses, and orphanage houses that have excellent programs for memorizing the Qur'an [2]. Various existing institutions also flocked to open the tahfiz program as an excellent program. Among the trigger of this is the increasing awareness of the Muslim community about the importance of studying and mastering the Qur'an. The most basic mastery is to memorize it. Various higher education institutions also appreciate the memorization ability of prospective students by opening registration for students on the Hafiz Al-Qur'an scholarship path. For those who pass the test, there are those who are given full scholarships, which are free of tuition fees, and even some universities provide additional monthly fees to support education, such as dormitory fees, living costs, and book fees.

This increase is in line with the emergence of various Qur'anic software, especially those that support the community of memorizers. The software is made in various forms and approaches that make it easy for users to add memorization and maintain memorization (muraja'ah). This software is spread on the PlayStore for Android users and the AppStore for IOS users. Each software tries to apply memorization methods commonly used by Islamic boarding schools and memorizers so that their existence does not replace the old system but strengthens and expands access to the Quran using a mobile app. Researchers have also published various articles discussing software for memorization.

Researchers discuss software in their research articles by looking at it from various points of view. Some focus on implementing methods like the *tikrar* (repetition) such as Ayat-Al Quran, Easy Memorizing Al-Quran, Memorize Quran; mind map as Tarteel.ai and Quran Hafidz; visualization techniques as Muslim Pal and "Read, Learn, Memorize Quran", acoustic signal method as Tarteel.ai and Hafal Quran Sambung ayat; gamification as Hafalan Quran and Cinta Quran Memorization; *talaqqi* and mushafahah used by Muslim Pal, Memorize Quran, BeHafizh, and Easy Memorizing Al-Quran. Among them, focus on the effectiveness on how to memorize that used by Hafal Quran Sambung ayat, Ayat, and Tarteel.ai. There are also a focus on features that are innovations in the memorization process, such as the use of voice recognition and gamification as in Tarteel and BeHafidz. In addition, system developers, through software that has been released and downloaded by many users, provide various features. These features have been proven to provide convenience and effectiveness in memorizing activities [3] [4][5][6].

The two sources of information, research papers and the existing Qur'an software for memorization, can be explored. This is an opportunity for the development of the Qur'an software for better memorization. This paper aims to conduct a literature review in order to gain a deeper knowledge contribution about the digital Qur'an for memorization. Researchers conducted two reviews: a paper review and a review of the Qur'an application for mobile-based memorization. The review was intended to answer several questions about several things. The important questions that will be answered in this research are as follows.

- RQ1: What are the research topics in the Quran memorization software?
- RQ2: What methods are used in the software for memorizing the Quran?
- RQ3: How to memorize the Quran based on software?
- RQ4: What are the key features of the Quran memorization software?
- RQ5: How to evaluate the function of Quran memorization software?

2 METHOD

Paper and the Quran Digital Memorizing application are two sources of data collection and analysis, . This study uses the Flow Diagram of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) in collecting articles [7]. PRISMA is used to identify, to select, to assess feasibility, and to synthesize studies to generate knowledge from a particular field. The selection of applications was downloaded from the PlayStore with a search about Memorizing Quran.

2.1 Literature Search and Selection

The search for articles related to the application of the Quran for memorization was carried out on three main databases, they are ScienceDirect, IEEE Explore, and Google Scholar. In addition to contain many sources of articles related to topics, the database is also easily accessible. The keywords used in the searching process are *"(Quran AND digital) OR (memorizing AND system) OR (tikrar OR tasmik OR hafiz OR huffaz)"*. Journal articles are taken for ten years between 2011-2021. The initial search returned 17,362 articles.

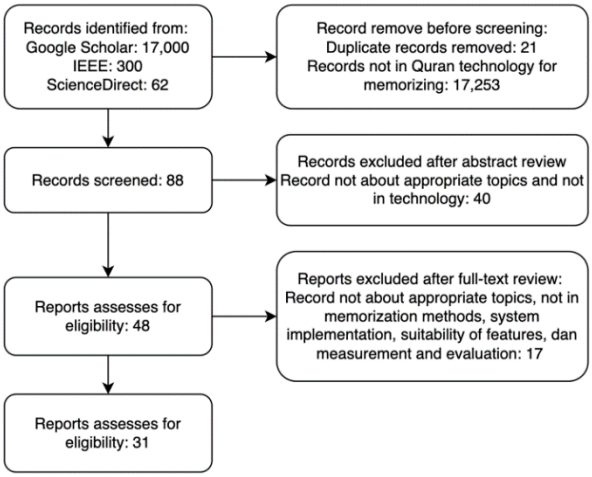

Figure 1. PRISMA flow diagram for selection of articles

Selection of the articles obtained is made by choosing those that discuss applications or software regarding Quran memorization. The application discusses several important

things, including the methods used, techniques, measurements, or evaluations, including the superior features provided. Quran applications are taken only those related to memorization so that the selection becomes more focused on the topic under study. Google Scholar Source at the initial initiation got 17,000 articles, then after the selection process resulted in 20 articles. IEEE of 300 articles there are 11 articles that match. Meanwhile, from a total of 62 ScienceDirect articles, none of them fit the context of Quran memorization. The total number of articles obtained are 31 articles. The flow of selecting articles is shown in Figure 1

2.2 Data Extraction

The paper extraction process is carried out to ensure the topics discussed in the paper are in accordance with Quran memorization. Each paper is read in depth in order to obtain sufficient information regarding the suitability of the content with the research questions to be answered. There are five criteria of suitability used, they are the suitability of the topic, method, implementation, features, measurement, and evaluation. The total selected articles showed 100% appropriate topics and shown in Table 1.

Table 1. Composition of topics

Topics	Composition	Amount paper
Memorization methods	84%	26 of 31 papers
System implementation	70%	21 of 31 papers
Suitability of features	80%	25 of 31 papers
Measurement and evaluation	58%	18 of 31 papers

The articles produced come from various types. Based on the type of publication, there are 45.1% (14 articles) of conference and 54.9% (17 articles) of journal. Based on the sources, there are 35.4% of (11 articles) IEEE at and 64.9% (20 articles) of Google Scholar. Based on the platform used, the majority use the Mobile platform 38.7% (12 articles), followed by multiplatform by 35.4% (10 articles), and Web base by 9.6% (3 articles). The remaining 19% (6 articles) did not mention the platform specifically. Meanwhile, based on country of origin, it is divided into four namely Indonesia at 35.5% (11 articles), Malaysia at 32.2% (10 articles), Pakistan at 12.9% (4 articles), and Saudi Arabia at 19.3% (6 articles). The composition on country and platform is shown by Figure 2 and Figure 3.

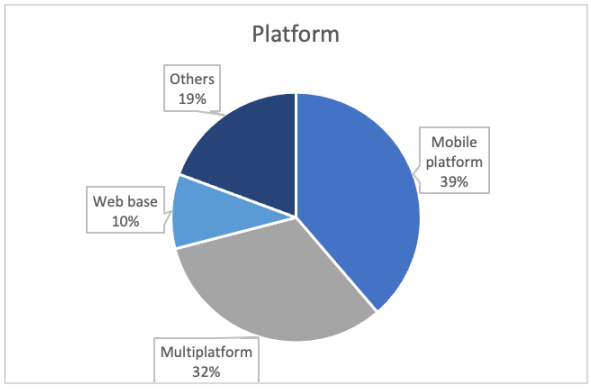

Figure 2. Platform used of articles

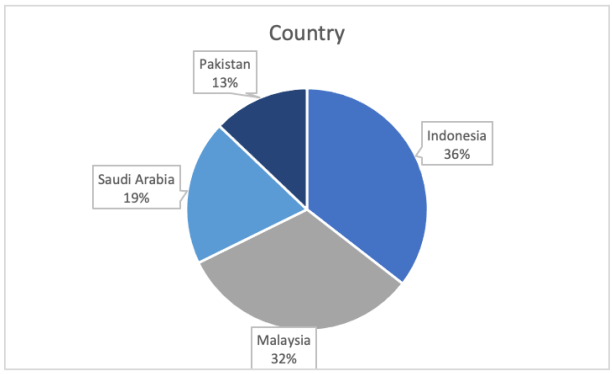

Figure 3. Articles base on country

The entire article by topic, the memorization method used, the features provided, and the evaluation of the functions carried out are shown in Table 1.

Table 2. List of Quran memorization apps

Name of App	Developer	Download	Review	Score	Description
Ayat - Al Quran	ETC King Saud University	10.000.000	247.000	4,8	The main functions are voice recitation, translate in English, tafseer, bookmark, change mode Quran, dan flexibility in repetition
Memorize Quran	Ottoman Software	1.000.000	25.531	4,7	The application will help users to memorize by choosing surah from the list which they want to memorize. The verses will be loaded into the recitation list at the end choose the verse range to recite till memorized
Hafalan Quran	Tim Anak Saleh	500.000	16.811	4,9	Memorizing the Quran is a game or digital game that aims to make it easier to memorize verses of the Qur'an. There are two modes in this game: game mode and reading mode. In addition, users can also download the pronunciation of each surah.
Muslim Pal	Bigitec Studio	500.000	6.220	4,7	Consists of memorizing progress indicator, creating playlists, recitation and loop mode, multiple user profiles with avatars, adjusting the speed of the recitation, filtering surah list by completion, not memorization, in-completion and favorites
Memorize Quran	Devine Companion Inc	500.000	5.000	4,7	The main features are ayah wise memorization, selecting a range of ayah for memorization, repeating single ayah, adding delay between ayah, repeating within range of surah, and special page/features targeted for revision needs.
Tarteel.ai	Tarteel Inc.	500.000	4.000	4,8	The main functions are to recite, to habit building, to locate and to learn, and to gain reading enhancement
BeHafizh	Gudeg Barakah	100.000	6.710	4,8	Provides the track Quran memorization both surah and verses, memorization test personally, audio player with repetition feature, and statistic color
Cinta Quran Memorization	Hedi Herdiana	100.000	3.436	4,9	The game quiz to memorize the Quran that makes it easy to memorize in hafiz Al Quran mode
Easy Memorizing Al-Quran	Alphadeena Studio	100.000	3.000	4,8	Consists of memorizing features, repeating, reciting, progress dashboard, adopted from Quran At Taisir
Quran Hafidz	quran.muslim-web.com	100.000	1.301	4,7	Quran Hafiz helps users read, search, understand and track memorization of the Holy Quran.

Read, Learn, Memorize Quran	Quran Academy Inc.	100.000	1.000	4,7	Consists of group challenges (leaderboard), guided lesson plans, daily hasanah for motivation, personal challenges, bookmarks
Hafal Quran Sambung ayat	Agus Haryanto	50.000	1.259	4,8	Provides features to test memorization. The goal is to find out if the memorization is strong and to provide testing by means of a verse connect game. It can be used by teachers in testing their students' memorization

2.3 Mobile Apps Selection

Applications regarding Quran memorization analyzed in this study were downloaded from Playstore with the keywords *"quran memorization" OR "hafiz" OR "huffaz" OR "quran memorization"*. The search resulted more than 100 applications. Only applications that are relevant to the Quran whose main function is to memorize. Some of the criteria used in the selection of this application are the number of downloads above 50,000, the number of reviews more than 1000, the review score above 4.7 out of a maximum score of 5. These numbers indicate the number of users and the benefits of the application felt by the user. The list of Quran applications is shown in Table 2.

3 RESULT AND DISCUSSION

This section shows the results and discussion about the answers to questions above. The questions are about the topic, the method, the way on how to memorize, the key of feature, and the evaluation.

3.1 RQ1: What are the topics of research in the Quran memorization software?

There were 24 topics discussed in the article, nine of them were discussed by more than one article. The most discussed topic was Mobile application that found in 12 papers, followed by the topic of Quran memorization method found in 6 papers, Speech recognition found in 5 papers, Mobile learning found in 3 papers, and several other papers that are discussed by one paper as shown in Table 3 and Figure 4.

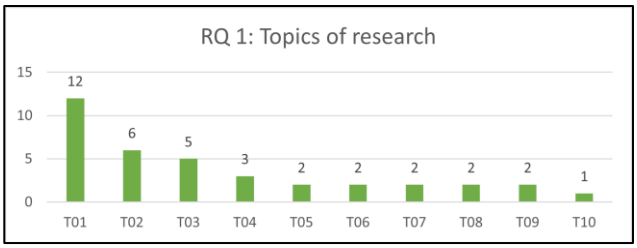

Figure 4. The topic of article distribution

Table 3. The topic of articles

ID	Topics	The Title of Papers
T01	Mobile application	A Preliminary Study on Mobile Quranic Memorization for Remote Education Learning Using RFID Technology: KUIS as A Study Case [8], Digital Quran Computing: Review, Classification, and Trend Analysis [9], Quran Memorization Using Mobile App [10], Embedding Repetition (Takrir) Technique in Developing Al-Quran Memorizing Mobile Application for Autism Children [11], i-Tasmik Mobile Platform – Enabling Tahfiz Student to Memorize Al-Quran Independently [4], Elayah: Mobile Based Media For Al-Qur'an Memorization Using Takrar Method [6], Pengembangan Aplikasi Al-Quran Untuk Membantu Hafalan Al-Quran Secara Mandiri Menggunakan Metode *Tikrar* [2], Comparison between conventional method and modern technology in Al-Qur'an memorization [12], An Evaluation of Quran Memorization Mobile App among Middle-Aged Adults and Early Elderly [13], Implementation Levenshtein Distance Algorithm for Hifdzil Quran Quiz [14], Quran companion-A helping tool for huffaz [5], Development and Alpha Testing of EzHifz Application: Al-Quran Memorization Tool [15]
T02	Quran memorization method	Mobile learning with gamification for Alquran memorization [16], Towards a Comprehensive Online Portal and Mobile Friendly Qur'an Application [17], i-Tasmik Mobile Platform – Enabling Tahfiz Student to Memorize Al-Quran Independently [4], The Application of *Wahdah* Method in Memorizing The Quran for Students of SMPN 1 Unggul Sukamakmur [18], The Effectiveness of Al-Quran Memorization Methods for Millennials Santri During Covid-19 in Indonesia [3], *Tajdied* Method Implementation in Improving The Quality of Tahfidz Al-Quran Juz 30, 29, and 1 in SD Muhammadiyah 10 Surabaya [19]
T03	Speech recognition, Voice recognition	Qur'an recognition for the purpose of memorisation using Speech Recognition technique [20], E-hafiz: Intelligent system to help muslims in recitation and memorization of Quran [21], i-Tasmik Mobile Platform – Enabling Tahfiz Student to Memorize Al-Quran Independently [4], TeBook A Mobile Holy Quran Memorization Tool [22], Quran companion-A helping tool for huffaz [5]
T04	Mobile learning	Mobile learning with gamification for Alquran [16], Development of Qur'an Memorization Learning Model Based on Mobile Learning [23], Quran Memorization Using Mobile App [10]
T05	Mind map, Topical interpretation	Towards Improving Quran Memorization Using Mind Maps [24], ITQAN : a Mobile Based Assistant for Mastering Quran Memorization [25]
T06	Gamification	Mobile learning with gamification for Alquran memorization [16], Implementation Levenshtein Distance Algorithm for Hifdzil Quran Quiz [14]
T07	Quran search engine	Searching Quran Chapters Verses Weight with TF and Pareto Principle to Support Memorizing (Case Study Juz 'Amma)[26], TeBook A Mobile Holy Quran Memorization Tool [22]
T08	Application testing	An Evaluation of Quran Memorization Mobile App among Middle-Aged Adults and Early Elderly [13], Website-based Al-Quran memorization monitoring and evaluation system design [27]
T09	VARK learning style	The design of Quran memorization tool using low-fidelity prototype [28], Development and Alpha Testing of EzHifz Application: Al-Quran Memorization Tool [15]
T10	MFCC, Visualization, e-learning, Expert system, RFID, Arabic digitalization, Active learning, Pareto principle, Breadth first	Qur'an recognition for the purpose of memorisation using Speech Recognition technique [20], ITQAN: A Mobile Based Assistant for Mastering Quran Memorization [29], A Model for Implementing E-Teaching Objects for the Holy Quran and Related Sciences Using Animations [30], Repetitive memorization mobile application development for elderly memory recall [31], Retaining Quranic Memorisation for Huffaz at the Malaysian Tertiary Institutions: Key Challenges and Future IoT Potentialities [32], The Future of the Quran's Role: Digitalizing versus Memorizing in the Southeast Asian Muslims [33], Unlocking Opportunities in New Norms Era Using 21st Century Technology and

search, IoT, Quran role, Levenshtein distance	Application in Memorization of Qur'ān [34], *Tajdied* Method Implementation in Improving The Quality of Tahfidz Al-Quran Juz 30, 29, and 1 in SD Muhammadiyah 10 Surabaya [19], Digital Quran Computing: Review, Classification, and Trend Analysis [9], Quran Memorization Using Mobile App [10], Searching Quran Chapters Verses Weight with TF and Pareto Principle to Support Memorizing (Case Study Juz 'Amma)[26]

3.2 RQ2: What are the methods used in the software for memorizing the Quran?

The method most widely used and discussed in the paper is repetition or *tikrar*. This method is discussed specifically by ten papers, followed by the Evaluation method, which is discussed in five papers. Gamification is discussed in three papers, Mind map, Voice recognition are discussed in three papers each. VARK and Ubiquitous memorization are discussed in two papers. In addition, each paper discusses the Monitoring method, Term frequency, *Talaqqi* and mushafahah. Those are the method used by dealing with the teacher personally and asking for private memorization., Quran companion, *Tajdied*, and *Wahdah* is the method for memorize verse of Quran one by one. The meaning *Wahdah* in arabic is one. The methods and papers that are discussed are shown in Table 4 and Figure 5.

Table 4 The method in articles

ID	Methods	Papers
M01	Repetition/*Tikrar*	[4], [17], [30], [31], [2], [13], [9], [10], [11], [6]
M02	Evaluation	[22], [34], [5], [27], [21]
M03	Gamification	[16], [17], [14]
M04	Mind map	[29], [24], [9]
M05	Voice recognition, Quran automatic recitation, Automatic speech recognition	[20], [12], [9]
M06	VARK	[28], [15]
M07	Ubiquitous memorization, RFID	[32], [22]
M08	Monitoring, Term frequency, *Talaqqi*, Quran companion app, *Tajdied*, and *Wahdah*	[23], [26], [8], [12], [19], [18]

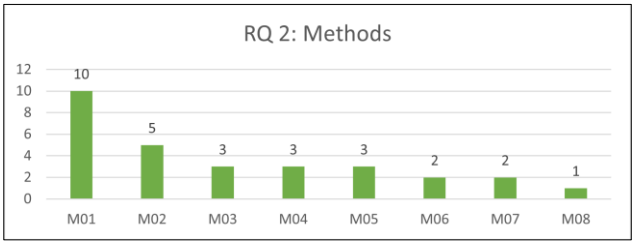

Figure 5. Methods in memorizing Quran distribution.

Repetition is the most basic way of memorizing. Therefore, in Table 4, it is shown that this method is the most frequently mentioned by the paper. The whole process of memorizing will use repetition. The basic step is to read the verse that will be memorized repeatedly until it is memorized[2][11]. Repetition can be done on a time basis as well as based on the number of repetitions. For the number of repetitions, at the beginning of memorizing, at least repeat the reading up to 40 times. At the same time, time-based can be started by reading a maximum of 20 minutes. This process puts memorization into the subconscious brain so that memorization is stored in long-term memory.

Sequentially the next most widely used method is Evaluation which is widely used to test memorization and measure the level of fluency towards memorization owned [27], [21]. Gamification is often used in conjunction with evaluation because the game will give a question or a command to continue the verse or to guess the letter with the correct answer given a score. This method motivates the memorizers to repeat and to increase memorization [16], [17]. The Mind Map method is used with the method of understanding the meaning as well as making color blocks on the display of the mushaf [29], [24]. Voice recognition is used to search and to test memorization. Quran automatic recitation is a method of placing navigation over a designated verse, and the Quran will recite it through the voice of the qori that has been saved. Qori is someone who recites the Quran in a good tone and follows a predetermined pattern in the method of reciting the Quran. Automatic speech recognition is used for verse tracking through cursor movement according to the sound of the verse being read. VARK is a method that utilizes four elements, those are Visual, Audio, Reading, and Kinesthetic [28]. Ubiquitous memorization with an IoT approach that embeds the Quran in various things that are easy for users to find and use. RFID is one of the methods used for communication between devices. Monitoring, Team frequency, *Talaqqi*, Quran companion app, *Tajdied* is a fun method by learning to read and to memorize the Koran based on recitation through chanting verses or songs., and *Wahdah*, each with a paper that discusses it.

3.3 RQ3: How to memorize the Quran based on software?

Memorizing Quran has many memorization methods. These methods have been widely applied in existing applications. This section will describe how these methods are implemented and deployed through existing applications. Some of the methods discussed are repetition/*tikrar*, evaluation, gamification, mind map, and voice recognition.

Repetition is also known as *Tikrar* in Arabic, which means repeating the reading until memorizing it. This is one of the traditional and most widely used methods to date [2] [31]. This method has been scientifically proven to place memorization in long-term memory because of its process of driving continuous activity to produce long-lasting synaptic growth [35]. In addition to repeat by reading several times, it is also repeated in listening through audio with a specified time duration and number of repetitions [13]. Audio is important as an input that stores what is heard in the subconscious brain. The *Tikrar* method is suitable to be used in conjunction with the tahfiz method. This method requires facing the teacher before memorizing to show what will be memorized. This is done until they get permission from the teacher that the reading is declared correct. Then they memorize by reading it over and over again until it is memorized. Finally, he had to listen to his memorization to the teacher again until it was justified by the teacher [11]. Repetition can be based on the number that is read as much as 40 times in each verse or part to be memorized. However, this method will be easy to succeed if it fulfills several

conditions such as a focused mind, sincerity, patience, *istiqomah*, good morals, and getting the blessing of parents[6].

The next method is Evaluation. This method is based on the memorization process which involves two roles, the first is the role of the memorizer and the second is the role of the evaluator who assesses whether the memorization is correct or not. With this method, the memorizers will be sure that what is memorized is appropriate and tested [22]. The traditional method requires that the evaluator is a human being who has limitations in space and time. The presence of several evaluator systems is used to assist the evaluator's role. Through this system, the memorizers will read the verses or surahs that have been memorized. The system will record and search for audio sources from the Al-Qur'an database. The recording results will be compared with the audio verse database to assess the level of quality of the reading. Finally, the system displays the evaluation results to the memorizers. This method can also be more responsive by using the Tarteel.ai application which receives the memorized voice directly from the memorizer and the device will vibrate if there are mistakes. Finally, the results of the evaluation will be shown in the form of a list of surahs and what words need to be corrected. Another method can use Tasmi' and Quiz conducted by a teacher or application to memorizers [34]. Evaluation can also use the pair method and take turns listening to each other [5].

Gamification is a model of memorizing the Qur'an that includes fun elements. The quiz model used by Darmalaksana [14] For memorizing games, the user enters the game application and selects the game level, the system will ask questions, the user will read the verse asked, the system will calculate the level of accuracy using the Levenshthein Distance algorithm method and give a score. This step is repeated until you reach the score for the next level. Levels and scores are given to challenge the memorizers to get high scores and answer as many questions as possible. Thus, the user will further improve his memorization [14]. This quiz model is also used by Yusep Rosmansyah with a game application that visualizes scores in statistical form. The game element is placed in front of the user, the user first determines the target to be achieved then the system provides questions to be answered by the user based on the scope of the target. In this game, group games are also provided by sending pictures, messages, and audio recordings as the answers to each question to the common room. At the end, each member's score is displayed [16].

Another model that helps the memorization process is the Mind map. The basis of this model is on the visualization of verses based on the relationship of topics and meanings between verses. In addition, it can also group words, ideas, tasks, or items that represent a message that is related to each other. Mosallam tested two groups, first by memorizing in the usual way and by dividing the pages into several and memorizing them by repetition per verse until they were memorized. The second group was given a mind map of Surah Al-Baqarah based on the section, topic, and the meaning relationship between verses and then asked to memorize the part shown on the mind map. Finally, the researcher measured understanding, memorization time, and the number of mistakes made. The group that used the mind map was twice as understanding and faster than the others, and even got a small error score. This visualization can also be done by dividing the contents of the page into several parts with color visualizations per block [24]. This will help to make it easier for the memorizers to identify the location and position of the memorized verses[9].

Voice recognition is often used in using a human computer interaction approach that involves machine learning (ML) [9]. The Tarteel.ai app uses Automatic Speech Recognition (ASR) for verse search using voice. The user presses the mic button and reads out some of the contents of the verse to be searched. The system will translate the voice into Arabic text and search for the manuscripts. Once found, tracking will be carried out in real time between the verse being read and the cursor movement following the text of the verse being read. This system is also equipped with a correction mode, which identifies reading errors made by the reader. Tabbaa also made corrections to readings from sound sources by utilizing Computer Aided Language Learning (CALL) by integrating ASR to translate voice to text [36].

3.4 RQ4: What are the keys of features in the Quran memorization software?

This question is answered by identifying all the features contained in the application in Table 5 and described by scientific publications, then grouped into groups of similar features. The urgency of the feature is also described through the results of the study so that it can be used as a recommendation for the next Quran application developer.

There are ten main features found and 32 detail features spread over the main features. These features are shown in Table 5 and the distribution shown in Figure 6.

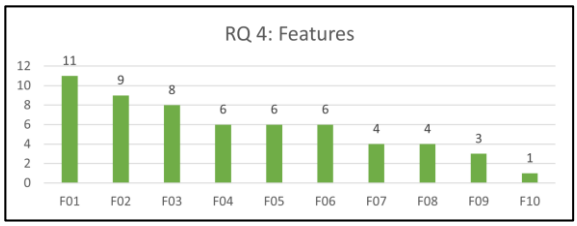

Figure 6. Features in Quran memorization application

Table 5. List of main features

ID	Main Feature	Detail and Feature Description
F01	Mushaf	There is one section with three layout forms. This section is the main place that displays the verses of the Qur'an. The layout consists of three: the Medina manuscript layout, the Indonesian manuscript, and the adaptive layout. Almost all applications provide this feature, namely 11 of the 12 applications reviewed. Only one that does not provide because it is a rote game application and contains verse guessing.
F02	Navigation	There are eight kinds of features, they are: search text base, search audio base, detect mistakes, hide page all, hide page except first part, mark memorized verses, mark surah, and mark juz. There are at least nine applications that provide these features.

F03	Audio	The audio feature has three details, they are tracking verses using voice, selecting qori, and *tikrar* mode (repetition) of verses or a range of verses in a surah. Loops can be time-based or frequency-based. There are eight applications that provide Audio features.
F04	Dashboard	This feature can provide motivation to the memorizers because it shows the progress of memorization. There are five detailed progress features: overall memorization progress statistics, progress per chapter, per letter, progress in memorizing time, and progress of verses read. There are six apps that provide a progress dashboard.
F05	Translation	Including interpretation(tafsir). Translation has features per page, per letter, per paragraph, and per word. While the interpretation contains an explanation of the contents of a verse or letter from the book of interpretation. There are at least six applications that provide this feature.
F06	Bookmark	This feature contains notes and markers that are given a description of a verse. There are six applications that provide this feature.
F07	Interoperability	A feature that contains the transfer of the content of the Qur'an to other applications. There are two detailed features such as sharing verses to other message media and copy-pasting content features containing verses in Arabic and their translations. There are four applications that provide this facility.
F08	Evaluation	This feature is partly provided in the form of a game and partly in the form of a quiz. Quiz given with questions and answers choose which one is correct. Also, by sending a recording of a verse that is read and the system will give a score of accuracy that is read. Some systems also provide facilities for teachers to provide assessments, especially on group features.
F09	Gamification	Game features are widely used to practice and repeat memorization. Some use the continuous verse model, questions with a score for each correct answer, also by arranging words in one verse or arranging verses in one letter. Giving scores and levels will challenge users to test their abilities and motivation to complete the game (test/evaluation)
F10	Group – Companion	Features that contain memorization in pairs or per group. This feature can be used in groups with one teacher or leader, it can also be done on a small scale by finding memorizing friends who regularly listen to each other and provide progress to motivate each other. Not many people use features like this yet.

The Mushaf feature is the main page that displays each verse to be read/memorized. There are three kinds of layouts: the fixed manuscript layout with two models - the Medina model and the Indonesian model. Both consist of 15 lines per page and a corner verse where the end of each page is always the end of a verse. The difference is that on some pages there are some positions that are not the same. The Medina manuscripts are simpler and do not have too many punctuation marks, while the Indonesian manuscripts have a lot of navigation and punctuation. Another layout is the adaptive layout, which is arranged each paragraph in a row from the beginning to the bottom. This layout was originally used by the Indonesian Ministry of Religion's translation of the Mushaf.

The second main feature is Navigation. This is the main feature of an application because it is useful for making it easier for memorizers to navigate. The eight detailed features in it can be summarized into four features: the search feature, error detection feature, hidden verse feature, and marking an aya, letter, or juz that has been memorized. Searching can be done in two ways of text base and audio base. Text base is to search for verses or letters by writing some of the information to be searched in the search field. While the audio search is done by recording the part of the verse you are looking for, for example to find and go to a letter, by reading the initial verse in the letter, the page containing the verse will be displayed. The detect mistakes feature is the system's ability to identify errors made by users. Errors can be displayed on incorrect words in a verse, also displayed in the statistics of each page, and one of the applications shows it by vibrating mode when it finds an error when a verse is read. The hide page feature is used to close the verses on a page to be read without seeing the text of the verse, but still seeing the closed page to help remember where the position of the verse sounds like. The hide feature also closes some of the contents of the verse and only displays the first word of each verse. While the feature of marking verses that have been memorized can be done per verse, per letter, or per chapter to make it easier to mark verses that have been memorized.

The Dashboard feature is the main feature that displays the memorization progress. Progress shows the achievement of the entire contents of the Qur'an in statistical figures using percentages. There is also a progress per juz and per surah which shows the percentage and number of verses achieved for the entire contents of the verse in a chapter or letter. Some apps show progress in how long it takes to read and memorize.

The Audio feature is an important feature because it serves as an example for the memorizers before they start memorizing. Audio is a reading of the Qur'an taken from the qori 'mainly from middle eastern scholars who do have a language originating from Arabic. The memorizers can choose the qori' they want. Readings that are played are generally per verse so that the memorizers can play an audio repeatedly as needed. This repetition is also called *tikrar*. Repetition can be time-based, i.e., determined for a certain time, it can also be done per frequency a number of times, for example 10 or 20 times. The loop can also be done continuously until it is stopped by the user. This repetition mode is most widely used by memorizers because it can save memorization to long-term memory.

The translation feature includes interpretation and explanation of the contents of a verse. Translation can be shown per page, per letter, per verse, and even per word in a verse. Translation is widely used by memorizers to provide convenience by understanding the meaning and intent of a word or verse. This method is widely used in the mind map feature. Display it in various ways. Some are displayed by navigating the verse, clicking on the part of the manuscript will display the translation at the bottom. Another way is to press the verse and a pop up will appear containing the translation and interpretation. While the interpretation itself can be provided from several books of interpretation. Tafsir can be explained each verse or letter. Most are found in every verse because the interpretation is a more complete and contextual explanation of a verse.

The bookmark feature is the main feature that provides the facility to mark a verse and note the marked verse. This feature is useful as a reminder when the user has important notes on a verse. Notes can be in the form of mistakes that have been made, explanations of the meaning of words, as well as topics that are considered important. This feature can

also be used for tracking memorization by marking a verse that has been memorized and has a special content. Some applications provide a note feature by not linking to a particular verse so that the notes are free to add and delete as needed. While other main features such as group, gamification, and evaluation have been described in Table 5.

3.5 RQ5: How to evaluate the function of Quran memorization software?

Evaluation of the function of memorizing the Quran has been discussed by 17 of the 31 papers reviewed. The evaluation is related to two things, the evaluation of the results of the function test to user respondents and the evaluation of the process used and carried out in evaluating a system. How to evaluate it is seen from the system testing carried out. After being grouped based on how to evaluate the application of the Qur'an, seven methods were used. The list of test methods and applications tested is shown in Table 6 and Figure 7.

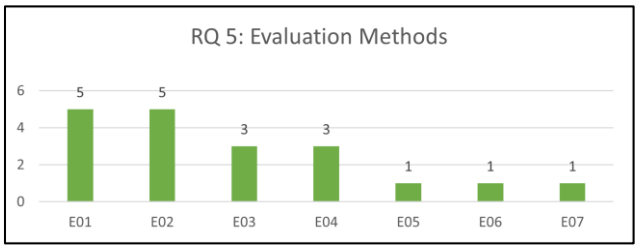

Figure 7. Evaluation methods distribution

Table 6. List of methods, products, and source articles

ID	Evaluation method	Product and Source (article)
E01	Comparative Experiment	There are five products and publications that use this test: E-Hafiz[21], EzHifz[23], MindMap Quran Memorization[24], Quran Companion[5], iHafaz[11]
E02	Questionnaire	There are four products and papers tested using this method: Elayah[6], E-Hafazan[13], Quran Memorization Learning - Prototype [28], Quran Memorization[10], [18]
E03	Content Validity Test	There are three products and articles that use this test: Memorizing Quranic Verses[31], Gamification in mobile learning for memorizing Al-Qur'an[16], Elayah[6].
E04	Interview & Observation	There are three products and papers tested with this method: ITQAN[29], Quran Memorization Learning - Prototype[28], Personalized Al-Quran Memorization Testing[1]
E05	UAT	One paper that discusses UAT along with the heuristic test method is: EzHifz[15]
E06	Impact Analysis	There is one paper that uses Impact Analysis testing, namely[16]
E07	Usability Testing	There is one paper that discusses Usability Testing to test the design of the Quran *Tikrar* application[2]. This method is run concurrently with unit testing using white box testing, validation testing using black box testing, and usability testing.

The Comparative Experiment in Table 6 is a test method used by five applications reviewed by five articles. On the E-Hafiz application [21], Records are collected from experts or teachers in the form of verse by verse reading in the Qur'an and stored in a database. Furthermore, a memorizer is asked to read the verse that will be or is being memorized to be recorded. Record files are compared with expert records to determine the level of accuracy. In measuring accuracy, three groups of memorizations were tested, namely adult men, adult women, and children. The three groups were asked to read ten verses each and take measurements. The results show that adult men have the highest accuracy rate with a score of 92%, followed by children with a score of 90% and adult women 86%. These results indicate a good and acceptable degree. Another application, EzHifz, is a Quran Memorization application that uses the VARK (Visual, Audio, Reading, and Kinesthetic) method. The test is carried out using the User Accepted Test (UAT) and Heuristic Test. Two groups were created, namely group A and group B. Group A was tested using a heuristic test by teaching all the features and how to use the application in front of them and then they were given cases. Each completed case will be recorded and calculated using Fleiss's Kappa coefficient (k) and the results reach a value of k = 0.737 which means Good. Meanwhile, group B was tested using UAT and the result was a qualitative statement which stated that VARK gave the user the freedom to choose the method according to the learning character of each user. This UAT coefficient value reaches 0.727 which means Good.

Another comparative method was carried out by Al-Mosallam in evaluating the application of the Quran memorization Mind Map method. You do this by forming two groups containing members aged 16-18 years. Both were asked to memorize part of the Al-Quran Surah Al Baqarah with a certain topic. The first group memorized freely what they usually use on a daily basis, while the second group was given a mapping of the meaning of each verse and grouped according to the relevant context to make it easier for users to understand the meaning of the verses to be memorized and then memorize them. The results in the second group that used the Mind Map had a speed of memorizing up to twice that of the other group. The understanding of the memorized verses is also two times more understandable. Similarly, the number of mistakes made is doubled less.

The content validity test is carried out by focusing on testing the content in the application being tested. The first application is Quran verses memorization, namely the Qur'an which is designed for parents by using repetitive technique[31]. Parents generally have decreased ability to memorize, therefore the application provides the easiest option first for users to memorize. After choosing, the user is asked to determine the number of repetitions to memorize and then memorize it. Experts will test the content that has been successfully memorized. The test was carried out by three experts with different durations and similar questions. The results show that the design of this repetitive system is appropriate and provides motivation for parents to memorize because it is easy.

The content validity test was also used by Yusep Rosmansyah in testing the memorization application in the form of an Android-based game[16]. The researcher formed

two memorization groups. The first group consisted of five people and memorized the Qur'an using games in groups. The second group consisted of 15 people and memorized in groups, but the way was listening to each other (traditional way). Game players managed to memorize 11.67 verses during the allotted time while the traditional group only managed to memorize 8.07 verses. This shows that memorizing with games can result in more verses being memorized. This test of getting the amount of memorized content is also called Impact Analysis.

Testing on the Elayah app [6] one of them is using test validity through software functionality. Experts who are memorizers and Arabic linguists were chosen as respondents. They were asked to examine all the features and functions of the application and provide an assessment of the suitability of the content as it should be. Of the ten test materials which include clarity of appearance, suitability of verses for memorization, ease of flow to follow, interactive and communicative, the media used can encourage memorizers to increase the amount of memorization, the media used is not confusing, clarity of function in each feature, media improves understanding, and the media can help achieve the target. The maximum score for each material is ten. The average acquisition value reaches 93%, this shows valid quality.

Other testing methods are observation and interviews. This method is used to test the ITQAN application, which is a mobile-based application that uses a Mind Map approach. To memorize a part of a letter or a collection of verses, the system provides a topic view that is related to one verse to another with the addition of a few notes to make it easier. Applications are brought to "Dar Makah", which is a Qur'anic school in Saudi Arabia. The study asked 20 students to memorize using an app. During use, the researcher observed them seriously. Finally, they were interviewed about the application used. 85% of them stated that the ITQAN application was useful and made it easy for them to memorize. 80% stated that this application motivated them to complete memorization because there was a rote progress feature. Rian Adam Rajagede uses the Group Decision Support System to test the quality of memorization [1]. This method uses a lot of group interviews, which involve experts in assessing someone's memorization results then calculated using the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) method.

There are researchers who use the questionnaire method in testing an application of the Qur'an for memorization. Siti Fatimah Abdul Raof uses it to measure application usability and user acceptance [13]. The test was conducted by dividing a questionnaire to 30 respondents aged 40-70 years. After using the application with the name E-Hafazan, respondents were asked to answer two questionnaires, namely usability and UAT. The measurement scale used is between 1-5. The higher the number the better. The minimum UAT score obtained is 4.2. This indicates that the system is more interactive and makes it easy to memorize anywhere and anytime. While the usability scores obtained varied scores. Category cognitive, content, navigation, audio, perception, and dexterity achieved score above of 4.0 that indicated Good. The navigation category got a score of 3 which means neutral, this happens because the navigation feature is not clear, and the instructions are not easy to understand. Overall, respondents considered that E-Hafazan has an easy-to-use design and is suitable for older users. For the Usability testing method on paper [2] has been described in Table 6.

4 CONCLUSION

We have reviewed 31 papers and 12 mobile-based applications regarding the digital Qur'an for memorization. The results are used to answer the five main questions in this study. It was found that the most discussed topics were the Qur'an based on mobile applications, followed by the Quran memorization method, Speech recognition (Voice recognition), mobile learning, Mind Map, Gamification, Quran search engines, Application testing, and VARK learning style. The most widely used method is *Tikrar* (repetition), followed by evaluation method, gamification, Mind Map, and Voice recognition (Quran automatic recitation, Automatic speech recognition). How to memorize using the application according to the user's style and the method used. The main features provided in existing applications are manuscript layout, navigation, dashboard (progress), audio, translation (including interpretation), bookmarks and notes, interoperability, group companion, gamification, and evaluation features. While the evaluation used to test the application according to the paper includes Comparative experiment, content validity test, UAT, Impact analysis, Interview (include observation), Questionnaire, and Usability testing. These results can be used for subsequent work, both researching more deeply about the methods and facilities at the design and implementation stages and for developers can be used as references in improving the application of the Qur'an for memorization.

AUTHOR'S CONTRIBUTION

The first author contributed to the writing, compilation, and analysis of the data. The second author supervises linguistically, helps analyze papers and makes graphical visualizations. The third author contributed to the data search, paper collection, and first stage paper selection.

COMPETING INTERESTS

For Complying with the publication ethics of this journal, Kholid Haryono, Rian Adam Rajagede and Muhammad Ulil Albab Surya Negara as the authors of this article declare that the paper is free of a conflict of interests (COI) or competing interests (CI).

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