A Guideline for Designing Mobile Applications for Children with Autism within Religious Boundaries

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Abstract—Autism spectrum disorder is a condition related to brain development that impacts how a person perceives and socialises with others, causing problems in social interaction and communication. The disorder also includes limited and repetitive patterns of behavior. Children with autism spectrum disorder (ASD) develop at a different rate and don't necessarily develop skills in the same order as typically developing children. Nowadays, children with autism spectrum disorder (ASD) are having difficulties in gaining religious skills. This is due to the lack of schools that provide special religious education for disabled children. Many technologies have been developed to help children with autism for education. Mobile applications have extensively been used to enhance their daily learning. Researchers are extremely trailing their applications but not many applications are able to meet the requirements and needs of children with autism, especially in the religious context. The lack of religious mobile application guidelines is crucial as a reference for researchers. This paper aims to propose a guideline to design a mobile application for children with autism in religious context. A systematic review of previous literature on mobile application guidelines for autism and religious mobile application guidelines was conducted. This study resulted in two key findings: (1) elements of multimedia consist of text, images and sounds (2) features of application consist of interface, navigation, customisation and interaction. The proposed guidelines are potentially to be used by researchers who are interested in designing religious mobile applications for children with autism.

Keywords—*Autism Spectrum Disorder (ASD); guidelines; mobile applications; religion; assistive technology; communication*

I. INTRODUCTION

In recent years, the study of children with autism has been on the rise as many have become aware of the importance of helping this group. Mobile application has become the main platform for researchers to develop technologies that can assist them [18]. However, not all applications can work well and can be used by children with autism in improving their daily learning activities. This is due to the lack of guidelines for mobile applications, especially in religious studies. Therefore, this paper will propose a guideline for the development of mobile applications for children with autism in religious context.

Assistive technology (AT) refers to any product, equipment, software program or system that enhances learning, working, and daily living for persons with disabilities. AT has been used in the field of education to overcome barriers to learning [1]. Children with autism appear to learn differently from other individuals and frequently have difficulty with spoken and written communication. For children with autism, computer-assisted training has proven to be more effective than personal instruction [19]. Children with autism were discovered to be more interested in computers than toys, and to prefer computer education to personal instruction [4]. However, the application development for children with autism must follow the guidelines that have been established.

It is crucial to avoid building applications without proper guidance. This is because developers need to ensure children with autism feel comfortable to use applications that will assist their daily routine. The study [3] reported that there is still a lack of providing guidelines for the design of spiritual mobile applications and the need to have the certification and authentication of these digital apps must be considered especially for digital Quran. This paper focuses on two categories of guidelines which are mobile apps guidelines for autism and religious apps guidelines. The proposed guidelines have the potential to be used as a guide for researchers who want to develop mobile applications for autistic children, especially in the field of religion.

Mobile apps were frequently used as assistive technology to assist special groups such as children with autism. Mobile apps are promising to help these children in their daily learning including in religious studies which makes religious activities highly relying on mobile apps these days [6]. Religious mobile apps are becoming widely popular and changing the faith-based landscape across the world [20]. The aim of religious mobile apps is to ensure that religious practices would no longer be limited to a specific time or place. With the help of a mobile app, these religious places can build a faith in community and transfer religious teachings to a younger generation.

The next section presents the literature review, followed by the methodology of this research, findings, discussion and the last section concludes the paper with potential benefits of the proposed guidelines and the next step of this research which to evaluate the proposed guidelines.

II. LITERATURE REVIEW

A. Multimedia Elements (Apps for Autism)

It is necessary for an effective mobile application to have better features for easy to use. The main factor for effective application is multimedia elements. Multimedia elements that are often emphasised in application development are text, images, and audio. The first important element in multimedia applications is text. The study [8] mentioned that the text used

for mobile apps must be clear, simple, and short. Correspondingly, [22] stated that the font used must be clear and large and only used a maximum of two typefaces. Furthermore, [24] suggested that sans serif fonts with 14 font size are suitable for children with autism. On the other hand, [3] mentioned that developers need to avoid writing long paragraphs by using lists and heading titles in paragraphs. In addition, [3] stated that apps for children with autism spectrum disorder should avoid jargon, misspellings, metaphors, abbreviations, and acronyms, and instead utilise terminology, idioms, names, and symbols that are known to the users. This study also demonstrated that those factors are important to prevent users from feeling disturbed and losing focus while using the apps.

Images are also among the multimedia elements that need to be considered in creating apps for autistic children. Each autistic child has different preferences in using apps based on their personal interests included in the selection of images that are suitable for them [30]. It is important to have a suitable size of pictures and images in developing apps for children with autism. The authors [3] suggest allowing images magnification for better visualisation and ensure that the children with autism are able to understand when enlarged. Similarly, this statement was mentioned by [26] in her study that the mobile application must be able to allow users to adjust image size based on their preferences. Meanwhile, [13] stated that the use of photographs for concrete places and people while icons, pictograms and symbols for abstract terms is appropriate. Sharing the same opinion is [8] who said that the picture can be drawings, photographs and symbolic images. He added that the images should be easy to understand, should not fade into the background and should be in a sharp focus. The author in [21] also thinks that images must be identical to real life. For example, use a picture of real food instead of illustrated food. The research in [13] similarly reported that an application should use real images to represent people and places.

Audio also plays an important role in the creation of a successful application. The use of appropriate audio can also attract users [33]. However, audio selection for children with autism must adhere to guidelines so that it does not become a distraction for them. In [24], it was reported that mobile applications for autism should use clear, comprehensible short audio expressions. The app developer must select audio content in a way to motivate and not to distract users. In a similar vein, [3] mentioned that the application must be able to provide audio instructions and subtitles for texts but ensure that it is not the only alternate content representation. The author [5] added that the apps need to avoid the use of disturbing and explosive sounds like sirens and fireworks. In addition, [21] stated that the audio should correspond to the images and must be user-friendly. Each step can also have audio added to it, especially with the voice of someone the children is familiar with. For example, the instructor voice for the apps might be the voice of the teachers or parents.

This concludes that these multimedia elements are essential for developers to emphasise before they develop apps for autism. It should be noted that the use of multimedia elements for children with autism is not similar to normal users. The selection of text, images and even audio should be appropriate and not cause discomfort to them. These guidelines should be followed and adapted by all developers to avoid the development of less effective apps to users.

B. Features of Application (Apps for Autism)

In addition to the element of multimedia, application features for children with autism also play an important role. This is to ensure that children with autism can take full advantage of the applications developed for them. Among the following features are interface, navigation, customization and interaction. As for the interface, most researchers agree that the interface for apps for children with autism must be simple. The study [8] stated that design and structure should be simple, clear and predictable. The research [22] mentioned that an application must be designed for simplicity and few elements on screen. A simple interface only presents the features and content needed for the current task to be performed by the user [3]. In addition, [26] suggested to design an interface that is easy on the eye of users. For example, use simple icons that can be easily understood by the users. Moreover, [22] stated that a mobile application for children with autism should avoid cluttered interfaces. The arrangement of the app interface must be well-organised and easy to use. Similarly, [13] mentioned that an application for children with autism must provide an uncluttered layout with white space between the text in one column. White space helps the user to read faster and will focus on the specific paragraph [29].

The second important feature of the apps for children with autism is navigation. A simple navigation is needed to ensure children with autism can easily understand how to use the application properly. The author [21] mentioned that the application should have simple navigation and easy to use. in [22], author also stated that a mobile app for children with autism should strive for simple and clear navigation. A simplified navigation should be provided on every page [3]. Furthermore, navigation in an application should be consistent and similar in every section [8]. The position and icon used must be similar without making any changes to avoid confusion for children with autism. For example, the icon of a home was used to indicate back to the homepage and the location of the icon was located at the center bottom of each page. The study [21] describes consistent navigation as similar actions and similar buttons located in similar positions. The research in [22] suggested using standard navigation icons that are familiar to children with autism. Similarly, [3] reported that an application must present a global navigation button such as exit, back to home page and help button.

Every child with autism has different preferences and interests. It helps in making them feel comfortable when using the apps. Therefore, customization is needed in each application to assist the children with autism to choose what is best for them. Similarly, [8] and [22] mentioned that every application should allow customization for children with autism. For example, the customization of font type, font size, themes and colours. The developers must provide options to customise information visualisation with images, sound and text according to users' individual preferences [3]. For instance, the user can choose whether to use a small or large

font, loud or slow audio and small or large images. The existence of customisation in this application enables children with autism to feel more confident to use it and attract their interest in using this application.

Furthermore, the feature of application that needs to be taken into account is interaction. An interactive app is more user friendly when you allow users to interact with the app as it creates a connection between them. An interactive app provides users with the freedom to navigate from one window to another comfortably. The author [13] suggested avoiding simultaneous tasks and only one task is allowed in every section. Also, [13] stated to avoid distraction in the apps such as captchas and pop up advertisements. Moreover, [8] mentioned that the application has to make adaptive interaction with users by considering their interaction history, preferences, request, and needs. Further, [3] suggested that an application should have high sensitivity and responsiveness. Touch screen interactions should have the appropriate sensibility and prevent errors in selections and accidental touch in interface elements [25]. Lack of sensitivity will cause children with autism to feel depressed and give up using the apps again. In addition, [24] reported that it is important to provide feedback after learning activities and navigation actions. For instance, the correct text should appear for the correct answer and "try again" for incorrect answers. Prioritising in-app interaction will definitely make children with autism more focused and complete the tasks given in apps [31].

C. Multimedia Elements (Religious Apps)

Guidelines are also needed to build applications related to religion. Although there are some similarities between mobile apps guidelines and religious apps guidelines, there are still some details that need to be carefully scrutinised to distinguish between the two guidelines. In the context of elements of multimedia, emphasis is always given to elements such as text, images and even sounds. The study [1] suggested using suitable font size in developing an application for children with autism. The font size should not be too large or too small where the use of font size should be between 12 and 14 points. In a similar vein, [3] stated that an application must use a large size font type and try to make it adjustable. Medium or boldface type is encouraged. Further, [3] also added to make sure the use of text coincides with the original source. For instance, the Arabic text in the application was written based on the same number of pages in the Holy Quran. This means that if the verse in the Quran contains 10 verses, then the verse in the application must have the same number of verses which is 10 verses.

Next, the elements that need to be emphasised in multimedia are images. The author in [16] mentioned that the dress code of man and woman should be appropriate. The applications are encouraged to use formal attire that are modest to religious sentiments for any character, figure or real person. For example, the compliant driven ('awrah or clothing boundary). In addition, [3] suggested choosing appropriate images for the apps. The images used in apps should be relevant to the content and not display images that are not related to Islamic elements. The study [2] added that the application's selection buttons, icons, menus, and information

should be of excellent quality and resolution to make it easier for viewers to understand and receive clear Islamic material. Furthermore, the final multimedia element that needs to be considered in developing apps for children with autism is sounds. Also [16] suggests that the page be accompanied by an Islamic background sound. The many sorts of Islamic audio sound may help to enhance the site's Islamic spiritual sense. Moreover, [16] also suggested to use audio commonly used in Islam. For example, the sounds of Al-Quran recitation and the sounds of azan. The author [3] suggested providing good recitation audio. Pronunciation and melodious voice are important elements to attract users in learning Islam. For instance, a voice of Qari reciting Al-Quran can help the user to listen to the recitation clearly and can improve their pronunciation correctly. Finally, [3] also mentioned that an application should allow the user to adjust the volume. These customizations are required for the user in determining their preferred volume.

D. Features of Application (Religious Apps)

Apart from the elements of multimedia, features of apps also play an important role in building successful religious apps. Interface, navigation, customization and interaction are the categories that are often mentioned and discussed by previous studies. For interface, the most important thing to consider when developing a religious application is to ensure that the application shows the identity of a specific religion [23]. For example, [16] stated that the application should be based on the elements that best symbolize Islam which are widely recognized by the Islamic community. Similarly, [3] reported that an application should use features that present the Islamic identity like using the mosque icon as a homepage button for the user. Meanwhile, [2] mentioned that in terms of information and distribution, an application layout is characterised by Islamic concepts. For instance, the application needs to display an ustaz icon for male voice selection and ustazah icon for female voice.

Navigation is the second category that is important for religious application development. The research [1] suggested to ensure the user interface navigation structure is simple and straightforward. The buttons should be familiar to the user and predictable. For example, the home icon is used as a homepage button that will navigate the user to the home screen as the safe point to return. Similarly, [2] stated that the user should be able to navigate between screens in the built application at a reasonable cost and with ease. A consistent navigation button is required as it has to be arranged in the same position with the same size and same icon.

Customisation is also involved in ensuring that an application successfully meets the needs of users. The study [2] suggested that for the Islamic features, the application should provide for relevant modification based on the user's preferences. For example, the volume of the audio, the colour of text and the magnification of the screen. Furthermore, [3] stated that the application has to provide fonts, buttons and icons that can be easily resized. The users are able to choose the font size, font type and the colour of the buttons according to their preferences.

The last category to consider in developing a religious mobile application is interaction. Fast response is often mentioned by previous researchers when it comes to interaction. Further, [16] reported that the speed of the application interaction must be consistent without any delay occurring. Similarly, [2] said that the application must provide accurate and fast response to users. Interruption should be avoided while the application is running as it will distract children with autism when they are using the apps. The author [2] added that all functions in the application must work well and be reachable by the user. It is important to facilitate users in obtaining religious knowledge in the application. By using the mobile application, students can obtain information on religious studies more quickly and easily [32]. Moreover, [1] mentioned that the application should avoid using interaction timeouts to memorise Al-Quran using fast-moving objects and animation. Interaction timeout can be a distraction in memorising Al-Quran. It is encouraged to allow customization for moving objects and animation speed as the users are able to control the speed based on their preferences.

In summary, both these mobile apps guidelines are crucial as guides and references for future developers in focusing on children with autism. Each guideline has important features that the developer must adhere to. From the combination of these two categories of guidelines, a new guideline focusing on religious mobile apps for children with autism will be produced at the final stage of this study. This is in line with the goal of the study to fill in the gap where there is a lack of guidelines that focus on religion and children with autism at the same time.

III. METHODOLOGY

Systematic Literature Review (SLR) method was used in this study to identify, evaluate and summarize the related guidelines from previous literature. This study follows five steps for systematic literature review as suggested by [34]. The steps are framing questions for a review, identifying relevant work, assessing the quality of studies, summarizing the evidence and interpreting the findings. Meta analysis was conducted to take findings from several studies on the same subject and analyze this using standardized statistical procedures. In meta-analysis patterns and relationship are detected and conclusions are drawn. Meta-analysis is associated with the deductive research approach.

In order to obtain previous studies related to mobile apps guidelines for children with autism, several searching techniques were performed. The search for related information was divided into two categories which were mobile apps guidelines for children with autism and religious mobile apps guidelines. For the first category, the keywords used in the search were "mobile apps", "guidelines" and "autism spectrum disorder". As many as 12,900 publications were successfully obtained using the keyword. After filtering for published articles from the last five years (2015-2020), the number of articles decreased to 8,600 publications. Of these, only 35 articles were relevant to be analysed based on the guidelines criteria related to the study. The relevance of a paper was assessed based on its relation to searches on mobile applications guidelines for children with autism. Any paper

that writes about the guidelines used to develop mobile applications for children with autism will be selected and shortlisted for further analysis. Based on the relevant papers, only 20% of the papers were further analysed related to the study domain. As a result, this paper proposed a guideline for the development of mobile apps for children with autism.

The second searching category used the same terms of "mobile apps" and "guidelines" with additional words such as "religious" and "Islamic". A total of 32,200 publications was found based on the keywords. Last five years publications were inserted in the filters and the number of publications reduced to 16, 800 publications. Of these, only 26 publications were analysed for analysis in the first cycle. This publication was selected based on its relevance to religious mobile application guidelines for children with autism. After an extensive analysis of related guidelines criteria, only 19% publications were further analysed related to the study domain. Therefore, mobile apps guidelines for religion will be elaborated in the next section.

IV. FINDINGS

This study found that the lack of religious mobile apps guidelines was clearly proven based on analysis that was conducted in the literature review section. Most researchers only focused on general mobile apps guidelines for children with autism and for religious guidelines researchers, most of the researchers do not focus on children with autism. From these two guidelines, a guideline focusing on religious mobile apps guidelines for children with autism was identified. This guideline will be based on the criteria that had been extracted from the literature review analysis. 19 % papers were used during the literature review analysis which combined mobile apps guidelines for children with autism and religious mobile apps guidelines. Two main categories were identified which are multimedia elements and application features.

Text, images and audio are often mentioned by previous researchers when discussing mobile application guidelines for children with autism. Table I shows the guidelines which have been classified according to the elements.

Text is a crucial component of any user interface (UI). Text was utilised to deliver immediate context-based assistance information to interactive elements, often known as hints [33]. One of the challenges that children with autism have is reading comprehension. Usability will be affected by a complex user interface with numerous text fragments [34]. It is important to organise the textual UI elements in such a way, that they do not impose reading difficulties. Real-life images aid recognition and help children learn more quickly and effectively [7]. The use of inappropriate images will cause children with autism to be confused. This will cause them to lose focus during the learning session. Appropriate sound selection helps motivate and not to distract the user [35]. The audio should be clear but not too loud as it will be disturbing for the children with autism. The audio should correspond to the images and must be user-friendly [15]. Children with ASD can benefit from visual assistance such as text, graphics, and sound to help them learn and communicate with their family, friends, and teachers [21].

The second category is the features of application. Interface, navigation, customisation and interaction are features that are required to develop applications for children with children with autism. Table II shows the guidelines which have been classified according to the features.

Making a simple interface helps children with autism to navigate easily. Complex interface with many text fragments will reduce usability [22]. The use of intuitive navigation principles will help users to navigate quickly by discovering and without additional support. Customisation is a key element for the successful user experience for children with autism because they have very different personal preferences and needs [9]. Customisation enables users to adapt documents (font typeface, font size, line spacing, colours) to their preferences [17]. It also helps children with autism to match their own reading and comprehension abilities. Providing interaction in multiple dimensions and providing them in a balance is important [36]. Considering characteristics and differences of children with autism, these interaction types should be chosen carefully and only if necessary. The study [24] reported that interactive learning software with gesture-based user interaction designed on the basis of universal design principles are highly effective learning materials.

TABLE I. MULTIMEDIA ELEMENTS GUIDELINES

Elements	Autism Apps	Religious Apps	Sources
Text	1. It should be clear, simple, and short. 2. Use a simple visual and textual language. 3. Avoid writing long paragraphs. 4. Textual style features according to individual differences and learning backgrounds of the users. 5. Amount of words must be reduced. 6. Avoid too many texts in a column 7. The typeface must be consistent and do not exceed more than two types.	1. Use suitable font size 2. Information should be well-organised. 3. Use a large size font type and try to make it adjustable. 4. Make sure the use of text coincides with the original source	[8], [22], [24], [26], [3]
Images	1. Pictures can be drawings, photographs, and symbolic images. 2. Allow images magnification for better visualisation and ensure they continue to be understandable when enlarged. 3. Able to have a suitable size of pictures, images. 4. Use photographs for concrete places and people; icons, pictograms and symbols for abstract terms. 5. Images must be identical to real life. 6. Do not overlap transparent images and text	1. The dress code of men and women should adhere to Islamic dress code. 2. All graphics should be of excellent quality and resolution to make it easier for viewers to understand and receive clear Islamic material. 3. Choose appropriate images.	[8], [2], [13] [16], [22], [24], [26], [3]
Sound	1. Provide audio instructions and subtitles for texts but ensure that this is not the only alternate content representation. 2. Avoid the use of disturbing and explosive sounds. 3. Using distinctive audio and visual effects. 4. Using non-destructive, plain and melodic effects. 5. Using clear, comprehensible short audio expressions. 6. The audio should correspond to the images and must be user-friendly.	1. The Islamic background sound accompanying the page and the types of Islamic audio sound may further stimulate Islamic spiritual sense of the site. 2. Use male voice. 3. The user can easily adjust the volume. 4. Provide good recitation audio.	[8], [3], [21] [26]

TABLE II.   FEATURES OF APPLICATION

Elements	Autism Apps	Religious Apps	Sources
Interface	1. Design and structure should be simple, clear and predictable. 2. Simple interface. 3. Using simple, objective oriented, presentative layout design. 4. Interfaces must be easy on the eye of users. 5. Provide an uncluttered layout white space between text in one column. 6. Should be user friendly. 7. Design for simplicity and few elements on screen.	1. The Islamic identity is characterised by identity identifiers. 2. Application layout is characterised by Islamic concepts in terms of information and delivery. 3. Use features that present the Islamic identity.	[8], [2], [13] [16], [22], [21] [24], [26], [3]
Navigation	1. Navigation should be consistent and similar in every page/section. 2. Provide a simplified and consistent navigation between pages on every page. 3. Employing intuitive navigation principles in which users can navigate easily by discovering and without additional support. 4. Limit the number of options in menus to reduce cognitive load. 5. Ensure the user can identify menus and navigation functions. 6. Strive for simple, clear navigation. 7. Do not use complex menus.	1. Ensure navigation structure is simple and straightforward. 2. Navigation between screens to other screens in the developed application should be affordable and easy to control by the user.	[8], [3], [13] [21] [26]
Customisation	1. Provide options to customise information visualisation with images, sound and text according to individual user's preferences. 2. Allow personalisation of apps for users. 3. Allow customization in the application.	1. On the program's Islamic features, the application should provide for relevant modification based on the user's preferences. 2. Users can easily resize the font, buttons or icons.	[8], [22], [24], [26], [3]
Interaction	1. Adapt the interaction with users. 2. Touch screen interactions should have the appropriate sensibility and prevent errors in selection and accidental touch in interface elements. 3. Providing interaction through hardware and sensors of application device. 4. Avoid captchas and simultaneous tasks.	1. Usability traits may ignite a sense of professionalism in Islam. 2. Must have good interaction with users. 3. Avoid using interaction timeouts to memorise Al-Quran. 4. Avoid using fast-moving objects and animation. 5. Users receive accurate and timely responses from the application. 6. All functions in the application work well and are fast and accurate when reached by the user. 7. Users should be able to obtain religious information through the application's interactions, which should perform smoothly and consistently	[8], [2], [13] [16], [22], [21] [24], [26], [3]

V. DISCUSSION

Based on the findings, this paper resulted in two key findings in relation to mobile application guidelines on religious context for autism. Firstly, findings revealed that elements of multimedia consist of text, images and sounds is important to encourage children with autism to engage in active learning by mentally representing the material in words and in pictures and by mentally making connections between the pictorial and verbal representations. Secondly, the features of application consist of interface, navigation, customisation and interaction makes user interfaces perceivable, operable, and understandable by people with a wide range of abilities, and people in a wide range of circumstances, environments, and conditions.

Thus, the findings extended a previous guideline to inform design framework for design with children with autism still has validity. However, this paper builds on it and adapts two new perspectives which consist of 24 guidelines under two categories as outlined in (1) and (2).

1) New perspective on multimedia elements guideline for designing apps with children with autism.

Proposed Religious Mobile Apps Guidelines for children with autism (Multimedia Elements) are as follows:

a) The text used must be clear, simple and short. (Font size of 14).

b) Use only a maximum of two typefaces.

c) Use of text coincides with the original source. (Arabic text in the application was written based on the same number of pages in the Holy Quran).

d) Provide suitable size of images.

e) Use images that are identical to real life.

f) Use formal attire that are modest to religious sentiments clothes for any character, figure or real person. For example, the compliant driven ('awrah or clothing boundary).

g) The images used in apps should be relevant to the content and not display images that are not related to Islamic elements.

h) Use clear, comprehensible short audio expressions.

i) Avoid using disturbing and explosive sounds.

j) Use familiar sounds and voices. (Voice of parents and teachers).

k) Use audio commonly used in Islam. (For example, the sounds of Al-Quran recitation and the sounds of azan).

2) New perspective on application features guideline for designing religious mobile apps with children with autism

Proposed Religious Mobile Apps Guidelines for children with autism (Features of Application) are as follows:

a) Design and structure should be simple, clear and predictable.

b) Avoid cluttered interfaces.

c) Application should be based on the elements that best symbolizes Islam which are widely recognized by the Islamic community.

d) Application should use features that present the Islamic identity.

e) Applications should have simple navigation and easy to use.

f) Navigation in an application should be consistent.

g) Use standard navigation icons that are familiar to children with autism.

h) Allow customization (Font type, font size, themes and colours)

i) On the program's Islamic features, the application should provide for relevant modification based on the user's preferences. Avoid simultaneous tasks at one time.

j) Avoid distraction and interruption in the apps.

k) Speed of the application interaction must be consistent without any delay occurring.

l) Avoid using interaction timeouts to memorise Al-Quran using fast-moving objects and animation.

This research presents 24 guidelines under two categories. The first theme was the elements of multimedia used in developing mobile applications for children with autism. The findings section highlighted three important multimedia elements which are text, images and audio.

1) Text: This element refers to the selection of appropriate and accurate text in the application. This includes font size, font type and colours. It is necessary to use clear and simple text for children with autism [28]. It is well known that people with children with autism literally interpret the text content, and have problems understanding complex sentences [10]. Some researchers suggested allowing text customization for children with autism to choose what is best according to their individual preferences. It is important to choose and organise the textual elements in such a way to ensure children with autism do not experience reading difficulties.

2) Images: This element refers to the use of proper and suitable images in the application. In a religious context, the images should be appropriate which do not expose children with autism to forbidden views such as awrah in Islam. In addition, parents, teachers and children with autism requirements, interests, and preferences should be able to be reflected in the app through personal images of genuine scenarios and activities [11].

3) Audio: This element refers to the appropriate audio selection and arrangement in the application. Familiar voices are recommended to be used in the application to ensure that the children with autism feel comfortable when using the application. Some children feel scared and less confident when hearing voices that are unfamiliar to them. For religious mobile apps, the sounds that are commonly used need to be included in the apps such as Quran recitation, sounds of Azan and Doa recitation. This will help them to better know and approach their religious studies that are in line with the practice of daily life.

The second theme is the features of applications that are required in developing apps for children with autism. The features are interface, navigation, customization and interaction.

1) Interface: This element refers to the simplicity in designing interface for the mobile application. A cluttered interface must be avoided. Cluttered applications will be frustrating to be used by children with autism. When there are too many elements on a single page, the user might miss important information. Besides, the application should use features that present Islamic identities. These requirements are less mentioned by the previous researcher but have been extended in this paper.

2) Navigation: This element refers to the use of standard and consistent navigation. The icons, buttons and symbols must be familiar to the children with autism. This will help them to easily understand the use of the button and prevent confusion [27]. The arrangement of the navigation button must also be consistent to avoid any errors while using the application. This will help children with autism to use the application with their own capability without the need for special monitoring from teachers and parents.

3) Customisation: This element refers to the enabling customization in the application. Because children with autism have highly varied personal preferences and demands, customization is a critical component of a good user experience [14]. It notes that children with autism can benefit from this as it enables them to directly ensure that the interface is personalised to their individual needs. Font size, images magnification and colours are among the customization that is needed to be inserted into the application.

4) Interaction: This element refers to the responsiveness of the application. Delay, interruption and distraction must be avoided. The application should improve the speed and accuracy to complete a task. It is also referred to give responses toward the action performed by the children with autism. The application must be able to reduce the time in performing the task. According to [12], attention deficit and concentration times are very short among children with autism with at least 10-15 minutes per session. Therefore, it is important for mobile apps to interact with children with autism to prevent them from losing focus while using the application.

There are some significant differences when comparing the previous guidelines with the proposed guidelines. Previous guidelines focus more on guidelines in general for mobile applications while the proposed guideline focuses more on

guidelines improvement in a religious context. For example, the use of text in previous guidelines focused more on font, typeface and also the readability of text in the application. For the proposed guidelines, emphasis is placed on the use of text that needs to coincide with the original source (Al-Quran). In addition, previous guidelines highlight more on the use of images, size, and quality. While the proposed guidelines have improved the existing guidelines by emphasizing the importance of using images that are compatible with religious sentiments such as clothing boundaries. Most other elements also have improvements especially in the context of religion. This clearly shows that there is a significant difference between the previous guidelines and the proposed guidelines.

The limitation of this study is that the literature review that examines mobile applications for autistic children in the context of religion is very limited. Most of the articles found are related to mobile apps for autism context. As for the context of religion, limited study do not use mobile applications as the main platform for their research. This causes difficulties in finding accurate information in line with the objectives of this study.

VI. Conclusion

In conclusion, this research found that there are guidelines that can be used for the development of religious mobile applications for children with autism. The guidelines were based on the reviewed guidelines provided in the literature. It is hoped that these findings can be used as a reference for other researchers who are interested in developing applications that focus on religious context. However, these guidelines need to be verified by experts who are experienced in developing religious mobile applications for children with autism. It is important in order to ensure that the application is effective to be used by children with autism. Next, a prototype of a mobile application that applied the proposed guidelines will be developed and given a trial. An evaluation of the application is needed to determine how children with autism react and interact with the application. Feedback from the teachers, parents, and the children with autism will be gathered as it will be useful to improve the existing guidelines.

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