CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss the literature on icon design for mobile applications, semiotic icon design, gap analysis on mobile applications related to icon design and Quran studies, analysis on the technique in reciting Quran and youth in Malaysia. The subsequent review on the design and development research, theories, and models related to studies. The review of elements identified from icon design, usability, motivation, and acceptance will also be used by the researcher to construct the items for the questionnaire instruments. The chapter then proceeds with the design of the theoretical framework and conceptual framework. The review in this chapter is derived from the documentation and literature from the icon design practitioner and scientific community. The chapter closes with the chapter summary.

2.2 Icon Design

Today, graphics have become essential for communicating information in a variety of fields, such as education, medicine, and advertising. Graphics are used in advertisements to persuade consumers, as well as medication, management, and others for their business. In education, graphics play a significant role as a mediator in transmitting of information and knowledge. Today, graphics technology can communicate information and knowledge more quickly and effectively by using an

engaging and interactive environment to improve information accessibility. People generally look at web page graphics in contrast to the text page before reading (Lin et al., 2013). Moreover, pictorial advertising is better suited to capturing attention than text advertisements and this is so regardless of the image size, as cited by Goodrich (2010). Graphics are thus essential in increasing ability to understand information easily and communicate information visually.

Icon is one of the elements in graphical user interface study and it has become more important and complex. Designing the graphic or icon is closely related to visual perception to achieve the understanding of icon language. According to Horton (1994), icon represent visual and spatial concepts. The words are not the natural language for describing visual appearance or spatial relationship. Graphics work better than words for representing subtle concepts of shape, color, position, angle, size, texture, and pattern. Engineers, scientist, architects, medical doctors, illustrator, and graphic designers work and think in image. Hence, icons can speak their language.

In the context of interface design the icon has acquired more general meaning where it stands for any visual representation that contributes a function or content type. The growing use of visuals is to meet diverse needs and desires. Not only are visuals viewed as important, they also promote information acquisition and understanding in a shorter time (Fabil et al., 2012). Therefore, this study proposed an appropriate icon design to be employed that can assist the identification and interpretation of the meaning of Surah genre in Quran.

2.2.1 Icon

Icon refers to a small graphic displayed on mobile devices. Landa (2014) defined icon as a visual (pictorial image or symbol) to represent an object, action, and concept.

Horton (1994) defined icon as a small pictorial symbol used on computer menus, windows, and screen. Icon also can act as a visual representation of an object, action, or idea. An icon resembles the thing it represents or, at a minimum, shares a quality with it. Therefore, the icon can create better visual perception and is capable of communicating information meaning (Batista et al., 2019; Chandler, 2007; Landa, 2014; Lin & Lin, 2014; Qiang & Fei, 2016).

Icon as visual representation enables conveying of abstract information clearly to the users. Icons play a key role in delivering knowledge and interpretation using figurative expressions in many fields. Icon has several functions, such as branding, defining goals, and attracting user interface visual attention (Yang, 2015). The benefits of using icons in graphical user interface (GUI) include save space and compact, fast to recognize immediately (Harley, 2014; Horton, 1994), easily touched, no need to translate and visually pleasing (Harley, 2014). The icon is also easy to recognize and remember (Qiang & Fei, 2016).

According to Horton (1994), icons alone are meaningless. However, when an icon is used in a specific context, it triggers memories and associations in the user's mind, resulting in what we call the icon's meaning. The icon is more like a substance that releases meaning in the existence of a context and a human mind. The icon in particular context triggers the mental process that led to the meaning. Furthermore, he found that icons can benefit by saving space, speed search, reducing the total dependence on text; helping those with limited reading skills, for example, those who read English as a second language; adding an alternative channel to overcome reading disabilities, such as dyslexia; even those who can read the text often won't read the text; well-designed icon can make a product more visually appealing to the user and to help interface to go

global; simple graphic symbols prevail in folk art and as travel signs along the road and highways. Icon can be understandable regardless of native language.

Overall, icons provide the visual display that facilitate information acquisition and understanding, thus creating a better visual perception, and communicating the meaning in a specific context and human mind. Figure 1.1 shows the sample of icon that represent the objects which can be leveraged to enhance the meaning of learning content (Malamed, 2015) in a particular context. Therefore, the benefit of icons can be utilized and extended to other fields to enhance the meaning of information that can assist people to understand the meaning of information visually.

2.2.2 Type of Icon

Various kinds of icons are widely used in multimedia, mobile devices, computer field, medical, and everyday life. England and Finney (2007) studied and classified the icon in terms of icon, picon, micon, while other studies classified it as desktop metaphor icon, electrical device icon and brand icons as cited by Yang (2015). In computing scholars classified icon as pictogram or ideograms and pictogram symbols (Horton, 1994). In medical, icon may integrate several different symbols to construct meaning (Zender & Mejia, 2013). Table 2.1 and Figure 2.1 summarized type of icon from previous studies that mentioned icon in different perspectives of study.

Table 2.1: Type of Icons

Studies	Findings	Dimension	Example	References
Multimedia	Icon used on a webpage button, representing of idea. Picon uses a real image on button. Micon is an animated GIF, an animation of picon and used as animated graphic as well as an animated photo.	Icons, picon, micon	Icon Send Mail to send comment or order	England & Finney 2007
Desktop metaphor Electrical	Desktop metaphor icons enables user to understand tasks in common office space setting. Electrical device icons help user to navigate unfamiliar system easily.	Desktop metaphor icon,	Basic icons file folder Standardized power icon	Horton, 1994

Studies	Findings	Dimension	Example	References
Device, Brand for commercial software	Brand icons have no functional meaning besides representing the product itself.	electrical device icon brand icons	Facebook Twitter	As cited by Fei Yang, 2015
Mobile and Computing	Pictogram is an icon of symbol conveys meaning through its resemblance or reference to a physical object. Ideograms illustrates whole idea. Ideograms are basic shapes, and their meaning must be learned.	Pictogram or ideograms	Pictogram airplane is airport. Ideogram circle with line across "NO".	Justas Galaburda, 2016
Taxonomy of Icons (computer field)	Data icons are objects used in actions. Function icons are objects perform actions. Icons described as representational technique in (1) metaphoric (road sign for falling rocks), (2) paradigm of use (fork and knife for restaurant), (3) symbolic (broken glass stands for fragile objects), and (4) abstract representation should be memorized by user (symbol for electricity).	Data Icons - Function Icons	Data icon (folders, files) Function icons (paintbrush)	As cited by Koutsourelakis & Chorianopoulos, 2010)
Taxonomy of Icons (outside computer field)	According to Peirce, semiotic dimensions of a sign are lexical (production), syntactic (arrangement), semantic (references to that for which they stand), and pragmatic (consumption). Signs are icons, indexes, or symbols. Icons are "naturally" meaningful, Indexes are signs caused by something and therefore referring to them. Symbols are abstract, must be learned. In many cases, icons in graphical user interfaces are not icons at all, but symbols. Index - like muddy boot prints on kitchen floor being a trace.	Signs are icons, indexes, or symbols	Icon - thin pencil line is line. index of children walking through	As cited by Koutsourelakis & Chorianopoulos, 2010)
IT User system interfaces and symbols	Icons are used on visual display terminals (VDTs, or screens) to facilitate interaction between computer-based applications and users. Icon graphics provide a language-independent means of communicating information to user. Part of a graphical interface facilitate user's ability to learn, understand, and remember functional elements of system, and aid in manipulation of these elements.	Icon symbols and functions General icon Object icon Pointer icon Control icon Tool icon Action icon	Used on VDTs or screens	ISO/IEC 11581-1:2000 (2000)
Computer industry	The small pictorial symbols used on computer menus, windows, and screen are icons. In computer industry, the term icon is often used as a synonym for any small visual symbol.	Pictorial symbol	Used in computer menus, windows, and screen	Horton (1994)
Medical Field	Icon is a collection of symbols and then match symbols to individual concepts of the referent definition. The interaction of the right number of symbols for the referent, and a more apt combination of individual symbols for the referent, can significantly improve the construction of an icon that communicates what was intended.	Collection of Symbols	Combines six symbols: hat; cross; woman; man; stethoscope; desk; intended to communicate the referent "medical services." Combine two symbols: woman with the hat and cross on it represent "nurse,"	Zender & Meija (2013)

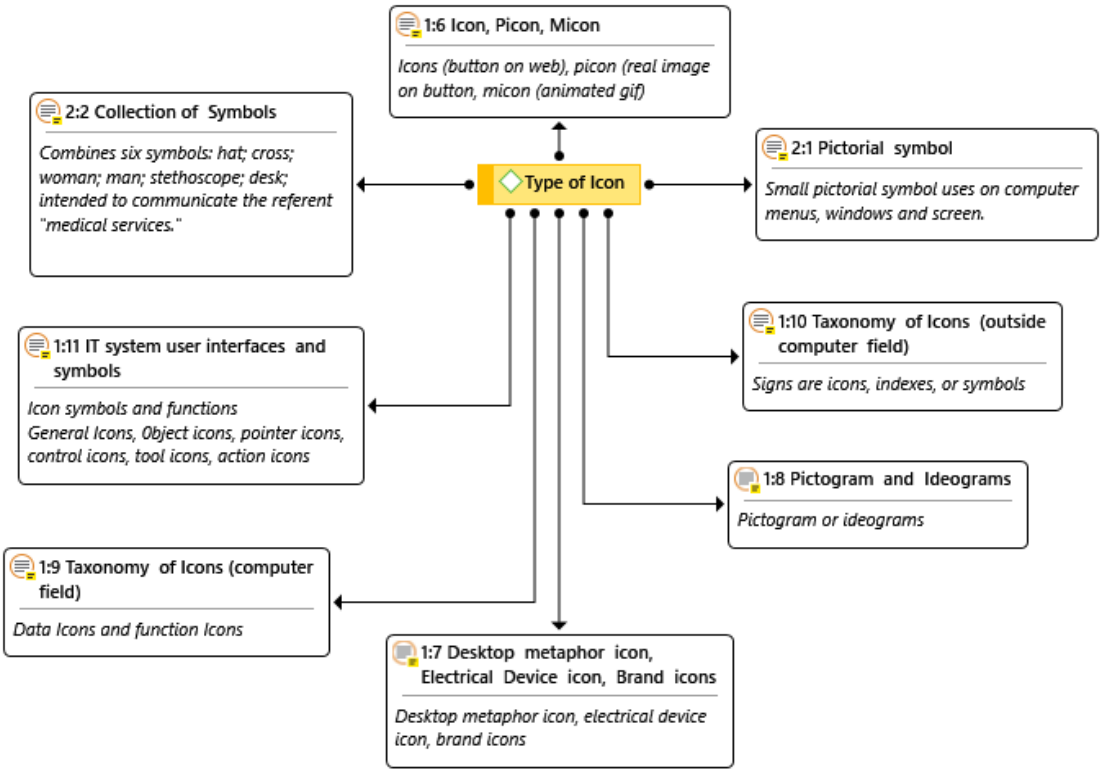


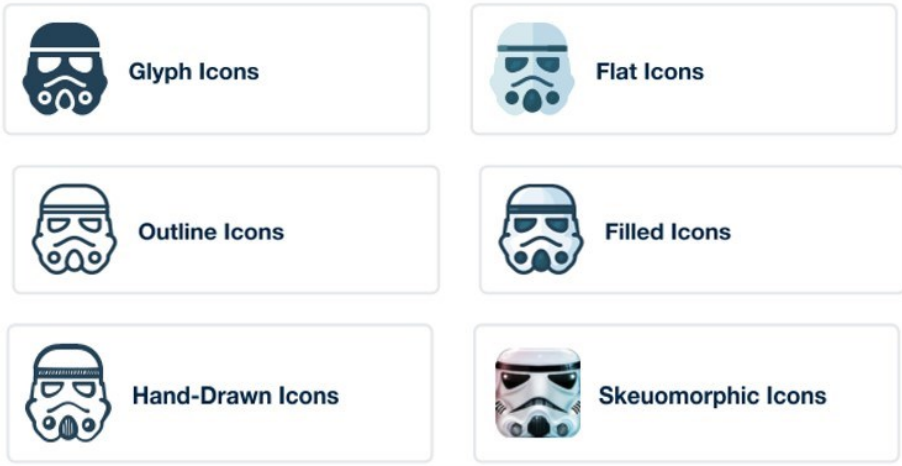
Figure 2.1: Network view for Type of Icon

In this study, the researcher focused on the icon related to semiotic and sign as stated by Peirce's theory of semiotics (1931-1958) (Chandler, 2007) from the study of taxonomy of icons (outside computer field) that mentioned signs are icons, indexes, or symbols. The icons are naturally meaningful. The icons can convey and visualize abstract information clearly to the people.

2.2.3 Style of Icon

According to Justas (2016), as seen in Figure 2.2, icons can be segmented into a variety of different styles and design variations. The most popular of these are outline icons, filled icons, glyph icons, flat icons, hand-drawn icons, and skeuomorphic icons. Outline icons are created from outlines which are the easiest style to start for beginners. Filled icons combine color into a single outline icon which is quite new but is becoming more and more popular these days. Solid icons are called glyphs. Flat icons are a

variation of outline icons that imply color combinations. Hand-drawn icon is an imitation of icons drawn by hand and skeuomorphism is the design concept that concentrates on creating items resembling their real-world analogs.



Source: Justas (2016)

Figure 2.2: Style of Icon

Pol (2015) mentioned that the current trend and academic literature concerning app icon highlights design of skeuomorphic and flat design. Skeuomorphic design is a realistic app icon design style in which the icons have embossed effects, 3D artificial textures, drop shadows, reflective shimmers, and a glossy look. Flat design represents a simple and clear icon with clear lines and a lighter, bolder, and more colorful color palette than the skeuomorphic design. Flat design is also more sophisticated and versatile than the realistic skeuomorphic design. Pol's study concluded two (2) of aesthetic trends in app icons, namely concrete with detailed app icons and abstract app icons with detailed decorations.

The skeuomorphic design style can be characterized as concrete, while on the other hand the flat design can be characterized as a more abstract app icon design. The new generation of users prefer the abstract design style. For entertainment apps,

skeuomorphic design was highly preferred compared to brand apps with a flat design. While, for informative apps, brand apps with a flat design were high preferred compared to skeuomorphic design.

In this study, the researcher applied the flat design icon, as it is the most appropriate and preferred icon design style for youth and more relevant to the Quranic domain. The researcher has summarized the style of icon through the thematic analysis using Atlas.ti software. There are six (6) styles of icon developed: solid icons, filled icon, hand-drawn icons, outlined icons, flat icons and skeuomorphic icons. The codes under these styles of icon are summarized using network diagrams in Figure 2.3.

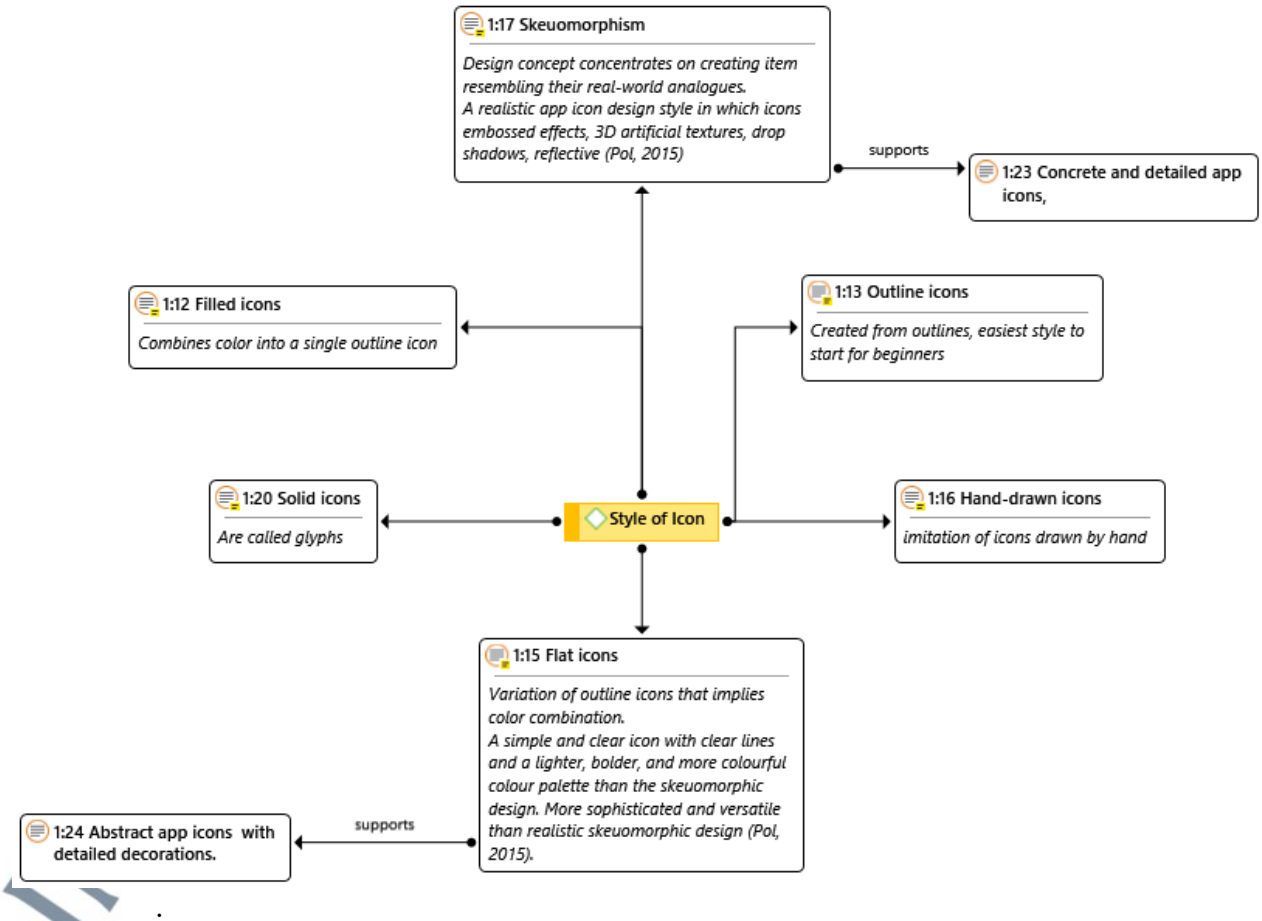


Figure 2.3: Network view for Style of Icon

2.2.4 Icon Design for Mobile Application

Today, people regularly interact frequently via their mobile device for business and daily activities (M. Wang & Li, 2016). Hence, an enormous market has emerged for mobile applications. It is stated that smartphone is the most common device for internet access (around 89.4 percent compared to other devices) and that it continues to grow (Malaysian Communications and Multimedia Commission, 2017). Such figures show that those mobile devices and mobile applications have become deeply embedded in our daily lives. Given the pervasiveness of mobile apps recently, icons have become a vital part of the mobile user interface (Lin & Chen, 2019; Lin et al., 2016) and as cited by Zhang et al. (2017).

Icon design means generating a graphic symbol that can express a specific meaning. An extensive guideline of icon design is significant, especially involving the style aspects of icon design. Appropriate designed icons would let users recognize their meanings without extra commands. Icons should be designed properly to be identifiable to reduce uncertainty (Salman et al., 2007). Icon design for mobile application is among the vital challenges in adopting mobile applications. Appropriate icon designs for mobile applications are essential to improve the meaning of icons to the user. Therefore, the icon design should be focused on to ensure the icon manages to convey the correct information to users.

A mobile application, commonly referred to as an app, is a type of application software designed to run on a mobile device, such as a smartphone or tablet computer. Mobile applications frequently serve to provide users with similar services to those accessed on PCs. Mobile applications are a specific program intentionally created for portable devices.

Chen (2015) had explored app icon design across different mobile operating systems with different icon design principles respectively to understand recognition performance and user preference of different icon types. He found that icons designed in square or with round corner outline, with distinct image-background combination are usually adopted by Apple and Microsoft UI. The icon designed in free outline (any shape), without distinct image-background combination is usually adopted by Google Android as summarized in Table 2.2.

Table 2.2: Icon Border

Border	**Close**	**Open**
Examples		
Outline		
Character	1. Icon designed in square (or with round-corner_ outline, with distinct image-background combination. 2. Usually adopted by Apple iOS and Microsoft Modern UI	1. Icon designed is free outline (could be any shape), without distinct image-background combination. 2. Usually adopted by Google Android

Source: Chen (2015)

Chen (2015) mentioned results had shown that participants prefer pictorial illustration icons but have no significant preference on border shape. Furthermore, the open border shape icon is beneficial for recognition. In conclusion, icons designed with open border shape and graphic rendering are better for user recognition and preference on the smartphone. In this study, the icon employed the free outline design adopted by Google Android as the mobile application will be in Android platform to increase accuracy and understanding of information delivered.

2.2.5 Semiotic Icon Design

Over the centuries, semiotics has been applied to various fields including literature, music, poetry, film, and advertising. Icon study has discovered by Peirce Theory of Semiotics (1931-1958 (Triadic) (Chandler, 2007) as fundamental theory representing information as a visual sign to convey information faster to people. Peirce classified semiotic as a study of signs that concern meaning and classified signs into 3 aspects which are: what is represented (object), how it is represented (representamen), and how it is interpreted (interpretant) (see Figure 2.8).

The semiotic icon focuses on what is represented and how it is interpreted as a visual sign to represent the object, action, or idea (Chandler, 2007; Sendera et al., 2014). It provides better visual perception with the ability to communicate meaning (Chandler, 2007; Lin & Lin, 2014). Therefore, the benefit of semiotics icons can be utilized and extended to other fields to enhance the meaning of information visually.

Semiotic icon design is the process of generating a visual icon to convey a particular meaning. Icons must be designed appropriately to be recognizable, or else ambiguity would be increased (Salman et al., 2007). In this study, the semiotic icon design was applied in the Quranic field to visualize the genre of Surah that can assist in understanding the idea of Surah thus assist in motivating in reciting Quran.

Further explanation on semiotic icons and semiotic analysis by Peirce's Theory of Semiotic (Semiotic Triangle) is illustrated in Figure 2.8. The findings on the analysis of semiotic icon design elements for mobile applications and for reciting the Quran were summarized in detail in Chapter 4.

2.3 Mobile Application

Nowadays, the market for mobile application has emerged tremendously. People regularly interact frequently via mobile device for business and daily activities (M. Wang & Li, 2016). It is stated that smartphone is the most common device for Internet access (around 89.4 percent compared to other devices) and that it continues to grow (Malaysian Communications and Multimedia Commission, 2017). Such figures show that mobile devices and mobile applications have become deeply embedded in our daily lives. Because of their pervasiveness, mobile app icons have become a vital part of the mobile user interface (Lin & Chen, 2019; Lin et al., 2016).

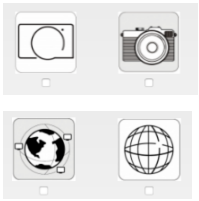
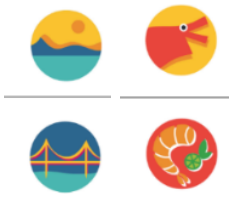
A mobile application, referred to as an app, is a type of application software designed to run on a mobile device, such as a smartphone or tablet computer. Mobile applications are specifically programmed intentionally for portable devices. They frequently serve to provide users with similar services to those accessed on PCs. Mobile application makes the icons as a faster and effective informational tool. This mobile technology produced a more meaningful icon that can be recognized immediately by users. Hence, the benefit of mobile technology and mobile application was utilized in this study as the mobile user interface and platform for the semiotic icon design for reciting Quran.

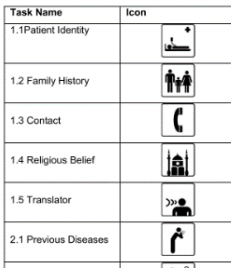
2.3.1 Gap Analysis on Mobile Application related to Icon Design Studies

Many studies of mobile application related to icon studies. The reviewed studies on mobile application related to icon design are summarized in Table 2.3.

Table 2.3: Gap Analysis of Mobile Application related to Icon Design

Icon Design Studies	Findings	Dimension	Gap	This study	Reference
Comprehension problems in icon design for mobile devices: Analysis and prototype design	Research on Human cognitive processes needed to focus more on causes and solutions. Study how various age groups might interpret same info differently.	Ineffectiveness of icons affected by oversimplified form, inappropriate message, ambiguous message, bad association between icons and pre-existing mental model	Lacked element recognition, relevance, uniqueness. Focus a specific user group. May include cultural difference	Focus elements recognition, relevance. Focus one specific group - youth	Yang, 2015
Effects of the aesthetic design of icons on app downloads: evidence from an android market	Industry considered aesthetics of icons for years. However, research on how app icons should be designed to attract users is limited.	Analysed in aspect of color, complexity, and symmetry, through image processing	Focused more on aesthetical aspects of icon design for several years but less on other elements	Focus elements to attract user. related to meaning	Wang & Li, 2016;
The icon matters: how design instability affects download intention of mobile apps under prevention and promotion motivations	Consumers with more promotion focus (prevention focus) would have higher download intention for apps with unstable (stable) icons. Perceived some symmetric shapes (e.g., circles) as stable shapes	Other elements, salience of stability, the boundary condition, and consumer involvement.	Influence of other design elements, such as color, contrast ratio, brightness, and saturation, could be considered in future research, as could personality.	Focus on element color	Lin & Chen, 2018
Improving Icon Design: Through Focus on the Role of Individual Symbols in the Construction of Meaning	Comprehension studies show failure rate of 90 percent on comprehension of medical icons design for cross language and cultural barriers.	Recognition	Suggest incorporating element related to icon meaning such as recognizable, semantic at same time maintain simplicity, clarity, and consistency	Focus elements recognizable semantic, maintain simplicity, consistency	Mike Zender & Meija, 2013
The Effects of Icon Characteristics on Users' Perception	Research related to icon ease of use for numerous groups of users still narrow		Lack of studies on icon ease of use of icon design for numerous user groups.	Evaluate the icon ease of use.	Ghayas et al., 2013,
Experimental Study: The Effects of Mobile Phone Icons Characteristics on Users' Age Groups	Determine the recognition rates of icons from two sets of users with different age groups i.e., younger adults (20 – 40 years) and older adults (+50 years). Users	Complexity, familiarity and semantic distance affect icon user experience	Design of semantic close icons that are more familiar for users.	Focus elements of semantic and familiarity	Ghayas et al., 2019

Icon Design Studies	Findings	Dimension	Gap	This study	Reference
An icon recognition study on different simplicity levels 	Simplified icons had similar correct icon recognition rates as those of relatively more detailed icons, and participants' personal backgrounds affected the icon recognition.	Expand icon styles, including color, simplicity, and other design elements.	Examines people with different personal backgrounds, how preferences differ in icon styles, including color, simplicity, and other design elements.	Focus on color, simplicity	Guo, 2016b
Icon Usability	Icons meanings hard to memorize interpret precisely. Text label to overcome ambiguity. Standard icon, safer to include label, especially if altered icon to match aesthetic preference or constraints.	Using text label alongside an icon to clarify its meaning in particular context	Icon understanding based on previous experience. Due to absence of standard usage for most icons, text labels are necessary to communicate meaning and reduce ambiguity	Some icon may need text label	Harley, 2014
Icon design for Tourism Mobile App - FloripaTour App 	Icons developed to represent type tourist attractions: natural landscapes, architectural, urbanistic, singular cultural, gastronomy, and festive symbols. Icons express required meaning. If some was ambiguity, possible to redesign to improve design	Icon design: research, analysis, image refinement, standardize thru same graphic style and evaluate icon clarity.	When icons represent very abstract concepts, difficult for user to make a correct analogy, image must be accompanied by a text label.	Some icon may need text label	Batista et al., 2019
A preliminary study on aesthetic of apps icon design	Proposed kansei interface (KI) to depict relationships among app icon basic elements for users and designers as a follow-up to icon design studies. Varying aesthetic app icons impact on user emotional reactions.	Evaluation grid method structure (EGM) to identify potential relationship between icon style and user emotions	Current trend app icons are concrete-abstract and detailed-terse. Future works suggest detailed effect/relation connection between app interface design and user emotions	Applied simple icon design	Hou & Ho, 2013

Icon Design Studies	Findings	Dimension	Gap	This study	Reference
Icon and User Interface Design for Mobile Banking Applications 	Icons and user interfaces for mobile banking app with actual users' participation. Consists task analysis, icon design survey, final icon design, evaluation, and installation of mobile banking app with icons	Sketch figures for related terms, frequently drawn selected as initial design. Changes done based on design expert reviews and existing design guidelines.	Although ambiguous icons would raise various interaction problems, properly designed icons improve end user performance.	Applied sketching figures as initial design, gain feedback from expert review.	Merdenyan et al., 2014
Participatory icon design for medical information system 	Icon selection process for medical information system for emergency service of a hospital in Istanbul, Turkey.	Medical terms given to each subject, asked to draw icons represented given terms and frequently drawn figures are selected for interface. Recognizable, intuitive, and easy to identify with no error	Designed cautiously to avoid ambiguity and improve performance. Proper designs of iconic interfaces for correct functionality.	Focus recognizable	Salman et al., 2007
An icon that everyone wants to click on: The relationship between consumer perceptions and app icon successfulness 	Game app icons to maximize internal validity. Choice of not informing participants about purpose of apps behind icons was made to avoid systematic bias.		Investigating concrete-abstract and simple-complex relationship on app icons	Applied simple icon design	Jylha & Hamari, 2019

Based on the analysis in Table 2.3, various icon studies on mobile application were related to icon design studies such as icon preference study on color, icon recognition study, icon usability, aesthetic apps icon design, icon design for tourism, medical, and mobile banking as well as study on relationship between apps icon with consumer perception. Figure 2.4 summarized the gaps for mobile application related to icon design studies.

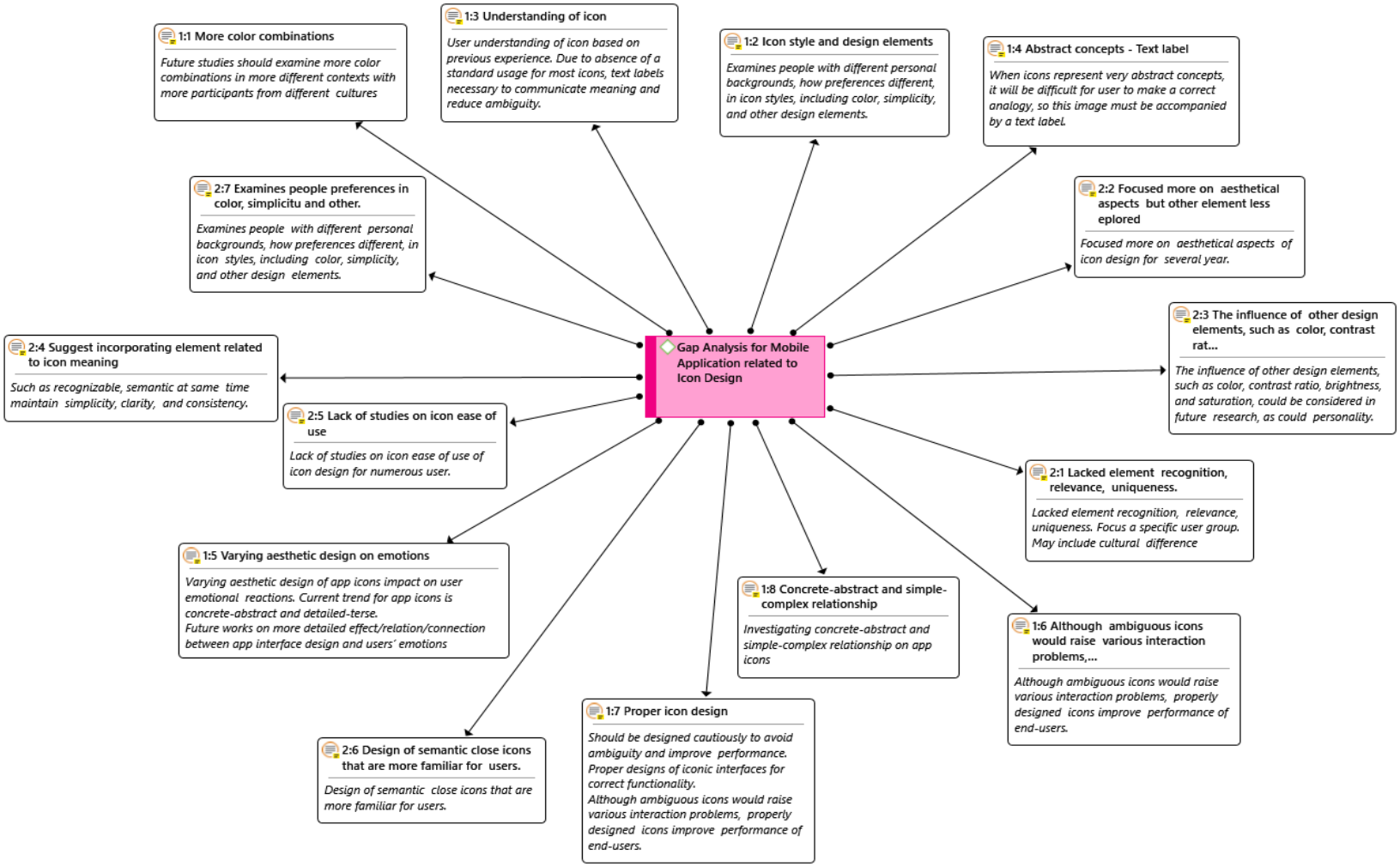


Figure 2.4: Network view for Gap Analysis of Icon Design

This analysis recommended some future works on icon design for mobile application. Among the gaps of icon design studies are lacked element recognition, relevance, uniqueness, and need to focus on a specific user group; focus on elements related to icon meaning such as recognizable, semantic at the same time maintain the familiarity, consistency, and color; examine on more color combination in more different context with more participants from different cultures, investigating concrete-abstract and simple-complex relationship, varying aesthetic design on emotions, understanding of icon using text label to reduce ambiguity, examine preference in icon style and icon design elements, abstract concept icon using text label and stress on proper icon design to avoid ambiguity and improve performance.

Table 2.4: Gap of Icon Design Addressed in this Research

Icon Design Elements	Research Gaps	This Study
Recognizable Familiarity Semantic Consistency	Lacked element recognition, relevance, uniqueness, focus a specific user group (Yang, 2015); focused more on aesthetical aspects of icon design for several years but less on other elements to attract user (Wang & Li, 2016); design of semantic close icons more familiar for users (Ghayas et al., 2019); suggest incorporating element related to icon meaning like recognizable, semantic at same time maintain simplicity, clarity, and consistency (Mike Zender & Meija, 2013); Designed cautiously to avoid ambiguity and improve performance. Proper designs of iconic interfaces for correct functionality (Salman et al., 2007)	Focus on the elements that related to icon meaning such as recognizable, semantic, relevance, maintain the icon simplicity, consistency and color to attract user through visualizing the icon for genre of Surah. Focus on color element and color contrast.
Color	The influence of other design elements, such as color, contrast ratio, brightness, and saturation, could be considered in future (Lin & Chen, 2018)	Focus on element color, simplicity
	Lack of studies on icon ease of use of icon design for numerous user groups (Ghayas et al., 2013)	Evaluate icon ease of use
Simplicity	Examines people how preferences different, in icon styles, including color, simplicity, and other design elements. (Guo, 2016)	

Icon Design Elements	Research Gaps	This Study
	Icon understanding based on previous experience. Due to absence of standard usage for most icons, text labels necessary to communicate meaning and reduce ambiguity (Harley, 2014)	Some icons may need text label to assist in communicating meaning of Surah genre
	Although ambiguous icons would raise various interaction problems, properly designed icons improve performance of end-user (Merdenyan et al., 2014)	Sketching icon as initial design, gain feedback from Quran expert review.
	Investigating concrete-abstract and simple-complex relationship on app icons (Jylha & Hamari, 2019)	Applied simple icon design

Based on the analysis of gap in icon design studies, the researcher summarized the gaps according to the elements of icon design to be addressed in this study as shown in Table 2.4. This research focused on addressing gaps in the icon design study by focusing on the icon design elements namely recognizable, semantic, familiarity, relevance, simplicity, consistency, and color of the icon design for better understanding of icon and visualizing the idea of Surah genre in Quran domain. Semiotic icon design was proposed as a supportive tool to assist in visualizing the genre of Surah that can communicate the meaning of the information thus motivating youth to recite the Quran.

2.3.2 Mobile Application in Quran Studies

Reading Quran nowadays has become easy with the advancements in mobile technology. In Malaysia, the Quranic learning is the focus in Muslim education. The aim is to enhance learners' skills in reciting, understanding, and appreciating the Quran. Quranic education is an obligation to every Muslim. It is the responsibility of parents and teachers to help the new generation in Quranic learning to become true Muslims and better human beings (Che Noh et al., 2013).

Today, learning, and reciting Quran through mobile learning application is becoming a new trend. Alternative method for learning Quran and efforts to elevate

those elements are highly beneficial and considered as a good deeds in Islam (Ibrahim, Yakub, et al., 2012). Having a mobile application that facilitates searching, reading, and listening to Quranic verses would be a helpful tool for people. M-learning functions integrate a number of hardware and software technologies into multimedia applications to facilitate understanding of educational content (Alqahtani & Mohammad, 2015).

In encouraging the reciting of Quran using mobile application in Malaysia, a 'Program Malaysia Ngaji' has been organized recently by the Sarawak State Library with the cooperation of State Islamic Affairs Department and Islamic Information Centre (IIC). Sarawak Deputy Chief Minister Datuk Amar Abang Johari Tun Openg encourages Muslims to instil the culture of reciting the Quran using alternative methods besides using the conventional script. According to him, using the latest methods such as applications downloaded into the smart phone was a positive development. This is a new alternative that can be installed into the smart phone and be read anywhere and anytime (Jonathan Chia, 2016).

Additionally, usage of the Quran application in smart phone is a positive development that instils the culture of reciting the Quran especially among the younger generation. Due to the changes in time, the culture of reciting the Quran now was different compared to the olden days partly due to the technological advancement that had changed the method of reciting the holy book, which was easier and could be done anywhere. Previously the recitation involved using the conventional Quran script but now, the holy book can be obtained digitally (Jonathan Chia, 2016). Hence, the use of mobile application as an alternative medium for reciting Quran is beneficial for Muslims. This study employed the mobile technology and mobile application for semiotic icon design for motivating in reciting Quran.

2.4 Reciting Quran

The Quran is the final revelation and book from Allah s.w.t to humankind as guidance and direction to the right path. Quran is one of the main sources in Islam which comprises all parts of life, provides valuable lessons for all mankind at all times (Abd Rahman et al., 2017; Anas et al., 2017). The Quran can be described as a book of guidance for every human being and there is no doubt about it (Abd Rahman et al., 2017). Allah has mentioned in the Quran Surah Al-Baqarah: 2 "*This is the Book about which there is no doubt, a guidance for those conscious of Allah"* (Al-Quran. Al-Baqarah 2:2). Besides, the Quran is the book that guides and leads humankind to the light of Iman and knowledge, away from darkness as mentioned in the Quran, Surah Ibrahim, verse 1 "*Alif, Lam, Ra. This is a Book which We have revealed to you, (O Muhammad), that you might bring mankind out of darkness into the light by permission of their Lord to the path of the Exalted in Might, the Praiseworthy"* (Al-Quran. Ibrahim 14:1). Furthermore, in surah Yusuf, verse 2 mentioned *"Surely we have revealed it an Arabic Quran that you may understand.*" (Al-Quran. Yusuf 12:2).

Thus, understanding the main primary source of Islam is necessary for every Muslim (Abd Rahman et al., 2017; Anas et al., 2017), besides reading the Quran, Muslims must be able to understand it, so that we can convey the message and practice in our life (Mazlan et al., 2016). Due to its importance to Muslims, studies on how to understand the contents of Quran should be given more attention to help Muslims understand and apply its teachings (Abd Rahman et al., 2017).

Generally, people read Quran using the conventional printed version on book format called Mushaf. The latest advancement of mobile technologies such as smart phones, digital devices and tablets have enabled daily life practices with single touch

and these new tools have been adopted by Muslims with rapid growth (Shameera et al., 2017). Today, it is becoming a new trend to recite the Quran via mobile application. Alternate methods for reciting Quran and efforts to elevate those elements are highly beneficial and considered as a good deed in Islam (Ibrahim et al., 2012).

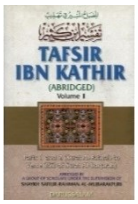
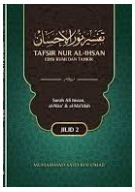
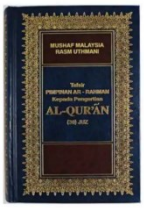
In Malaysia, many techniques are used to recite the Quran using conventional Quran (Mushaf) and technology. In this study, the techniques of reciting Quran conventionally and using mobile technologies were explored as benchmark for the proposed icon design and application developed to motivate youth in reciting Quran.

2.4.1 Analysis of Technique in Reciting Quran

The analysis of technique in reciting is important to explore the previous studies on technique of reciting Quran. This study had reviewed previous studies on technique of reciting Quran from both conventional and technology use perspectives. Table 2.5 summarized the techniques in reciting Quran in Malaysia using conventional Quran.

Based on the analysis of Quran recitation technique in Malaysia using mobile application as summarized in Table 2.6, there are still limited mobile applications in reciting Quran approved by the recognized authorities in Quran. In this research, the semiotic icon design mobile application as a supportive tool is proposed to assist youth in visualizing the genre of Surah thus motivating them to recite the Quran. This application is proposed to be reviewed and authorized by the respective authority in Quran such as JAKIM before being published in future.

Table 2.5: Analysis Technique for Reciting Quran (Conventional)

Mushaf Quran	**Findings**	**Features**	**Technique**	**References**
Tafsir Al-Ibn Katsir 	Tafsir Al-Ibn Katsir	With tafsir	Reciting Quran with Tafsir	Faizan & Hussin, 2014
Tafsir Nur al-Ihsan 	Tafsir Nur al-Ihsan is a work of Malay Jawi which interact with texts of Arabic language including verses of Quran.	Use six methods translation interlingual, bound or katawi, full, partial, communicative, and direct	Reciting Quran with Tafsir Malay Jawi	Wan Hakimin et al., 2018 Faizan & Hussin, 2014
Quran with Tafsir Pimpian Ar-Rahman 	Translation of Quran into Malay Language by Abdullah Basmeih. Received an encouraging and positive response by Malay community, especially in Malaysia. Reprinted several times and most recent 2013.	Use simple language, and easily understood by readers.	Reciting Quran using Tafsir Rumi	Sheikh Abdullah Basmeih, 2001 Nasimah et al., 2017
Al-Quran Mushaf Malaysia	Al-Quran 30 Juz by applying visual arts and design motifs of Malay Islamic culture characterized by all states in Malaysia.	Illuminated (decorated) and full color. From handwriting of four local Khattat (khat writers) use handam or resam (fern tree type).	Reciting Quran with illumination design	Wan Hakimin et al., 2018
Quran Amazing with Tafsir	Quran Amazing with Tafsir	With tafsir	Reciting Quran using Tafsir	Naurah, 2019
Al-Quran with Color Tajwid and Translation	Al-Quran with Color Tajwid and Translation	Color tajwid and translation	Quran with color coded tajwid	Wan Hakimin et al., 2018 Lembaga Pengawalan dan Pelesenan Percetakan Al-Quran & Kementerian Dalam Negeri, 2016
Quran with Waqaf Ibtida	Quran with Waqaf Ibtida		Quran with waqaf and ibtida' symbol	Hakimi et al., 2018 Lembaga Pengawalan dan Pelesenan Percetakan Al-Quran &

Mushaf Quran	Findings	Features	Technique	References
				Kementerian Dalam Negeri, 2016
Quran with Kaligrafi & Khat	Quran with Calligraphy & Khat		Quran with calligraphy and *khat*	Wan Hakimin et al., 2018
Quran with Translation	Quran with Translation		Quran with Translation	Naurah, 2019
Quran with Muslimah theme & color Tajwid	Quran with Muslimah theme & color Tajwid		Quran with Muslimah theme & color Tajwid	Naurah, 2019
Quran with Transliteration, Translation, Color Tajwid *Al-Quran mushaf AlMumayyaz.*	Quran with Khat Utsman Thaha, color tajwid, rumi transliteration per word, translation per word, translation per sentence, tesaurus (tafsir sinonim),	Asbabun nuzul, etiquette in reading quran, index doa in Quran, index alphabet, history Quran, hukum tajwid	Quran with Transliteration, Translation, Color Tajwid	Al Mumayyaz, 2015
Al-Quran Ar-Rayyan	Al-Quran with color Tajwid and Translation Pimpinan Ar-Rahman		Al-Quran with color Tajwid, Translation Quran Tagging	Media, 2020

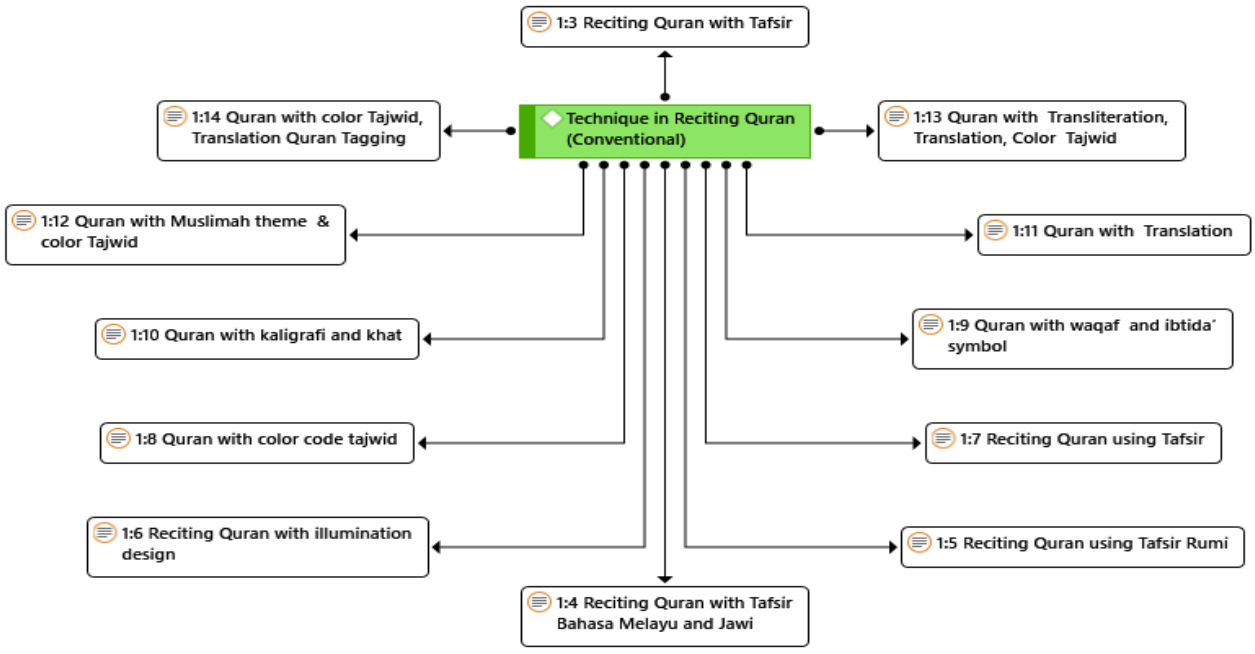
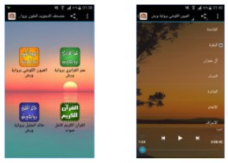


Figure 2.5: Network view Technique in Reciting Quran (Conventional)

Table 2.5 and Figure 2.5 summarized the various conventional techniques used to recite Quran in Malaysia. The Quran recitation techniques are varying from many techniques in reciting Quran such as reciting Quran with tafsir jawi and rumi, reciting Quran with illumination design, Quran with color coded tajwid, Quran with waqaf, and ibtida' symbol, Quran with calligraphy and khat, Quran with Translation, Quran with Muslimah theme and color Tajwid and Quran with Transliteration, Translation, and Color Tajwid. Limited studies have been conducted on technique in reciting Quran using visual features such as icons or images. Therefore, there is a gap in existing studies that can be further explored. This study will propose a technique of reciting Quran using icon that can visualize the genre of Surah.

Table 2.6 summarizes the various techniques of reciting Quran using mobile application and Figure 2.6 visualizes the techniques of reciting Quran in network diagram. A variety of Quran applications are available in Android and Apple platforms. The content of applications also fulfils the need of Muslims as an easy and fast reference for Quran. Moreover, it was updated from time to time to improve features offered. Hence, it is very important for developers to keep the application on track and up to date so that it can meet user expectations and give users new and great experience when using the application (Zahari, Bidin, & Syamsuddin, 2017).

Table 2.6: Analysis Technique for Reciting Quran (Technology)

Quran	Findings	Features	Technique	References
Muslim Pro Quran Kareem 	"All in one application". Malaysians Youth judged Muslim Pro easy to use and believed comprehensive and multi-functional app supported "critical aspects" of their Muslim lifestyle	Islamic calendar, prayer times (salah), prayers (dua), Islamic confession of faith (shahadah), 99 names of Allah, list nearest mosques and many others.	Mushaf Quran Kareem	Rosli & Rahim, 2016, p. 40, p.39 Haukos, 2016 Daugaard, 2019
Smart Quran 	First Quran app approved by Al-Quran Printing Control and Licensing Board, Ministry of Home Affairs Malaysia (MOHA) under Printing of Quranic Text Act 1986 (Act 326). Partnership with Malaysian Communications and Multimedia Commission (MCMC), MOHA and Department of Islamic Development Malaysia (JAKIM).	Downloadable audio by page. Malay English translation by Tafsir Pimpinan Ar-Rahman. Jumped to Ayah/ page, bookmark favorite, night mode, search translation. Reciters: Syeikh Abdullah Ibn Ali Basfar, Syeikh Ali al Huzaifi, Syeikh Ibrahim al Akhdar, Syeikh Muhammad Ayyub Ibn Muhammad Yusuf	Mushaf Madinah V2 with Malay and English translation and audio of four reciters.	Hassan & Khairuldin, 2019 JAKIM, 2019 MOHA, 2019 Apple, 2020
Juz Amma and Terjemahan  Figure 10: Juz Amma + Terjemahan	Al-Quran apps in Malay language developed by Seven Goal, uploaded 2016. Contains Al-Quran from Juz 30. Content starts from Chapter 78 (An-Naba) to Chapter 114 (An-Nas).	Translation in Malay, verses in Arabic. Helpful, user friendly, nice arrangement, easy to read and understand verses clearly. Use soft color theme, calm setting to read Quran	Juz Amma with Malay translation	Zahari, Bidin, & Syamsuddin, 2017
The Holy Quran Full 60 Hizb MP3 	Al-Quran apps in English by Professional Learning. Streaming High Quality MP3. More than 50 Arab famous reciters such as Mishary Rashid Al-Afasy and Abdul Rahman al-Sudais. Listen to audio either from reading style Hafsh (حفص) or Warsh (ورش).	Easy and friendly theme. Use soft color, calm setting to read. Easier to choose preferred reciter. Listen to MP3 audio without Internet. Listen to chapters, verses, know correct pronunciation by hearing verses, memorize full text.	The Holy Quran with Full 60 Hizb MP3	Zahari, Bidin, & Syamsuddin, 2017
Colored Mushaf Tajweed with Reading Style Warsh) 	Best app for listening MP3 audio Al-Quran with reading style Warsh An-Nafi' which user can listen to chapters freely. Help us to know the correct reading style pronunciation of Al-Quran from Warsh An-Nafi' by hearing verses in chapters. These apps have multiple famous reciters such as Umar Al-Kazebri, Uyun Al-Kusyi, and Khalid Al-Jalil.	Listen to MP3 audio without Internet connection. built with easy and friendly use theme. Every reciter has their own background theme. So, user is not confused with reciters audio. List of chapters also arranged based on Al-Quran chapter numbering format	Colored Mushaf Tajweed with Reading Style Warsh)	Zahari, Bidin, & Syamsuddin, 2017

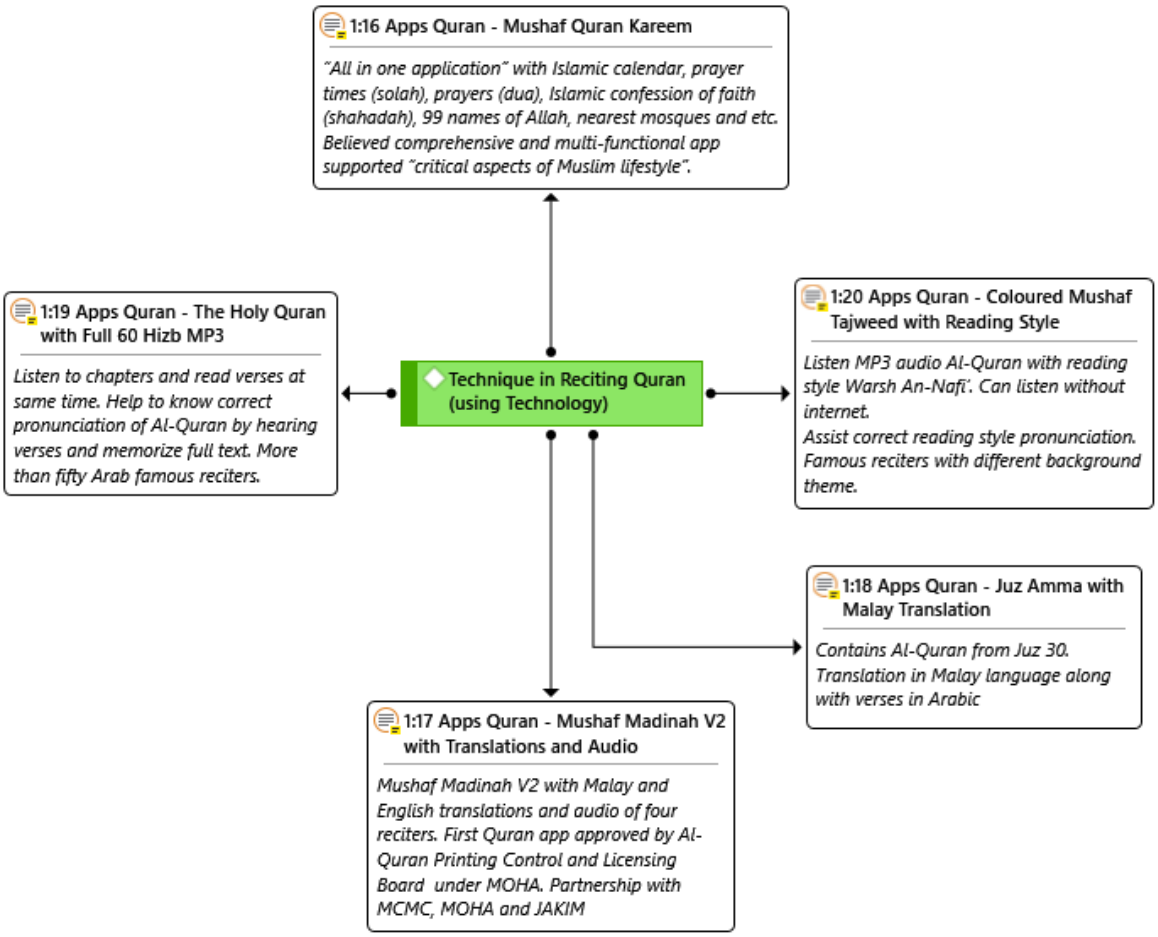


Figure 2.6: Network view Technique in Reciting Quran (Technology)

Based on the analysis of techniques for reciting Quran, the researcher can summarize that many techniques exist for reciting Quran using mobile application. Many applications focused on translation, listening MP3 audio, colored tajweed, translation, and transliteration. However, limited research has been conducted on mobile application that embed the icon to visualize the genre of Surah in Quran. Therefore, there is a gap in research on exploring the mobile application that focus on reciting Quran using icon. Hence this study proposed a semiotic icon design technique for reciting Quran with icon. The technique also can be a supportive tool that provides an alternative in reciting Quran visually using icon to understand the Surah genre thus assisting in motivating youth to recite Quran.

2.4.2 Reciting Quran among Youth

Reciting Quran is an obligation for Muslims. However, one study mentioned youth has lack of awareness on continuous reciting Quran although many technologies for recitation exist nowadays. The level of awareness in reciting Al-Quran continuously, daily is still apparently low with the percentage of 63.8 percent. It was also revealed that 50.3 percent of students did not recite al-Quran after obligatory prayers (Anas et al., 2017). The digital Quran application's frequency of usage may be low although the needs of this application in smartphones and tablets are high. This shows that students are lacking in awareness on the continuous recitation of al-Quran even though various technologies exist to ease the process (Anas et al., 2017).

In Malaysia, a survey reported that only few Muslim youths read the Quran often and understand it well. The Youth Survey for Malaysia and Indonesia 2011 reported that 73 percent youth read Quran sometimes and 78.4 percent youth understand Quran a little (Keng et al., 2011).

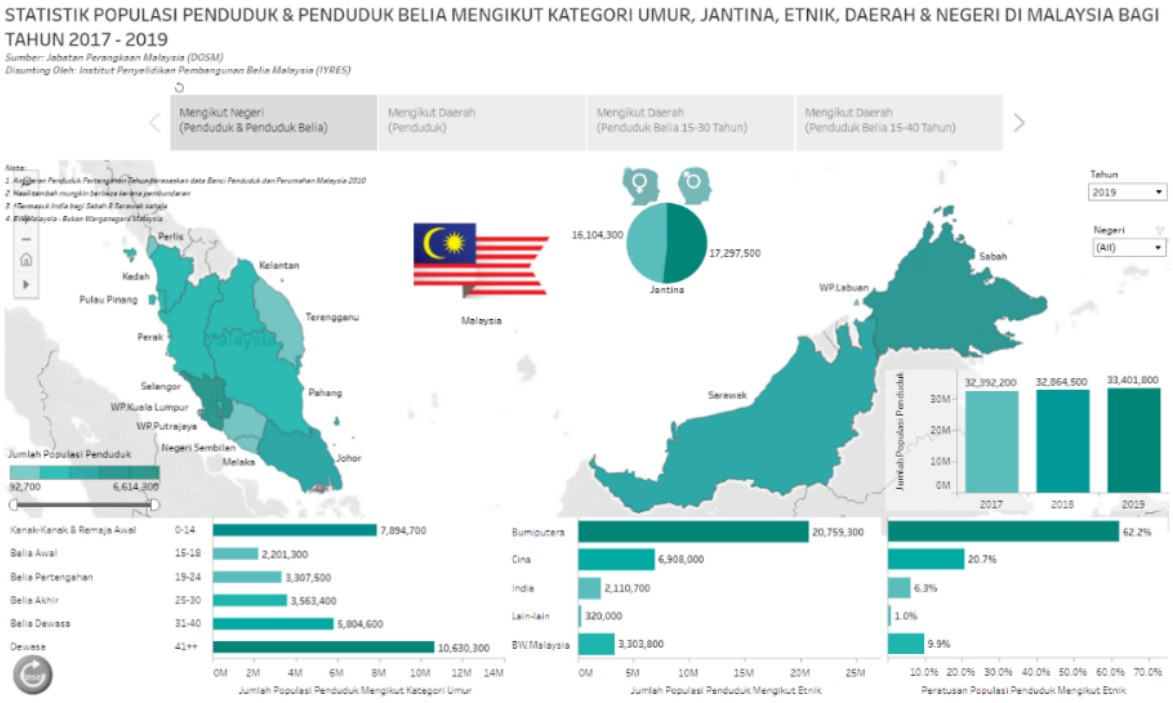
This survey mentioned that youth have less motivation to recite the Quran due to the low comprehension in Arabic language. Therefore, there is a need for a supportive tool that can assist youth in reciting Quran by understanding the idea of Surah, thus motivating them in reciting the Quran.

2.5 Youth in Malaysia

Youth is an important asset to the country today because they will determine the direction of the country in the future (Mohd Najib, 2015). Population of youth in Malaysia in 2018 is about 9.1 million, contributing 28 per cent of the total population of 32.86 million in the country for youth age 15 to 30 years where female youth contributes about 4.4 million (48.4 percent) and male youth about 4.7 million (51.6

percent) (Institute for Youth Research Malaysia, 2018; Department of Statistics Malaysia, 2018) as shown in Figure 2.7.

The National Youth Development Policy 1997 defines youth as those aged between 15-40 years (Norizan Sharif, 2003), while the classification of youth by Azimi Hamzah et al. (2007) is between the ages of 15-35 years only with the division of three age groups: early youth (15-20), middle youth (21-24) and late youth (25-35). However, according to the Minister of Youth and Sports, YB Khairy Jamaluddin, the existing age limit definition of youth will be replaced with a new definition which refers to youth as individuals aged between 15 to 30 years and this definition will be fully used starting in 2018 (Malaysian Youth Policy, 2015).



Source: Department of Statistics Malaysia (2018)

Figure 2.7: Population of youth 2017 to 2019

Meanwhile, the Malaysian Youth Index 2015 (IBM'15) made amendments to the definition of youth age to 15 to 30 years as an important essence in change and

improvement, in line with the current needs of youth. Furthermore, in July 2019, an amendment was made to the National Youth Development Policy 1997 to define youth as individuals aged between 15 and 30 years that will be applied in 2022 (Malaysia, 2019). This study will focus on the youth aged 15 to 30 years old as the focus group of study due to its important essence and the current needs of youth in Malaysia.

2.5.1 Generation Z

Generation Z, born from 1995 through 2010 (Seemiller & Clayton, 2019), is now the entire traditional-age undergraduate college demographic. While there are students of all ages in college today, the overwhelming presence of Generation Z students in higher education is a call to educators to adapt and create programs, processes, and curricula that align with the characteristics, motivations, and learning preferences of this generation.

Generation Z students are attentive more to intrapersonal learning. They also prefer video-based learning and applied learning where they can see a demonstration of the task they need to do either in-person or online (Seemiller & Grace, 2016). Many like their learning to be tied to real-world issues, those they are experiencing presently or those they will face in their future careers (Seemiller & Grace, 2019).

Generation Z simply denotes the tech-savvy 'Digital Natives' who are bombarded with digital technologies. They bring into focus a lot of m-apps and Internet-surfing. It is very important for technology developers to understand the psychology and demographics of these teens in terms of the kind of usage of m-apps so that they can target them well for both the present and future generations (Salleh et al., 2017). They are characterized as confident, high self-esteem, aware of latest trends, tech savvy, early adopters of technology, bright, globally connected, acceptance toward diversity and

concerned about environmentally safe products. Almost all the time they are engaged in information sharing through various open platforms.

When talking about gadgets and tools they are content creators and producers with latest apps and digital tools. They prefer interactive media. Mobile devices are their main source for consuming media and more preference are given to those websites, apps or social media which provide them multiple features such as comments, rating, text, posting pictures and videos and so forth. On the other hand, they are not considered as brand loyal and bring their gaming lifestyle with them into adulthood (Gaidhani et al., 2019).

Emotional attachment to their digital habits make them stay online even longer. They also have a different way of purchasing goods and services because they like to consider various online platforms such as facebook and so forth as an important source for browsing and researching services and products.

The behavioral characteristic development of generation Z is significantly influenced and affected by the dynamic surroundings and surrounding elements as contrasted with the previous generations. They grow against a highly sophisticated media and the technological world has made them an Internet-savvy nation and much more expert than their predecessors (Salleh et al., 2017). Generation Z students are determined to be highly connected, living in an age of high-tech communication, lifestyle powered by technology and widespread use of social media (Gaidhani et al., 2019).

In this study, the focus group for this research is the generation Z or youth in the age range of early youth, that is the age between 15-30 years based on age as prescribed by the Malaysian Youth Index 2015 (IBM'15) and the amended National Youth

Development Policy 1997 (Malaysia, 2019). This research concentrated on Muslim youth aged between 15 to 30 years.

2.5.2 Youth in Reciting Quran

Al-Quran is one of the primary sources that covers all aspects of life; it serves as a guide to humanity. Nowadays, the development of modern science and technology has positive effects on the community especially for young people. The emergence of modern gadgets such as mobile phones and tablets has become a recent phenomenon not only to Muslims but for all people around the world (Anas et al., 2017). Youth is the largest group of mobile consumers in the region.

Reciting Quran is an obligation to every Muslim. However, one survey reported that only few Muslim youths read the Quran often or understand it well. The survey found that only 18.1 percent read the Quran often, 8.6 percent never do so and the rest of them read it sometimes. Their low understanding of the Quranic verses could be a factor for the low reading rate which necessitates knowledge of Arabic, which is taught at low proficiency levels in High School. Furthermore, only 0.9 percent of youths understand all the verses and 11.7 percent understand most of them, while the vast majority (78.4 percent) understand little. Age makes little difference to their ability to understand the Quran. Rural youths appear to experience more difficulties than urban youths (Keng et al., 2011; Muslim Youth Survey for Malaysia and Indonesia, 2011).

In Malaysia, it was shown that youth have less motivation in reciting Quran because of their low understanding in Arabic language used in the Quran. Hence, there is a need for an alternative way in motivating the youth in reciting Quran.

2.6 Design and Development Research (DDR)

DDR is a broad research approach involving a variety of quantitative and qualitative research techniques (Richey & Klein, 2007, 2014). DDR is also known as development research, design research or design-based research. Richey (1994) defined DDR as the systematic study of designing, developing, and evaluating instructional programs, processes, products, and modules that must meet the criteria of internal consistency and effectiveness. DDR facilitates the study of new models, tools and procedures so that we can reliably anticipate their effectiveness and efficiency and at the same time address the pressing problems of this field (Richey, 1994; Richey, Klein, & Nelson, 2004). DDR in general focuses on the process of developing a product that involves context and situation analysis, as well as product evaluation (Alias et al., 2013).

2.6.1 Type of DDR

DDR involves identification research problems, based on research highlights and the contribution of knowledge (Ellis & Levy, 2010). The two types of DDR studies (Alias et al., 2013; Richey & Klein, 2007; Siraj et al., 2020) are:

Type 1 in which specific product development studies or programs involve design, development, and evaluation processes. A specific teaching model design such as the ADDIE and the ASSURE model is used as a guide to process development.

The Type 2 studies (Ellis & Levy, 2008) focused on generating new knowledge in terms of model development. Knowledge in the form of new designs or techniques, evaluated through a formative way or a complete model development process, involving one or more phases of design and development studies. The explanations of these types are shown in Table 2.7.

DDR studies are structured and phased (Richey & Klein, 2005) and according to Saedah et al. (2013), the DDR process involves four phases. These phases are: the needs analysis phase, the design phase, the development phase, and the implementation and evaluation phase. Ellis and Levy (2010) proposed six phases of DDR, namely identify problem solving, describe the objectives, design, and develop the artifact, test the artifact, evaluate the result of testing, and communicate the results. Furthermore, three phase of DDR have been introduced by Siraj et al. (2020) which are phase 1: needs analysis, phase 2: design and development and phase 3: evaluation.

Table 2.7: Two types of DDR research

Product and Tool Research (Type 1)	**Model Research (Type 2)**
Design and development comprehensive project - Product and instructional program - Other instructional product and program	Model Development - Comprehensive model development - Component model development process
Specific project phase	Model validation - Internal component model validation - External impact model validation
Development tool	Model Usability - Research on condition impacted the usability of the model. - Decision-making research - Research on characteristics and expertise
Emphasize - Research on specific product or development and assessment project	Design and development research assessment or model usability
Outcome/Output - Learning from specific products and analysis of the conditions for better usability - Specific conclusion	Design and development procedure or new model and situation that supports usability. General conclusion.
Research technique -Various techniques such as case study, survey, qualitative research	Various technique such as qualitative research, case study, survey

Source: Richey & Klein (2007)

Therefore, this study applied the DDR type 1, which is the product and tool research. The choice of three main phases of the prototype development is Phase 1: Needs Analysis, Phase 2: Design and development and Phase 3: Evaluation. In the next section, a description of the method used, sample selection, instrumentation, data

collection procedure and data analysis method from the first phase to the fourth phase is discussed. Justification of each method used is also provided.

Many instructional design models can be employed under DDR, such as the ASSURE model (1981), the ADDIE model, and Sidek Model (2005). However ADDIE is the most widely used instructional design model to develop a program or tool because of its generic characteristics and that it can easily be modified to suit the study needs (Ellis & Levy, 2010). Richey and Klein (2004) stated that ADDIE phases are generally put under the DDR research and have been used widely as the core phases in the instructional design model. In this study, the semiotic icon design (SIDQ) employed the DDR Type 1 approach embedded with ADDIE model that consists of five phases, which are analysis, design, development, implementation, and evaluation that focused on product and tool research. The design and development using DDR approach has produced a broad icon design that met youth motivation and objectives.

2.7 Theory and Model Related to Studies

The underpinning theory of this study is the theory of semiotics by Charles Saunders Peirce (1931-1958). Four models are employed in this study namely the ARCS Model of Motivational Design (Keller, 2000), People at Centre of Mobile Application Development (PACMAD) Usability Model (Harrison et al., 2013), Technology Acceptance Model (Davis, 1989) and Prototyping Model (Sommerville, 2016). Model selection is based on the literature that has been conducted on the models deemed suitable for this study.

Historically, there are few prominent modern Theory of Semiotics (1989-1998) such as Peirce's Theory of Semiotics (1931-1958), Saussure Theory of Semiotic (1974) and Barthes Semiotic Theory by Roland Barthes (1964).

Generally, semiotics is the study of signs and sign process or an epistemology about the existence or the actuality of sign in societal life. Each theory carried their own philosophy. In the development of the modern semiotic history, there are two pioneers from western countries who have made big contributions to the field, namely Ferdinand de Saussure (1857-1913), a linguist from Switzerland and Charles Sanders Peirce (1839-1914), a philosopher from America (Mahmoud & Hassan, 2015; Sendera et al., 2014) .

The reason for choosing semiotic approach is primarily because these researchers have been known as pioneers of the recognized epistemology in the history of modern semiotics. Besides, their approaches are not only limited within their area of studies but have reached and produced significant impacts across other disciplines or a multidisciplinary basis. Nowadays, the semiotic approaches and concepts that they introduced have received extensive attention and are often used as references in various fields and disciplines of thought that are not only narrowed to the field of philosophy and linguistics, but also arts and literature, such as music, theatre, movies and text analysis as well as communications, advertising, anthropology, psychology, archaeology, architecture, mathematics and so on (Sendera et al., 2014).

Charles Sanders Peirce, an American pragmatic philosopher, and Ferdinand de Saussure, a Swiss linguist, are regarded as two major contributors of modern semiotics, or semiology. Both are considered two founding fathers of mathematical symbolic logic. Saussure called it semiology and Peirce called it semiotics (Lin & Lin, 2014).

2.7.1 Peirce's Theory of Semiotics

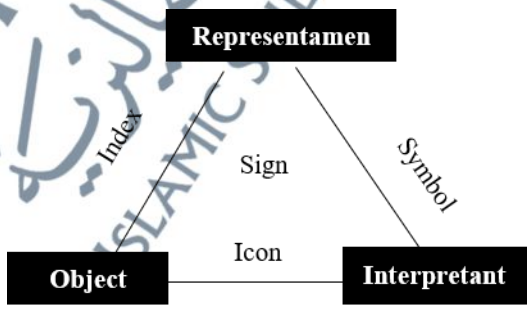
While Saussure was formulating his model of the sign and of 'semiology', the pragmatist philosopher and logician Charles Sanders Peirce formulated his own model

of the sign of 'semeiotic [sic]' and of the taxonomies of signs. In contrast to Saussure's model of the sign in the form of a 'self-contained dyad', Peirce offered a triadic (three-part) model consisting of the *representamen* or the form which the sign takes called by some theorists the 'sign vehicle'; an *interpretant* is not an interpreter but rather the sense made of the sign; and an *object* is something beyond the sign to which it refers, a referent (Chandler, 2007). In Peirce's own words:

"A sign [in the form of a representamen] is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the interpretant of the first sign. The sign stands for something, its object. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen. (Peirce 1931–1958)

Source: Chandler (2007, pp. 29-35)

Chandler (2007) and Mahmoud and Hassan (2015) stated that all three elements are essential to qualify as a sign. Sign is a unity of three elements of what is represented (the object), how it is represented (the representamen) and how it is interpreted (the interpretant).



Source: Chandler (2007)

Figure 2.8: Peirce's Theory of Semiotic (Semiotic Triangle)

Charles Sanders Peirce had defined the semiotic as an action, or influence, which is, or involves, a cooperation of three subjects, such as a sign or representamen, its object, and its interpreter as in Figure 2.8. Peirce defined the three (3) elements of sign. Signs are physical objects that can be captured by the five human senses and a sign is something that refers to (represents) something other than the sign itself. Peirce sign consists of the Symbol (the marking of the deal), Icon (the marking of the physical representation) and Index (the marking of cause-effect relationships) (Chandler, 2007; Lin & Lin, 2014).

Icon represents signs with the resemblance of target object. By watching signs, themselves, the meaning of signs could be understood purely, for example, the house, the lock. Index represents the direct connection to the target object. Index signs will provide association to the target object, for example, the sign of stop, the signs of human body showing men's toilet and women's toilet. Symbol, however, has no relation to the target object, without semblance and connection, symbol plays by free statement or customary rules. Symbol needs to be learned to understand its meaning, e.g., numbers or punctuation or music note as described in Table 2.8.

Table 2.8: Example of Peirce's triadic semiotic

Sign Elements	Example 1	Example 2
Icon (physical)	 Lock	 House
Index (physiological)	 Stop	 Toilets
Symbol (psychological)	 Mathematic symbols	 Music note

Source: Lin & Lin (2014)

The sign itself is the production of a three-way relation between the representation (which represents), the sign's object (which is represented) and its interpretant (the process of interpretation) (Communities et al., 2015). Thus, when we design an icon, the icon is used to convey the information intended on the meaning. Icons used in an interface should activate the appropriate mental images in the users. Overall, the main principles containing Peirce's theory are the human mind and sign boundaries, the three-dimensional system (triadic/trichotomy) and the relativity regarding the three typologies or taxonomies of signs (icon, index and symbol) (Sendera et al., 2014).

a. Semiotic Analysis

To understand further on the theory of semiotics practically, the semiotic analysis was performed in the research to understand and practically use the theory based on the three elements of semiotics, the object, referent and interpretant as illustrated in Table 2.9. Semiotic analysis was first pioneered by Ferdinand de Saussure (1857-1913) as the founder of semiology and Peirce (1839-1914) as the founder of semiotics (Berger, 2000). Both are equally analyzing about signs, but through different approaches. Saussure states that the study of signs is inseparable from two things, namely signifier (sound or image associated with something) and signified (idea or concept of the thing), while Peirce mentioned trichotomy, namely icons, indices, and symbols (Danesi, 2004). Semiotic analysis looks at the structure of the object of research.

Semiotic analysis is widely adapted in many studies for analysis study in representing and interpreting of the information. Table 2.9 summarizes the previous studies on the semiotic analysis adopted by the researchers. The Peircean semiotic approach is a dominant player in semiotic icon studies and has been conceptually analyzed.

Table 2.9: Previous Studies using semiotic analysis

Studies	Findings	Dimension	Example	References
A Preliminary Semiotic-Conceptual Analysis of a Learning Management System	Mathematical formalization of semiotics that builds on a conceptual foundation to present a means for analyzing relationship between representations and meanings.	Semiotic-Conceptual Analysis (SCA)	Learning Management System	Priss, 2020
Perceived and projected authenticity of visitor attractions as signs: A Peircean semiotic analysis	Adopted Peircean semiotics to explore perceived and projected authenticity. Examined foreign tourists' perceived authenticity of White Tower of Thessaloniki. A twofold qualitative research method adopted by comparing content analysis and semiotic analysis.	Comparing content analysis & semiotic analysis	Interview 19 tourists with semiotic analysis 3 websites promote attraction	Paraskevaidis & Weidenfeld, 2021
Visual communication language and product mediation: A semiotic analysis	Endorsed through elements of graphic design (pictures, letters, colors, compositions, design layout). Media language to understand semiotics is essential, as it is main component to producing meaning of messages. Logo is difference in promoting product to give lasting effect. Positive image created via visual images are significant toward industries and gives positive impact on image of industries.	Employed taxonomy analysis (classification) focused on a domain object of analysis	Analysed Starbucks Coffee logo design.	Ibrahim et al., 2012

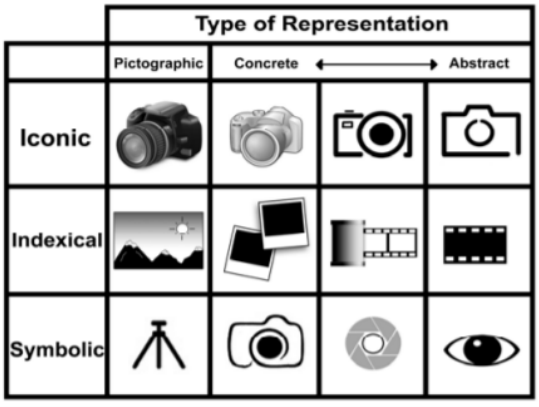
Table 2.9 shows the previous studies using semiotic analysis. In this study, semiotic analysis was employed by adapting the semiotic analysis studies by Ibrahim et al. (2012) using icon design elements to design semiotic icon design for reciting Quran (SIDQ). This is because this approach was focused on visual communication and product mediation endorsed through elements of graphic design and media language to understand the semiotic as main component in producing the meaning of the messages.

b. Icon Classification and Semiotics

Based on study by Gatsou et al. (2012), icon can be classified into broad categories based on Peirce's semiotics studies. Peirce classified the signs into three categories: icon, index, and symbol. It must consist of all three parts (object,

representamen and interpretant) and the interaction between them is a process called Peirce semiosis (from Greek, semiosis). An icon is the simplest of such of representation type, since it consists of a line pattern visually representing what it stands for. Icons display features identical to the object that they represent. An index correlates with its context in space and time and is implicitly related to its referent definition. A symbol is a sign which has a common or subjective relation to what is meant.

The three (3) functions of the images are described in similar terms by Arnheim (1969). “Images can serve as pictures or as symbols; they can also be used as pure signs”. The concept of signs by Arnheim is equivalent to Peirce’s concept of a symbol, an image arbitrarily associated with its referent. Images can serve more than a function at a time. The more subjective the relationship between the sign and what it represents, the greater the need for more organized cognitive resources to process the information. As for the categories employed by semiotics, the issue is how object, representation and interpreter relate to each other to form a sign as part of the communication between user and system.



Source: Nadin (1998)

Figure 2.9: Types of icon representations

Nadin (1998) explained that three (3) classes can be assigned in symbols. Pictorial, graphic, and verbal symbols vary from concrete representations to abstract ones. Figure 2.9 illustrates several representations of a camera based on the Nadin (1998) concept. Occurrence meaning from concrete to abstract and various forms of icons (iconic, indexical, symbolic) play an important role in user performance. It becomes easier to interpret, as the representation becomes more schematic. As the level of abstraction increases, the sign gradually becomes more generic and less complex.

From a semiotic point of view, the design of a mobile application interface is comprised of various signs. The designer tries to convey the meaning that he wants to convey (AlNuwaiser & Buchanan, 2016; Buchanan, 2010). As the users interact with the mobile phone screen, they expect to guess the sign's object, as the sign is designed to communicate specific meanings. When the user's interpretation (interpreter) suits the expected purpose of the sign, the designer has achieved his aim of producing a successful icon (Nadin, 1998). Ideally, the link between the representamen and object should be obvious to all the users of the interface and result in only one interpretant. This should activate the correct mental model, which allows the user both to understand the action and to interact appropriately (Isherwood, 2009).

c. Analysis of Theory of Semiotics

Table 2.10 summarizes the semiotic icon theories and its concept based on the three semiotic theories. It summarizes the semiotic theory concept in three different theory of semiotic by Charles Sanders, Ferdinand de Saussure, and Roland Barthes.

Table 2.10: Analysis of Semiotic Theories

Theories	Findings / Concept	Dimension	References
Peirce's Theory of Semiotics by Charles Sanders Peirce (1931-1958)	Human mind and sign boundaries, three-dimensional system (triadic/trichotomy) and relativity to three taxonomies of signs (icon, index, and symbol). Represents signs with resemblance of target object.	Sign is a unity of three elements of what is represented (the object), how it is represented (the representamen) and how it is interpreted (the interpretant). Classified into three elements: icon, index, and symbol. Index represents direct relation to target object. Symbol has no relation to target object, without semblance and connection, symbols are free statements or customary rules.	Lin & Lin, 2014 Chandler, 2007 Sendera et al., 2014 AlNuwaiser & Buchanan, 2016
Saussure's Theory by Ferdinand de Saussure (1974)	Emphasized language as a system of sign. Relationship between signifier and signified referred to signification.	Both signs are a signifier or sound pattern and a signified or concept.	Sendera et al., 2014
Barthes Semiotic Theory by Roland Barthes (1964)	'A Photographic Message' provides an outstanding view of images and their visible and implicit messages. Text and photo are connected and give mutual meaning.	Signifier is image used to represent something else, it signified what it stands for (a real thing or, in a stricter reading, a sense-impression).	As cited by Najafi & Abbas, 2014

From the table, Peirce emphasized on representing the signs with the resemblance of target object that involved three sign elements of object, representamen and interpretant and three taxonomies of sign namely icon, index, and symbol. Saussure emphasized on language as a system of sign and the relationship between signifier and signified or what is referred to as signification. Barthes emphasized on the signifier as the image used to represent something else; it signified what it stands for (a real thing). Figure 2.10 summarizes the modern theory of semiotics in network view diagram.

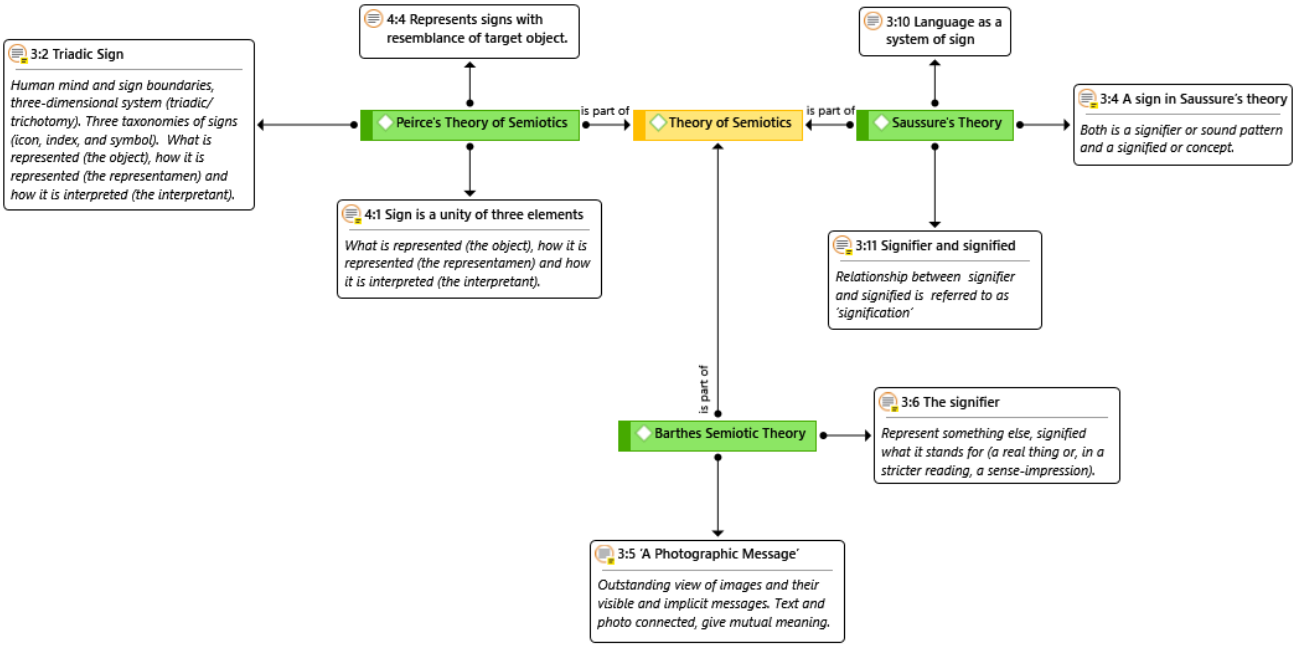


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Figure 2.10: Analysis of Semiotic Theories

In this research, the researcher selected Peirce's theory of semiotics as the underpinning theory because it is the most suitable theory for semiotic icon design and most related to the taxonomy of sign that consists of icon. This theory also emphasized on sign using icon to convey the meaning of information. By viewing the sign of icon, the meaning of signs could be understood purely by the user. Applying the semiotic concept in icon design would be able to convey the abstract information and enable understanding of the meaning of Surah genre in Quran.

d. Application of Semiotics

Over the centuries, semiotics has been applied to various fields including literature, music, poetry, film, and advertising. In current research, semiotics has been used as a theoretical base of information design in the areas of information systems engineering, organizational decision support systems, and the development of agent-based e-commerce systems. Information design means communication by words,

pictures, charts, graphs, maps, pictograms, and cartoons, whether by conventional or electronic means (Sharp, 2011). A few applications of semiotics in information design are in Systems Engineering, Organizational Decision Support System (ODDS) and Agent-Based E-Commerce Systems.

Sharp (2011) mentioned that in the information systems engineering, Peirce's classic semiotic model of representamen, interpretant, and object is applied as the theoretical foundation for understanding the nature of requirements. In ODSS, rather than using the semiotic triangle, Morris's semiotic framework of semantics, syntactics, and pragmatics is used to show how the semiotic approach can be beneficially used to identify and refine organizational level problems that are suitable for ODSS support. In agent based systems, application of semiotics to agent-based e-commerce systems draw heavily to identify three phases based on the semiotics approach. The broad semiotic application is to analyze "how meanings and intentions can be conveyed through language (signs) and what aspects of language need to be captured so that through the representation of data, the agent-based e-commerce can function as an effective substitute for human communication". Findings show that the semiotic approach provides a framework for "identifying the responsible human agents, software agents, and their potential actions and the behavioural norms which brings about the realization of the potential actions".

Furthermore, Sharp (2011) stated that semiotics can help us be aware of what we take for granted in representing the world, reminding us that we are always dealing with signs, not with an unmediated objective reality, and that sign systems are involved in the construction of meaning. Based upon the wide use of the semiotic approach in various fields and its specific application to the areas discussed above it appears that

with conscientious application semiotics can serve as an effective theoretical foundation for information design.

In this research, the semiotics studies are the theoretical foundation for icon design for mobile application for Quranic studies. Semiotics will be applied in the developing the prototype of semiotic icon design application for motivating youth in understanding the Surah genre. This semiotic application for Quranic field is to analyze how meanings can be conveyed through language (signs) and what aspects of language need to be captured so that through the representation of information, the semiotic icon can function as a support in visual communication.

2.7.2 ARCS Model of Motivational Design

Motivation is an essential aspect of instructional strategy. Motivation ensures that the users keep on using the learning objects after the initial usage. Since the users of mobile applications cannot be controlled like students of traditional classrooms, therefore motivation is needed to sustain interest among users of such applications. Despite its importance, however, most developed mobile applications have neglected the motivation aspect. This is even though motivation encourages retention among users especially if the learning content is complicated (Khalid et al., 2015).

Therefore, this study proposed to integrate the ARCS model into a semiotic icon design framework to cater to the problems faced by youth in reciting Quran which are to be continuously engaged in the mobile learning process. The ARCS is suitable because the main goal of ARCS is to build up and to retain motivation. A few available models of motivational learning theories that are useful for motivation and design studies are the ARCS model of motivational design and Maslow Theory of Motivation, Cognitive Evaluation Theory and Self-Efficacy Theory (SET). Among the models of

motivation, the ARCS model is chosen as it is widely used in education and information technology research.

ARCS model is based on a synthesis of motivational concepts and characteristics into the four categories of attention (A), relevance (R), confidence (C) and satisfaction (S) (Keller, 2000). Keller (2008) stated that many theories and models explain aspects of motivation, volition, and learning but most of them tend to stand alone as relatively independent areas of inquiry. ARCS is a well-established theory pertaining to motivation which provides a synthesis of motivational concepts and theories and a motivational design process. It is also a problem-solving approach for designing the motivational aspects of learning environments to stimulate and sustain student motivation to learn (Khalid et al., 2015). Besides, Farhadi (2012) stated that keeping the user interested all the time is a prerequisite for successful teaching. If the user is distracted, he or she will be unable to focus and pay full attention to the task at hand. Hence, learning will not be effective.

These four categories represent sets of conditions that are necessary for a person to be fully motivated, and each of these four has component parts or subcategories that represent specific aspects of motivation (Keller, 2000). It provides a basis for aggregating the various concepts, theories, strategies, and tactics that pertain to the motivation to learn. According to Khalid et al. (2015), as well as Ain and Amin (2013), ARCS is a motivation model propagated by Keller and Kopp (1987). This model can be used as guide by teachers to enhance learner motivation in teaching and learning. It had been widely used and validated by both teachers and trainers in numerous learning organizations such as elementary and secondary schools, colleges, and universities, and in adult learning settings in corporations, government agencies, non-profit organizations, and military organizations. The model can enhance the interaction

between the learning materials and the learners. It has also been used around the world on virtually every continent, and has been used extensively in Asia, Europe, and Latin America.

Derbali and Frasson (2012) and Keller (2000) mentioned the existing research on psychological motivation to identify the four components of motivation. The model has been used in training and games and has also been validated in numerous studies at all education levels and in many different cultures and therefore it is of interest in this study. Table 2.11 summarizes the studies applying the ARCS Model in mobile application.

Table 2.11: ARCS Model in Mobile Application

Studies	Field	Findings / Concept	Dimension	References
Four Components of Motivation	Psychological Motivation	Used in training and games. Validated in numerous studies with all education levels and in different cultures.	Attention, relevance, confidence satisfaction	Derbali & Frasson, 2012 Keller, 2000
Four factors of ARCS	Education	Gain learners' attention, arouse curiosity, provide surprises, brainstorming, pose problem. Make content relevant, explain objective, let student provide own example. Shows positive expectations, provide opportunities, feedback, acknowledge students. Provides satisfaction, reinforcements, and certificates.	Attention, relevance, confidence, satisfaction.	Faryadi, 2012
ARCS Questionnaire	Education	Uses questions to pose problems or paradoxes (Attention), uses language and terminology appropriate to learners and their context (Relevance), provides feedback on performance promptly (Confidence), makes statements giving recognition and credit to learners as appropriate (Satisfaction).	Attention, relevance, confidence. Satisfaction.	Derbali & Frasson, 2012
The four Factor in ARCS Model	Education	Four factors in ARCS model	Attention, relevance, confidence, satisfaction.	Ying & Yang, 2013
ARCS Model of Motivational Design	Education	Attention, relevance, confidence, and satisfaction	Attention, relevance, confidence, satisfaction.	Khalid et al., 2015

Majority field of studies applied the four elements which are attention, relevance, confidence, and satisfaction to enhance motivational design of the studies.

In this research, the ARCS model of motivation was employed to give implication to this study in term of motivational design for semiotic icon design for reciting Quran. This is because the ARCS model is the best model that can adopt the motivation features into the application to enhance youth motivation. In this study, the researcher applied the ARCS model of motivational design consisting of four main elements of attention, relevance, confidence, and satisfaction as the motivation elements for design and evaluation of semiotic icon design application. The design of the SIDQ also integrated the motivation elements to maintain user interest. Table 2.12 summarizes the ARCS Model of Motivational Design Strategies in a few studies.

Table 2.12: ARCS model of Motivational Design Strategies

	ARCS model of Motivational Design Strategies				
Studies	**Attention**	**Relevance**	**Confidence**	**Satisfaction**	**Reference**
Psychological Motivation	Perceptual arousal of surprise. Inquiry arousal (posing challenging questions. Variability (uses a variety of resources and methods of teaching). Perceive learning experience sync with goal and linked, any aspect.	Goal orientation (telling future usefulness of gained knowledge, Motive matching (learner's motive, provide choices, Familiarity (role model to tie content to learner's skills and experience.	Course constraint and objective clear. Believe success is doable. Established positive beliefs for achieving success. Attentive intent in content moderately challenged motivated.	Intrinsic reinforcement (inspiring and help intrinsic enjoyment of learning experience) extrinsic reward (provide positive reinforcement and motivational feedback, equity (maintain consistent standard and consequence for success)	Keller, 1983
Education	Refers to learner's interest. Critical to get and hold the learners' interests and attention. Perpetual arousal inquiry arousal and variability	Relevance of topic can understand topic clearly. Giving relevance for topic to be taught bridge gap between syllabus and real world. Goal orientation, Motive	Develop confidence expect success thru learning. Correlation among confidence level & success expectation. Estimate of success is important. Learning	Direct relation among motivation and satisfaction. Learners should satisfy of what achieved during learning process. Get good marks for work have kept. Intrinsic reinforcement, extrinsic rewards, and equity.	Keller, 2000

ARCS model of Motivational Design Strategies					
Studies	**Attention**	**Relevance**	**Confidence**	**Satisfaction**	**Reference**
		Matching and Familiarity.	requirement, success chance, own control		
Education	Gain learners' attention. Arouse curiosity Provide surprise Pose a problem. Provide brainstorming	Make content relevant, explain objectives. let students provide their own examples	Show positive expectations. provide opportunity, give feedback, acknowledge students	Provide satisfaction, provide reinforcements, provide certificates	Faryadi, 2012
Education	Uses questions to pose problems or paradoxes.	Uses language and terminology appropriate to learners and their context	Provides feedback on performance promptly	Makes statements giving recognition and credit to learners as appropriate.	Derbali & Frasson, 2012
Education	Perceptual arousal (use of novel, surprising, odd). Inquiry arousal (incite info seek actions by posing, or learner generate questions or problem to solve) Variability (keep interest by differing elements of training)	Familiarity (use specific language and example related to experience and values. Goal orientation (give example give objective and utility of instruction and either present goals for success or learner define. Motive watching (use teaching strategies match motive profiles of students.	Learning requirements (assess success by giving performance needs evaluative criteria) Success opportunity (task stages allow significant success skill under both learning & performance condition. Personal control (reaction option for control support internal credit for success	Natural consequences (opportunities to use newly acquired knowledge or skill in a real or stimulated setting) Positive consequences (feedback and reinforcement that sustain desired behaviour) Equity (maintain consistent standards and consequences for task accomplishment.	Ying & Yang, 2013

From the table, most of the studies applied the three subcategories of elements for attention (perceptual arouse, inquiry arousal, variability), relevance (familiarity, goal orientation, motive watching), confidence (learning requirement, success opportunity, personal control), and satisfaction (intrinsic reinforcement, extrinsic rewards, and equity). In this study, the sub elements and strategies employed are based on Keller (2000). This is because the model has been used in many fields and been validated in various studies. Therefore, it is significant in this study to incorporate the elements of

motivational design in the semiotic icon design and application to assist in motivating youth in reciting Quran. Table 2.13 summarizes the sub elements applied in this study.

Table 2.13: ARCS Model Strategies for Semiotic Icon Design Quran

Element	Sub element	Strategies for this study
Attention	Variability	Employed variability to grab the attention of the youth, need to use different ways of learning (reciting) methods.
Relevant	Goal Orientation	Employed goal orientation by giving usefulness of topic youth to get interest. It is worth to learn topic on visualizing Surah genre in present situation and useful for future.
Confidence	Personal control	Employed personal control where learners need to gain control over their learning process so that they can feel that their success does not totally depend on external factors. Instead, they have internal factors affecting their success.
Satisfaction	Intrinsic reinforcement	Applied intrinsic reinforcement by encouraging intrinsic enjoyment of learning experience so that learners have fun, continue the learning process without expecting reward or other kind of external motivational elements.

In this study, the sub element of variability used to grab the youth attention, goal orientation to give usefulness of topic to youth, personal control where youth can control over their learning process and intrinsic reinforcement by encouraging intrinsic enjoyment of learning experience without expecting reward. This due to its suitability for semiotic icon design for reciting Quran. If outcomes effort is consistent with expectations and users feel relatively good about those outcomes, they will remain motivated (Faryadi, 2012; Keller, 1983, 2000; Ying & Yang, 2013). In this research, the researcher employed the sub elements attention (variability), relevance (goal orientation), confidence (personal control) and satisfaction (intrinsic reinforcement). The elements of ARCS for this study were validated by expert IT and the validation results was summarized in Chapter 4.

2.7.3 Usability Model

Usability has been an important criterion of decision making for end-users, consumers, product designers and software developers for their respective purposes. In addition to the effort of defining usability concepts and dimensions to be evaluated and quantified, many usability evaluation methods and measurements have been developed and proposed. According to Gupta (2015), usability is evaluated by the quality of communication (interaction) between a technological product (application) and a user (the one who uses that technological product). For these reasons, a distinct approach and questionnaire would be helpful for evaluating electronic consumer products, even though some usability questionnaires claim to be relevant to products other than computer software.

a. Analysis of Usability Evaluation Factor for Semiotic Icon Design Application

Usability evaluation for icon is essential to evaluate the ease of use of mobile application to the user. Table 2.14 provides the information related to the usability evaluation for an application.

Table 2.14: Usability Evaluation Element for Mobile Application

Studies	Model	Findings	Dimension	Reference
A study of usability principles and interface design for mobile e-books	Nielsen (1993), Norman (2002), 3e indicator of Yeh (2010)	Integrated usability by Nielsen (1993), design principle by Norman (2002) and 3e indicators of meaningful criteria for evaluation of the interactive design by Yeh (2010). Proposed usability principles: Visibility (memorability, error): provides users with information that is conducive to communication and interaction, as well as clear instructions; Ease (learnability): easy to learn, and users can quickly familiarize themselves with the system's functions and operations, thus, time spent on learning is minimal; Efficiency: once users have learned how to use the system, it is easy to use functions of system at full capacity; Enjoyment (satisfaction): users feel satisfied upon	Visibility (memorability, error), learnability (ease), efficiency, satisfaction (enjoyment)	Wang & Huang, 2015

Studies	Model	Findings	Dimension	Reference
		completing a task when using the system.		
Digital Design in Action – Creative Solutions for Designers	Nielsen (1993)	Learnability: How easy to accomplish basic tasks first time encounter design. Efficiency: once users learned design, how quickly can they perform tasks? Memorability: users return to design after a period of not using it, how easily re-establish proficiency? Errors: How many errors do users make, how severe are these errors, and how easily can they recover from errors? Satisfaction: How pleasant is it to use design?	Learnability, efficiency, memorability, errors, and satisfaction	Jackson & Ciole, 2017
Usability Evaluation Framework of Mobile Application	People at Centre of Mobile Application Development (PACMAD)	Integrated by Nielsen (1998), International Organization for Standardization (ISO) (ISO/IEC, 1998). To overcome limit, exist in current usability model to measure usability app based on three attributes: effectiveness, efficiency, satisfaction. Proposed add four more attributes: Learnability, Memorability, Errors and Cognitive Load. Found almost 23% measured cognitive load of app under evaluation. Some 2% of studies evaluated Memorability, Effectiveness, Satisfaction, Efficiency was included in over 50% of studies. Errors were evaluated in over 30% of these studies. Context of use and user were considered in less than 10% of papers. Context of use vary enormously and is considered an important factor.	Effectiveness, satisfaction efficiency, cognitive load, learnability memorability and errors	Saleh & Ismail, 2015 Harrison et al., 2013 Saleh et al., 2017
Usability Evaluation	Usability ISO9241-11:1998	Effectiveness (reflects completeness and accuracy of goal achievement); Efficiency (resources utilized to effectiveness); and Satisfaction (comfort, and positive user interaction when using system).	Effectiveness, Efficiency and Satisfaction	Saleh et al., 2015

In this study, the investigation of these usability dimension for evaluating semiotic icon design mobile application includes comparison of the available usability dimension elements. Five elements have been found which are presented in Table 2.15. Table 2.16 describe the definition of usability elements. The common dimension of usability evaluation found in most of usability models are identified as satisfaction and effectiveness where the frequency was 5 or 20 percent. Learnability, efficiency, and

memorability were 4 or 16 percent. Errors made up 3 or 12 percent. Cognitive load was 1 or 4 percent. The common usability evaluation element discussed the area of mobile application. These elements were mainly categorized for evaluating usability of the mobile application from the perspective of the end user, which play an important role in building satisfaction.

Table 2.15: Comparison Matrix – Usability Evaluation Elements

No	Usability Elements	Model	Wang & Huang	Huang & Lai	Jackson & Ciolek	Harrison et al	Saleh, et al.	Total	Percents
1	Learnability	Nielsen	√	√	√	√		4	16%
2	Satisfaction	Nielsen/ PACMAD/ ISO9241-11:1998	√	√	√	√	√	5	20%
3	Effectiveness	Nielsen/ PACMAD/ ISO9241-11:1998	√	√	√	√	√	5	20%
4	Efficiency	Nielsen/ PACMAD/ ISO9241-11:1998	√	√	√		√	4	16%
5	Memorability	Nielsen/ PACMAD	√	√	√	√		4	16%
6	Errors	Nielsen/ PACMAD	√	√	√			3	12%
7	Cognitive Load	PACMAD				√		1	4%

Table 2.16: Usability Element definitions

No	Usability Elements	Definitions
1	Learnability	The ease with which an application or product can be picked up and understood by users. The better the learnability, the less training and time taken for person to use it. User can easily learn and rapidly use
2	Satisfaction	Fulfilment of user's wishes, expectations, or needs, or the pleasure derived from this. Users are subjectively satisfied during use
3	Effectiveness	The degree to which something is successful in producing a desired result; success
4	Efficiency	The state or quality of being efficient. Once users have learned how to use system, it is easy to use functions of system at full capacity with high level of productivity is possible
5	Memorability	Users return to design after a period of not using it, how easily re-establish proficiency. User can return to the system after some period of not having used it, without having to relearn everything
6	Error	The state or condition of being wrong in conduct or judgment
7	Cognitive Load	Refers to used amount of working memory resources. The amount of information to be kept and worked within the Human Working Memory

Therefore, the researcher proposed usability evaluation for semiotic icon mobile application. Based on the analysis, six usability dimensions have been identified as highest-ranking elements in the usability dimension for evaluating the semiotic icon design application for reciting Quran which are satisfaction and effectiveness.

In this study, the researcher employed the effectiveness and satisfaction from PACMAD usability model elements for evaluation of semiotic icon design application to determine the effectiveness of the application and satisfaction with it. The satisfaction was selected because to determine the fulfilment of user's wishes, expectations, or needs, or the pleasure derived from this study (Press, 2020). The effectiveness element was selected because to determine the degree to which something is successful in producing a desired result for this study. This is due to the suitability of the elements for evaluating the semiotic icon design application in reciting Quran. The evaluation of the semiotic icon design application does not focus on the elements of learnability, efficiency, error, and cognitive load elements.

The two usability elements were then validated by the three (3) experts in Information Technology (IT) in terms of usability elements and its suitability for evaluating the semiotic icon design application in Quranic field. The result of the usability element validation summarized in Chapter 4.

2.7.4 Technology Acceptance Model (TAM)

The Technology acceptance model (TAM) was first introduced by Davis (1989), which is adapted from the Theory of Reasoned Action (TRA) developed by Fishbein and Ajzen (1975) and the Theory of Planned Behavior (TPB) by Ajzen (1991). These are particularly well-researched intention models that have proven successful in

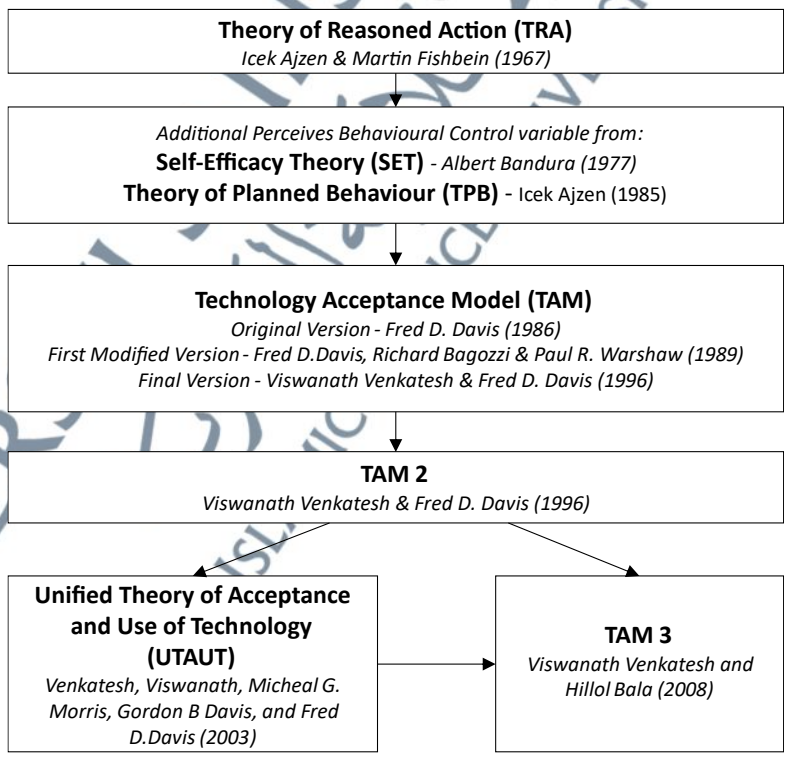
predicting technology acceptance behavior (Alqahtani & Mohammad, 2015; Barry, Jan, & Islamic, 2018; Nasri & Charfeddine, 2012).

In recent years, various studies have employed TAM to investigate user acceptance of new technology. The goal of TAM is to provide an explanation of the determinants of computer and application acceptance that is generally capable of planning user behavior across a broad range of end-user computing technologies and user populations (Davis et al., 1989). To understand further on TAM, the analysis was performed to understand the model based on the TAM elements. Table 2.17 and Figure 2.11 briefly summarized the evolution, type of TAM, and its elements.

Table 2.17: The Evolution of Technology Acceptance Model

Model	Findings / Concept	Dimension	Reference
Theory of Reasoned Action (TRA) *by Fishbein and Ajzen (1967)*	Analyzes determinants of conscious behavior. Explain the connection between attitudes and behaviors within human action.	Specific behavior is determined by an intention to carry out this behavior, behavior intention (BI). BI is determined by Attitude (A) & Subjective Norms (SN).	Aziz et al., (2020) Rondan-cataluña et al., (2015)
Technology Acceptance Model (TAM) *by Davis (1986)*	Adapted TRA for modeling user acceptance of IS. Preferred technology acceptance due to consistency and validity in explaining usage behavior in a different context (Liu & Yu, 2017)	Dropped SN. Add two (2) beliefs, perceived usefulness (PU) and perceived ease of use (PEU), as the main antecedent. Maintain use determined by BI.	Aziz et al., (2020 Rondan-cataluña et al., (2015)
First modifications *by Davis, Bagozzi, and Warshaw (1989)*	Describe wide-ranging determinants of computer acceptance that led to users' behavior with a broader range of end-user computing technologies and user populations (Lai, 2017).	Added Attitude (A) as a mediator between belief constructs and intention to use. Found PU & PEU exert strong impact on BI, and the effect of A decreases with time.	Rondan-cataluña et al., (2015) Aziz et al., (2020) (Davis et al., 1989)
Final version *by Venkatesh and Davis (1996)*	Formed final version by eliminating A. Over time, TAM has become well-established as a robust, powerful, and parsimonious model for predicting user acceptance.	Eliminating Attitude (A) mediator. PU and PEU have a direct influence on behavior intention.	Rondan-cataluña et al., (2015) Aziz et al., (2020) (Venkatesh & Davis, 1996)
TAM2 *by Venkatesh and Davis (2000) First extensions TAM*	Revised TAM to influence social forces. TAM2 was tested in voluntary and mandatory settings. Results show original TAM influences 40–50% of technology acceptance, while	Added the social influence processes (SN, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and PEU).	Aziz et al., (2020)

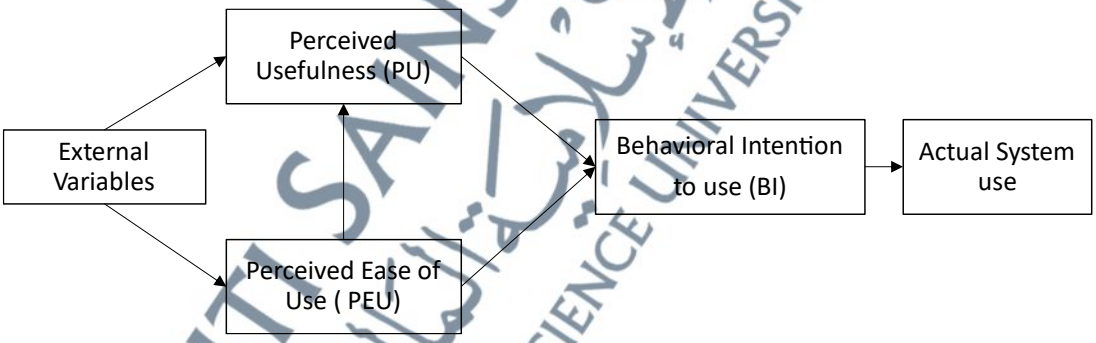
Model	Findings / Concept	Dimension	Reference
	TAM2, reaches 60% (Gupta et al., 2016)		
Unified Theory of Acceptance and Use of Technology (UTAUT) *by Venkatesh et al. (2003)*	Based on TAM2, combined 8 models into UTAUT - TRA, TPB, TAM, Motivational Model (MM), Combined TPB and TAM (C-TPB-TAM), Model of PC Utilisation (MPCU), Diffusion of Innovation theory (DOI), and Social Cognitive Theory (SCT).	Four (4) constructs as determinants of user acceptance and usage behaviour: performance expectancy, effort expectancy, social influence, and facilitating conditions. Improved predictive efficiency over previous TAM to 70%.	Aziz et al., (2020) Rondan-cataluña et al., (2015) Oye et al., (2012)
TAM3 *by Venkatesh and Bala (2008)*	Proposed advancement of TAM2 to enable understanding of the role of interventions in technology adoption. Presents a complete nomological network of determinants of individuals' IT adoption and use. Posits effect of perceived ease of use on behavioral intention diminish and effect of perceived ease of use on perceived usefulness will increase with increasing experience with a technology (Venkatesh & Bala 2008). TAM 3 tested and validated on IT implementations.	Enlarged by constructs precede PEU and which set forth in Venkatesh and Davis (1996) and Venkatesh (2000). Building on anchoring (computer self-efficacy, computer anxiety, computer playfulness, and perceptions of external control) and adjustment framing (perceived enjoyment and objective usability) of human decision making. Model of determinant of PEU developed.	Aziz et al., (2020) Rondan-cataluña et al., (2015)



Source: Aziz et al. (2020)

Figure 2.11: Summary on Evolution of TAM

Based on Table 2.17, the TAM has evolved tremendously from the original TAM until TAM3 with lots of improvement from time to time to suit the need of the study. TAM has been widely used to investigate user behavior in different environments and situations. In this study, the final version of the original TAM was employed for semiotic icon design for Quran study as it emphasized the perceived ease of use and perceived usefulness as strong determinants and predictors when explaining the behavioral intention indirectly toward actual using a technology (Venkatesh & Davis, 1996) as illustrated in Figure 2.12. Many researchers use two important beliefs, perceived usefulness (PU) and perceived ease of use (PEU) of the technology acceptance model (TAM) to study user acceptance of information technology (Lin, 2013). The selection of TAM is due to consistency and validity in explaining usage behavior in different contexts (Liu & Yu, 2017).



Source (Venkatesh & Davis, 1996)

Figure 2.12: Technology Acceptance Model (TAM) – Final version

a. Perceived Usefulness (PU)

Perceived usefulness can be described as the degree to which a person believes subjectively using a particular technology will enhance his or her performance (Fred D. Davis, 1989). This follows from the definition of the word "useful" that is capable of being used advantageously. This is consistent with (Lu & Su, 2009) who

regarded usefulness as the perception of an individual when performing a behavior to gain a specific reward. Aside from gaining the output rewards or behavioral performance, an individual tends to be satisfied or fulfilled by enacting the behavior under certain situations (Lu & Su, 2009). When individuals perceive technology as useful, they believe that technology will offer them a positive relationship (Hernandez et al., 2009).

b. Perceived Ease of Use (PEU)

The perceived ease of use (PEU) was originally defined as the degree to which people believe that using new technology can help to reduce their efforts and how useful the technology would be (Fred D. Davis, 1989). This follows from the definition of "ease": "freedom from difficulty or great effort." According to Davis (1989), perceived ease of use is the motivational aspect inherent in the interaction between the user and the application. The ease-of-use concept relates to the features associated with technology such as easily understandable functions and content, ease of learning or simplicity of use (Hernandez,et al., 2009). In technology usage, ease of use is related to finding information easily, the ability to quickly solve problems and application functionality (Pigatto et al., 2016).

c. Behavioral Intention on Actual Usage

According to Ajzen and Fishbein (2000), two major elements are associated with intentions: attitude and social pressure. Behavioral intention is the reflection of the likelihood a person would be willingly involved in the behavior of interest. The stronger the intention of engaging in a behavior, the higher the percentage of the person performing the behavior. Intention to use technology can also be explained by a large portion of the user's actual use of technology (Shin, 2009). Many studies have investigated the intention to use (Ajzen & Fishbein 2000; Davis et al., 1989; Okumus

& Bilgihan, 2014; Shin, 2009). As users retrieve and exchange information using the app, therefore, this is considered as the intention. In the TAM theory, the actual use will be determined by users' intention to use a system (Davis et al., 1989).

i. Analysis of Acceptance elements for Semiotic Icon Design Application

In recent years, various studies have employed TAM to investigate user acceptance of new technology. Table 2.18 summarized Technology Acceptance Model for Mobile Application studies. Many researchers use two important beliefs, perceived usefulness and perceived ease of use of the technology acceptance model to study user acceptance of information technology (Lin, 2013).

Table 2.18: Technology Acceptance Model for Mobile Application

Studies	Model	Findings	Dimension	Reference
App adoption and switching behavior: applying the extended Tam in smartphone app usage	Extended TAM (TAM3)	Examine the adoption of mobile apps using the technology acceptance model framework (namely TAM3 of Venkatesh and Bala, 2008) and the subsequent effects of the main TAM constructs on behavioral and switching intentions. To explore the influence of the major technology adoption constructs (i.e. TAM3) on commercial app adoption	Perceived Usefulness, Perceived Ease of Use and Behavioral Intention, Subjective norms,	Subhadin Roy, 2017
User satisfaction with mobile websites: impact of perceived usefulness (PU), perceived ease of use (PEOU) and trust	TAM (Davis, 1989)	To investigate the impact of perceived usefulness (PU), perceived ease of use (PEU) and trust on mobile website satisfaction. Results show that there is a positive relationship between PEU, PU, and mobile users' satisfaction. PU is positively related to trust and mobile users' satisfaction. Trust positively influences mobile users' satisfaction	Perceived usefulness perceived ease of use, trust on mobile website satisfaction	Muslim Amin et al.(2014)
Factors influencing the use of m-commerce: an extended technology acceptance model perspective	Final version Technology Acceptance Model (TAM) by Venkatesh & Davis, (1996)	Extends the Technology Acceptance Model (TAM) in the context of m-commerce by incorporating the privacy and security construct (PS). An extended TAM model is developed to achieve an understanding of user acceptance of m-commerce in Malaysia.	Perceived usefulness perceived ease of use, privacy and security	(Barry et al., 2018)

Based on the analysis, the common acceptance model adopted for mobile applications were original TAM and extended TAM. The original TAM model is a theoretical basis that has a strong ability to explain the use of technology by users (Davis, 1989). In this study, the final version of the original Technology Acceptance Model (TAM) developed by Venkatesh & Davis (1996) was employed to investigate the acceptance of the new application of SIDAQ and it is the better choice when performing an approximate analysis of technology and application adoption (Rihastuti et al., 2018). This TAM model is developed to achieve an understanding of user acceptance of semiotic icon design application for reciting the Quran.

The intention to use SIDAQ is important because it demonstrated whether the proposed elements are significant in the context of the user's acceptance of the application in the Quran domain. This study added to the body of literature on behavioral intention to use and on actual use of SIDAQ among Muslim youth in Malaysia. This study used three (3) elements that have been modified from the previous TAM research model: Perceived Usefulness as the first variable (PU), Perceived Ease of Use as the second element (PEU), and actual use as the acceptance of SIDAQ users as related element (A) which according to the TAM theory significantly usability element and convenience elements affect the acceptance of users in the use of SIDAQ. Table 2.19 summarized the elements used to measure the acceptance of online SIDAQ users.

Table 2.19: Acceptance - Elements used in the study

Variable	Definition	Indicator
Perceived Usefulness (PU)	Explain that youth believe that the SIDAQ will be able to motivate youth in reciting Quran	a. Apps short loading time b. Apps simple language c. Easy to learn app d. Happy to recite Quran e. Easy to be used

Variable	Definition	Indicator
Perceived Ease of Use (PEU)	A level where youth believe that the use of SIDAQ can reduce a person's effort in doing something	a. Better idea of Surah b. Recitation more interesting. c. Motivates to recite Quran frequently. d. Content useful e. App benefit user
Behavioral intention – Actual use	Acceptance level of SIDAQ by youth	a. Suitable to visualize genre b. Help understand idea verse c. Make Quran recitation more interesting d. Increase motivation in reciting Quran. e. As a supportive tool

The elements of PE employed in this study to determine the degree to which the youth believe subjectively using a particular technology of SIDAQ will enhance his or her understanding on the genre of Surah in Quran. The PU employed in this study to determine degree to which youth believe that using the semiotic icon design application as a new technology can help to reduce their efforts and how useful the technology would be. The elements of actual use applied in this study to determine the actual use, user acceptance toward the SIDAQ. The intention to use semiotic icon design application technology can also be explained by a large portion of the user's actual use of technology (Shin, 2009). These three elements PU, PEU and Actual use are applied in the instrument of the research to evaluate the acceptance of the user toward the SIDAQ to prove the research hypothesis on the significant influence between acceptance of Semiotic Icon Design Application (SIDAQ) and the youth's motivation in reciting the Quran. The result of acceptance validation is summarized in Chapter 5. The model of TAM against SIDAQ acceptance can be seen in Figure 2.13.

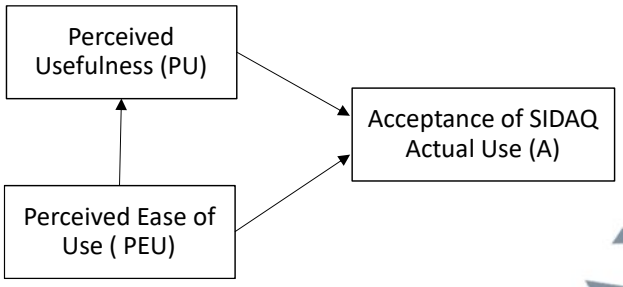


Figure 2.13: Technology Acceptance Model (TAM) for SIDAQ

The model of TAM against SIDAQ acceptance can be seen in Figure 2.13. Perceived usefulness is a level where the youth believe that the SIDAQ will be able to improve the youth motivation in reciting Quran. The definition of perceived ease of use is a level at which youth believe that the use of the SIDAQ can reduce a person's effort in doing something. This perceived ease of use refers to the user's belief that the technology application user does not require a great deal of effort when used. In this case at the time of SIDAQ, youth can access SIDAQ from anywhere based on the information provided.

These three acceptance elements of PU, PEU, and Actual use were then validated by the three (3) experts in Information Technology (IT) in terms of acceptance elements and their suitability for evaluating the SIDAQ in the Quranic field. The result of acceptance validation is summarized in Chapter 4.

2.7.5 Prototyping Model

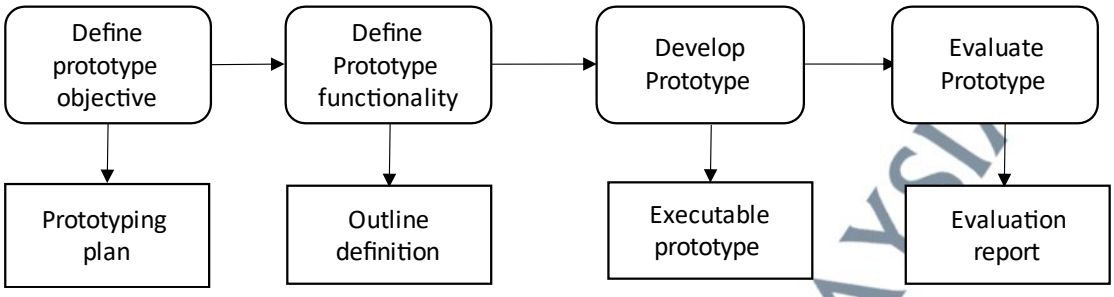
A prototype is a model or a program which is not based on strict planning but is an early approximation of the final product or application. By using this prototype, the user can get an “actual feel” of the application, since the interactions with the prototype can enable the user to better understand the need of the desired application. The goal is to provide an application with overall functionality (Jordaan et al., 2017).

Nothing brings us closer to the final product functionality than prototyping. Prototypes assist in providing proof of concept. A prototype is a draft version of a product that allows us to explore the ideas and show the intention behind a feature or the overall design concept to users before investing time and money in development (Cao & Kamil, 2015; Jackson & Ciole, 2017; Mcelroy, 2017). It is much cheaper to change a product early in the development process than to make any change after developing the application.

Nielsen (1993) has found that the biggest improvements in user experience come from gathering usability data as early as possible. He notes that it is cheaper to make changes before any code has been written than to wait until after the implementation is complete. Therefore, building prototypes early in the process should be considered. Prototypes are designed to demonstrate how an application works in each situation.

The prototype is usually not a complete application and many of the details are not built into the prototype. The goal is to provide a system with overall functionality. The prototype production is a powerful tool that promote integration, concept building, changes, and the success of application development (Howard, 1997). Prototype development is very useful for discovering and satisfying user needs (Sherell & Chen, 2001).

In this study, the choice of prototyping is because the prototype production is usually a small scale that can indirectly act as a representative or model of working application. This study uses a different approach that combined the ADDIE model (McGriff, 2000) and the Prototyping model (Sommerville, 2006) as a complete application development process. The prototype development process is shown in the following Figure 2.14.



Source: Sommerville (2016)

Figure 2.14: Prototyping Model.

The prototyping model consists of four steps namely define prototype, identify prototype functions, prototype development and prototype evaluation. An application prototype may be used while the application is being designed to carry out design experiments to check the feasibility of a proposed design. The steps involved in prototyping are:

i. Define prototype objective

The objectives of prototyping should be made specific from the start of the process (Sommerville, 2016) and creating an application to develop a clearly defined purpose and objectives for application to determine what the application should be able to do (Jordaan et al., 2017). The output is the prototyping plan. In this study, this step will cover in phase 1, needs analysis phase. The objective of semiotic icon design application (SIDAQ) is to visualize the Surah genre to motivate the youth in reciting Quran. The details of SIDAQ prototyping plan are discussed in chapter three and four.

ii. Define prototype functionality

The next stage in the process is to decide what to put into the prototype application (Sommerville, 2016). The foundation of the user interface was placed. This step visually conceptualized the main features and a rough layout and structure of the app. Sketches for the proposed layout and structure of the application were drawn which assisted in better understanding of the process (Jordaan et al., 2017). The output

is the outline definition. In this study, the SIDAQ interface, features and functionalities for visualize genre of Surah using semiotic icon. The details of the stage are discussed in chapter three and four.

iii. Develop prototype

The next stage in the process is to decide what to put into and, perhaps more importantly, what to leave out of the prototype application (Sommerville, 2016). All the ideas and features finished as a clear picture of the arrangement and a storyboard was created. The storyboard provided a road map which illustrated the connections between the different screens and how the user could navigate through the app. The storyboard formed the foundation for the prototype first version. Individual screen content was designed. The task was to create high-resolution versions of the prototype. With the screen designs completed and implemented, the actual app concept was complete, all the graphics were inserted, and actual design was implemented and made clickable (Jordaan et al., 2017). The output is the executable prototype. In this study, the SIDAQ storyboards were illustrated as the foundation of the prototype and Surah content screens were designed to complete the application concept. The semiotic icons were inserted in the SIDAQ mobile user interface and the actual design was implemented and made clickable. The details of this stage are discussed in chapter three and four.

iv. Evaluate prototype

The final stage of the process is prototype evaluation (Sommerville, 2016). This step is meant to test the full design and collect as much feedback as possible from a variety of users. Potential users need time to become comfortable with a new application and to settle into a normal pattern of usage. If possible, to monitor how they used the app, one should take note of their actions as these would provide

important feedback for the user interface (UI) and user experience (UX) evaluation (Jordaan et al., 2017; Molich & Nielsen, 1990). Based on their feedback, the prototype was modified. The aim was to finally specify the app concept before going into the implementation step. The output is the prototyping plan. In this study, the prototype of SIDAQ was evaluated by youth and experts to collect the feedback through pilot study and evaluation.

Overall, the application applied the four steps in prototyping the Semiotic Icon Design Application for Reciting Quran (SIDAQ). The application was consequently installed on Android devices and tested for functionality in a real environment. The detailed prototyping steps are discussed in Chapter 3 and 4.

a. Fidelity Prototype

The fidelity of a prototype refers to how it conveys the look-and-feel of the final product (basically, its level of detail and realism). Fidelity can vary in the areas of visual design, content, and interactivity. A prototype can be anything from paper drawings (low-fidelity) to something that allows click-through of a few pieces of content to a fully functioning site (high-fidelity) (Cao & Kamil, 2015). Table 2.20 summarizes sample of comparison study between high fidelity and low fidelity prototype by Cao and Kamil (2015).

The main function of prototyping is to put the design in a form that can be manipulated, considered, and tested. Prototypes can be in many forms. The prototype will often depend on the available time, designer skill and interface complexity. The medium and high-fidelity prototype present a more accurate test for users because it is closer to final product, but limit number of iterations required that can be completed. Many quick iterations are possible to be allowed in low fidelity prototypes. Usually,

low fidelity prototypes are used in early iterations to test the general look, feel and overall navigation evaluation (Zezovski & Hultgren, 2016).

A low fidelity prototype could be created based on the results of the research, preliminary study, and brainstorming sessions. By working iteratively with the methods described and by conducting usability testing, the prototype evolved into a medium fidelity and at last a high-fidelity prototype. The prototype design process is described in Chapter 4.

Table 2.20: Comparison between High Fidelity and Low Fidelity

Features	High-Fidelity Prototype	Low-Fidelity Prototype
	Interactivity	
Clickable links and menus	Yes, Many or all are clickable	No. Goals do not work
Automatic response to user's action	Yes. Links in prototype made work through prototyping tool (e.g., Invision, PowerPoint)	No. Screens are presented to user in real time by a person playing computer.
	Visuals	
Realistic visual hierarchy, priority of screen elements, and screen size	Yes. Graphics, spacing and layout look like a live application would look (even if shown on paper)	No. Only a few or none of visual elements of final live application captured (e.g., a black-and-white sketch or wireframe, schematic version of images and graphics, only sheet of paper for numerous screens of info). Spacing and element prioritizing may or may not be protected.
	Content and Navigation Hierarchy	
Content	Yes. Prototype includes all content that appear in final design (e.g., Full articles, product description, text, and images)	No. Prototype includes only a summary of content or a stand-in for product images.

Source: Cao & Kamil, 2015

The most compelling reasons for mobile prototyping is flow makes or breaks the mobile experience because mobile experiences span several pages; user flow should be front and center on the list of design priorities; animations make the experience fun and desirable as animations are the core element to mobile micro-interactions and; user experience (UX) mistakes are more expensive as mobile app cost is high (Cao & Kamil, 2015).

According to Mcelroy (2017), choosing a fidelity level is a critical part of creating a prototype. Fidelity means how closely the prototype looks and acts like the finished product. The proper fidelity level will focus the feedback to receive on the proper aspect of the design, so select the fidelity based on the goal for the prototype. Fidelity has varying levels (low, mid, and high, as well as mixed).

i. Low-Fidelity

To create the low-fidelity (lo-fi) prototype, the information from the background research and the preliminary study was gathered, brainstormed, and converted into design concepts in the form of sketches. The sketches were drawn on paper. The focus of the sketches was to illustrate the semiotic icons and compare different design concepts. The prototype functionality and flow were not considered in this process. At the end of the lo-fi phase, usability tests forming the base of design concepts to be used in prototype were conducted. The lo-fi prototype consisted of two sketches portraying different design concepts of the prototype (Mcelroy (2017).

ii. Medium-Fidelity

To be able to explore design ideas further, a medium-fidelity prototype (mid-fi) was developed. The idea was to create digital icons in an easy and quick way. This led to the choice of using the Adobe Photoshop program for the mid-fi. The results from the preliminary study and the lo-fi phase were discussed and transformed into digital icon. The Adobe Photoshop program was used to create appropriate colors and effects for the icons and elements. When all icons were finished, the Adobe Flash program was used to present the prototype on a mobile device as clickable screens (Mcelroy, 2017).

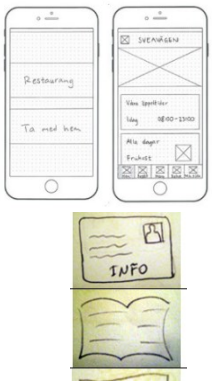
iii. High-Fidelity

The mid-fi phase was divided into two iterations and usability tests were carried out last in each iteration. Usability tests for mid-fi phase were performed. At this stage in the development process, several design concepts and ideas had been explored resulting in a final version of the mid-fi prototype. Given the thorough usability testing that had been conducted, the major concepts such as the basic structure, tab bar and home flow of the current prototype were decided. As mentioned before, one of the most important aspects to consider when creating a hi-fi prototype is to make it as realistic as possible. To accomplish this, the two tools Adobe Photoshop and Adobe Flash were used. All screens were created in Photoshop and then imported and animated in Framer. Mark that these processes were developed in parallel. In the following two sections, the processes are described (Mcelroy, 2017).

b. Analysis on Fidelity Prototype

A low fidelity prototype could be created based on the results of the research, pre-study, and brainstorming sessions. A medium fidelity prototype was created to explore the ideas further. It enables the possibility to include navigation, interaction flow and labels. A prototyping tool is used to create the medium fidelity and the focus is to get feedback on the graphical layout (Zezovski & Hultgren, 2016). The high fidelity assisted in enabling early visualization of alternative design solution. Table 2.21 summarizes fidelity prototype and its advantages and disadvantages.

Table 2.21: Analysis on Fidelity Prototype

Prototype	Findings	Advantages	Disadvantages	References
High-Fidelity 	Helpful in enabling early visualization of alternative design solutions.	Faster, better for product definition and estimates Help prompt innovation improvement. Like real application Can test graphic element	Very time-intensive, requires skills with software or coding, hard to test large concepts	Zezovski & Hultgren, 2016 Cao & Kamil, 2015 Mcelroy, 2017 Merdenyan etal, 2014
Medium-Fidelity 	To be able to explore design ideas further. .	Photoshop can be used to create appropriate color and effects for some icons and elements	More time-intensive, but not fully functional	Zezovski & Hultgren, 2016 Mcelroy, 2017 J. Cao & Kamil, 2015
Low-Fidelity 	Take as close as possible to a true representation of user interface. Much more effective in collecting true human performance data	Great for quick collaboration and exploration Sketches are quicker to create. Users feel more comfortable suggesting changes using rough sketches. Fast, low-skill, cheap, made with materials available. Less pressure on users Less time to prepare a static prototype. Can make design changes more easily during test. Paper-based sketched icon can also determine the icon recognition.	Often paper-based. Do not allow user interactions. Evaluation process more complicated and unpredictable Abstractness and unclearness of images presented. Lag of response time Limited interactions, harder to test details and full flows, little context for users	Zezovski & Hultgren, 2016 Lim et al., 2006 Merdenyan et al., 2014 Mcelroy, 2017 J. Cao & Kamil, 2015 Mustafa et al., 2019 Yatim et al., 2011

In this study, the research led to discuss how to design the semiotic icon for Quran by low to high fidelity prototypes that help the researcher do a more valid evaluation of the icon design. The low, medium, and high-fidelity technique was employed in the semiotic icon design. Each fidelity icon design needed to have the same icon interface, applying the same icon design elements, and involve user responses. Having the paper based low fidelity by sketching the icon is faster with static prototype. Using the paper-based sketched icon can also determine the icon

recognition (Yatim et al., 2011). The process was followed by digital design of mid fidelity prototype using Adobe Photoshop software. At the end, the final digital icon in high fidelity was designed and evaluated by youth and Quran experts. To enable design solutions, the icons were compiled in the mobile application platform as a working fidelity prototype of the application.

2.8 Theoretical Framework

The theoretical framework is the basis of the research structure which contains several theories that support the research conducted. The theoretical framework is also used as a guide to the whole study (Siraj et al., 2020). Based on the literature on the theory and model related to this study, the researcher illustrated the theoretical framework for this study as in Figure 2.20. For its theoretical framework, this study employed Peirce's Theory of Semiotics (1931-1958) (Chandler, 2007) as the underpinning theory for this study. This theory was chosen because it focused on visual icon as sign and is most suitable for this study. The elements in the Peirce's theory of semiotics were also mapped with proposed icon design elements for mobile application from the literature into the semiotic analysis to come out with a meaningful semiotic icon design.

This research also adapted proposed six icon design elements from literature and the ARCS model of motivational design (Keller, 2000) to design the semiotic icon design. The evaluation of semiotic icon design application proposed icon design element on icon design evaluation was based on the PACMAD usability model (Harrison et al., 2013) for usability evaluation, ARCS model of motivational model (Keller, 2000) for motivation evaluation and Technology Acceptance Model (TAM) (Davis, 1989) for acceptance evaluation. ADDIE model (McGriff, 2000) and

Prototyping Model (Sommerville, 2016) were implemented throughout the phases. Figure 2.15 illustrates the theoretical underpinnings of this study.

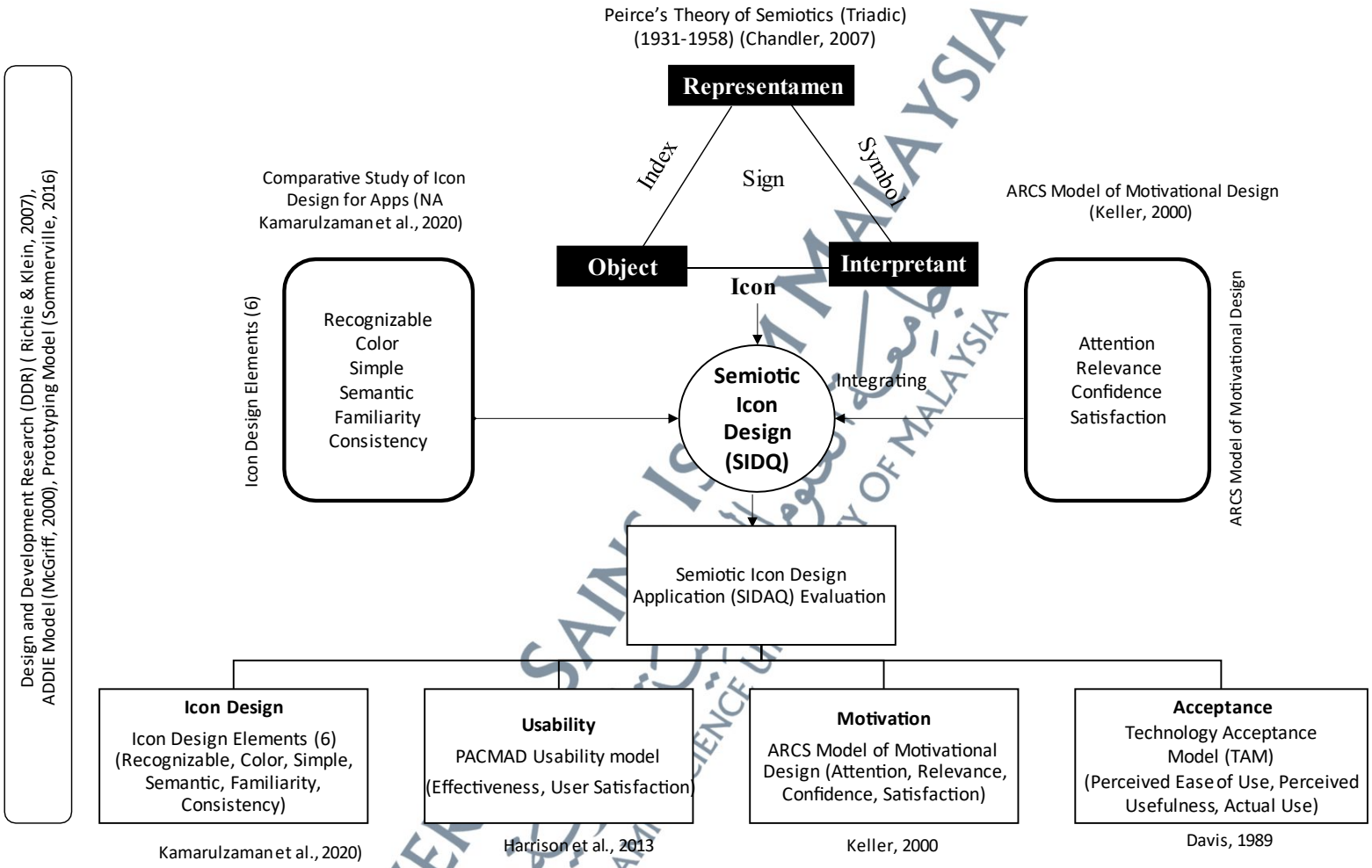


Figure 2.15: Theoretical Framework for SIDQ

2.9 Conceptual Framework

Conceptual framework of the study is in the form of steps taken to conduct the entire research, along with the relevant theories and models. To explain the conceptual framework of the study, a diagram is required to show how the theory is related to the design of the study. This is such that the research we conduct will be better understood and be on track. Researchers will be able to see the whole process of how research is conducted better and more transparently (Siraj et al., 2020).

The research conducted is a study of semiotic icon design for motivating youth in reciting Quran. The framework highlighted the main theory, elements and models underpinning the design and development of semiotic icon for motivating in reciting Quran. The general purpose of this study is to study the appropriate design of semiotic icon as a supportive tool that can motivate youth in reciting Quran. Based on the problem statement of the study (see Chapter 1), the main objective of the study is to identify appropriate semiotic icon design elements and to design and develop the semiotic icon for motivating youth in reciting Quran. This serves to contribute to the body of knowledge of icon design field and icon design for Quranic domain. Figure 2.15 summarizes the conceptual framework for this study that shows overall process on how to carry out the research.

This study consisted of three main phases, namely analysis phase, design and develop phase and evaluation phase. This research applied the design and development research approach (DDR) integrated with ADDIE instructional model. This study also employed the Prototyping Model (Sommerville, 2016) throughout the phases.

In phase 1, the literature review was performed on related Theory of Semiotics (1839-1914). Among the modern semiotic theories are Saussure's Theory (Saussure,

1974), Peirce's theory of semiotics (1931-1958) (Chandler, 2007) and Barthes semiotic theory (Barthes, 1964). The conceptual frameworks employed Peirce Theory of Semiotics as the underpinning theory and concept for this study as it was the most suitable theory that focused on visual icon. The systematic literature review and comparative study were performed to find the appropriate elements of icon design for reciting Quran. This phase produced a proposed six icon design elements for mobile application that guides the icon design for Quran. The related icon design elements are recognizable, simple, color, semantic, familiarity and consistency. The prototyping model was applied in this phase to guide in the needs analysis of the study. The results of literature review are the direction to answer the research questions of this study. The results of this phase are discussed in chapter four.

In Phase 2, the conceptual framework also included the models and approaches adapted to guide in the design and development. The proposed six icon design elements were used in the second phase for designing the semiotic icon design. In addition, the ARCS model of motivational design (Keller, 2000) was also being used to incorporate the motivational design elements in the semiotic icon design. The fidelity and prototyping technique were implemented as main tools in designing the semiotic icon design and semiotic icon design application. The results of this phase are discussed in chapter four.

Finally, in Phase 3, the semiotic icon design application was evaluated in the aspect of icon design, usability, motivation, and acceptance. The proposed six icon design elements were used to evaluate the icon design. The related models applied were the ARCS Model of Motivational Design to evaluate on usability of application, the PACMAD Usability model (Harrison et al., 2013) was used to measure usability of application and the Technology Acceptance Model (TAM) (Davis, 1989) was

utilized to measure the acceptance of the application. The results of this phase are discussed in chapter five.

Overall, the conceptual framework aimed at illustrating how the objectives of the study were achieved by connecting the elements, theories, framework, and models to design semiotic icon for reciting Quran and develop the prototype of semiotic icon design application. The design and development as mentioned were to serve as a technique and a supportive tool to visualize the Surah genre that can assist to motivate youth in reciting Quran.

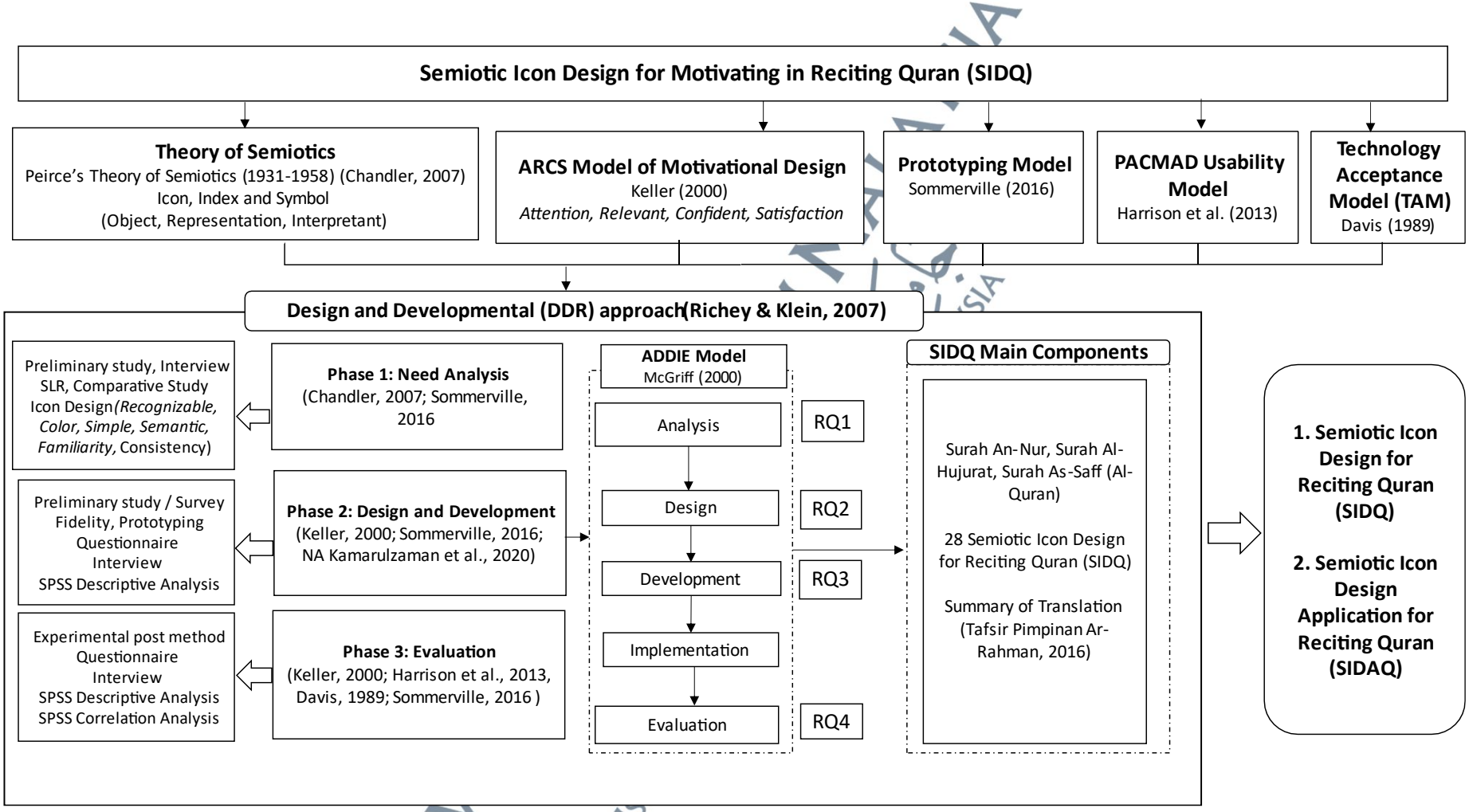


Figure 2.16: Conceptual Framework for SIDQ

2.10 Chapter Summary

This first section reviewed the definition of the key term such as icon, semiotic icon, type and style of an icon, semiotic icon design, icon design for mobile application, analysis of icon design elements for mobile application. The next section reviewed the gap analysis on mobile applications related to icon design and mobile application in Quran studies. The third section highlights the reciting Quran, analysis of technique in reciting Quran and reciting Quran among youth. The fourth section reviews the generation Z and youth in reciting Quran. The fifth section discussed the design and developmental research (DDR) as the main approach of this study using the DDR Type 1 embedded with the ADDIE model. The sixth section highlights the theories and models related to studies namely Pierce Theory of Semiotic, ARCS Model of Motivational Design, Usability Models, Technology Acceptance Model, and Prototyping Model. The researcher also discussed the theoretical framework which involved theories and models applied as the basis for this study, conceptual framework, and conclusion.

The focus of this chapter was the review relating to the common icon design elements for mobile applications and the appropriate semiotic icon design elements that can motivate youth in reciting Quran. The ten common icon design elements for mobile applications were reviewed from aspects of recognizable, simple, color, semantic, consistency, familiarity, shape, aesthetic, uniqueness, and concreteness. Six appropriate semiotic icon design elements have been identified for Quranic studies which were recognizable, simple, color, semantic, consistency, and familiarity. These elements were discussed in detail in Chapter 4. The next Chapter 3 will discuss the Research Methodology.