User Interface Design Issues for the Autistic Children

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Abstract: One of the most important problems of the autistic children is split attention that avoids them from being able to focus attention on their learning. Because of having higher visual abilities in comparing with ordinary people, visual supports are required to be used for these individuals. With the intention of presenting visual information displays, computers are used among children with autism. On the other hand, many other researches proved that by providing a structured and controlled computer based environments, autistic children could be supported effectively. Thus, specific design issues should be customized for them to facilitate their split attention in learning. Accordingly, This paper aims at providing an application that considers the identified design issues based on Fakih method for the autistic children to manage their split attention.
[Zeinab Shams Aliee, Nazean Jomhari , Reza Rezaei , Norlidah Alias. **User Interface Design Issues for the Autistic Children.** *Life Sci J* 2013;10(3):58-62]. (ISSN:1097-8135). http://www.lifesciencesite.com 10

Keywords: Autistic, Computer Based Intervention, Design Issues, Split Attention

1. Introduction

According to [1, 2], autism is defined as a complex developmental disability which is the result of a neurological disorder that affects the normal brain functioning and influences the development of social interaction and communication skills. As the word of [3], autism is defined as delay in language development, using language idiosyncratically and repetitively and not being able to begin or maintain a conversation [4-6].

Due to autistic children disabilities, they are facing various challenges in their life. One of the most important difficulties of autistic children in learning is not being able to focus attention on the relevant information [7]. This defect results in preventing autistic individual to pay attention to the appropriate information source, and focuses the child's attention only on a restricted area.

Many researches had been done to investigate a method of teaching and helping the autistic children most effectively and efficiently [8-13]. Reference [14] proved that providing practice and training in controlled environments for the autistic children is effective. For this purpose, multimedia computer based strategies could be used to present simulated environments containing structured and controlled setting [8]. As a result, in order to facilitate the autism individuals practice and training various skills, and prepare learning instructions for them, computer based intervention are used [8].

With the importance of Quran for Muslim people, it is essential to be able to recite the Arabic language. Nor Aziah Mohd Daud from SMK Temerloh Jaya has invented a technique to teach and recite the Holy Quran [15] which is named Fakih. Fakih method is a method for teaching the Quran by using colors and numbers for the deaf children [15]. The intention of this research is to use the same module as Fakih for the autistic, but using the computer based application. Due to autism challenges in their learning, and their split attention problem, they require an appropriate teaching method. Hence, in this study the main focus is how to prepare the interactive courseware prototype to teach the basic Quran recitation to the autistic children, and how to make autistic individuals focus attention on learning.

2. Basic Concepts

This section presents the main concepts of the paper.

2.1. Using Computers among Children with Autism

There are many researches demonstrating computers as a successful teaching instrument among autistic children because of providing a controlled, and structured learning environment, via multilevel interactive functions [16-19]. Also, the study by [20] shows that autistic children are highly responsive while using computers that could make academic demands. Additionally, a study by [9] shows that computers minimize the social defects impact on the autistic individuals, and benefits literacy instruction by reducing the children's complexity in the interaction with the teacher. As a final point, computers could be used for a particular student's

ability level by selecting the appropriate setting in order to utilize for an individual instruction [9].

2. 2. Split Attention

Split attention takes place when learners are required to divide their attention between at least two sources of information [21]. Intending maximum learning and understanding occurs, all disparate sources of information must be integrated as far as possible [21]. The split attention is applied whenever it is more effective for the learner to integrate different sources of essential and non redundant information in a learning strategy [21]. One of the most common usages of split attention effect is giving instructions to the learners to use a computer either from a computer screen or computer manual [21]. Reference [21] mentioned Learners must read the information and learn how to manipulate different parts of a computer, such as the mouse, or typing a specific text to run the particular application.

2. 3. Design for Autistic Children

Reference [7] highlighted that in designing instructions the problematic behavior of the children with autism should be considered in order to gain the child's attention. Instruction prepared for the autistic children should be given in a manner to emphasize on paying attention, comprehending, and using language in play mode. Incorporating visual material in teaching autistic children is suggested by [7] since they visual learners [22], and visually oriented. Therefore, the main question in this paper is how to present the instructions to the autistic children in learning to make them focus attention, and avoid splitting attention while using the computer.

3. Fakih Method

Fakih method is a method to teach Quran to the deaf individuals. According to [15], this method aims at addressing the lacking issue of learning aids, and teaching materials in the field of Islamic knowledge for deaf children having problem in learning. In this method numbering and coloring techniques are applied to represent each Arabic alphabet, and each Arabic sign in the holy Quran. Numbers and colors are used to avoid confusion and assist the deaf individuals easily learn the Quran. The method shows the steps of pronouncing the each Arabic alphabet, and each Arabic sign by using numbers. An example is provided from the Fakih book written by [15] who is the inventor of this technique (See Figure 1).
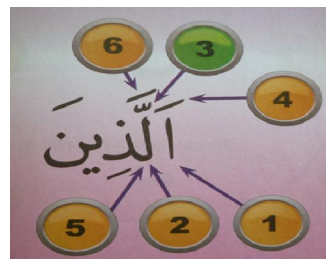

Figure 1. Fakih Method

As mentioned by [15], Fakih method had been tested, and proved effective as a proper teaching technique for teaching Quran to the deaf children that overcomes the problems and difficulties faced in learning Quran. The intention of this research is to use the same module as Fakih for the autistic, but using the computer based application.

4. Research Methodology

To identify the needs of the research, a set of data gathering techniques had been performed. These data gathering techniques were a set of interviews with the autistic children parents, and observations on autistic children learning classes at school. Interviews and observations had been done with the intention of getting familiar with the autistic child's behaviors, knowledge level, and the required teaching methods for them.

To establish the requirements, User Analysis, Task Analysis, Context Analysis, Technology Analysis, and Usability Specifications were performed. As the result of User Analyses, the user profile is illustrated showing the user characteristics. Task Analysis is carried out to specify the task that needs to be done while interacting with the application during the learning process [23]. To emphasize on the required physical environment for autistic individuals , Context Analysis is done. Besides, by considering Autism Spectrum Disorders, Technology Analysis points at the important elements such as including choices, touch screen, and respond features.

Furthermore, Usability specification is organized to ensure the preference measurement and Performance measurement. For the preference measures, the system should be easy for the autistic children to learn and remember the structure (Memorability), and it should be found helpful in teaching Quran to autistic children (Helpful). For the performance measures, the system should be easy for the autistic children to learn (Learnability), the autistic children must be able to complete their task from one level to another level to reach their goal (efficiency), and the system should be simple and clear, and provide easily accessible for the autistic children (effectiveness). As a result of the applied methods, the user interface requirements are offered.

5. User Interface Requirements

To present the user interface requirements, in addition to the steps performed, the researchers had to perform a literature review to specify how to facilitate split attention between autistic children using Computers. Categorizing the review work of different authors on how to facilitate autistic children split attention, the following table is risen showing the Design Issues that are required to be considered for Autism Spectrum Disorders:

Structuring Information in a Clear Format: According to [7], structuring information in a clear format is helpful to make the autistic children focus attention, and emphasizes on the most relevant information, because of autistic child's resistance to change. Reference [24] insisted on controlling the information display to avoid split attention and redundancy.

Using Color Coding Technique: In order to reduce the visual amount of search required, and direct the learners' attention, Reference [25] insisted on using colors coding technique. They declared although this technique is helpful to facilitate split attention in computer based intervention, but manageable amount of colors must be used. Also, Reference [7] mentioned to incorporate colors to emphasize on autistic children paying attention.

Using Segment-Number Strategy: As stated by reference [7], using segment-number strategy presents a stronger effect on the learner. Reference [21] identified the reason as having smaller information chunks; it is easier for the memory to hold. They also insisted on managing numbers in design in order to avoid complexity.

Using Visual Supports: reference [7] noted that using visual cues is an effective strategy to reduce the visual search for learners. Besides, they declared that incorporating visual materials emphasizes on paying attention, comprehending, and using language in play mode.

Providing Reinforcements and Rewards: Refer to [7], in order to motivate the autistic children, reinforcements and rewards should be provided.

Breaking down the Tasks: Due to autistic children split attention problems, reference [7] insisted on teaching in sequence, and breaking down the instructions into small steps.

All in all, it could be concluded that the information presented to autistic individuals must be clear, and properly structured to make them focus attention, and emphasizes on the most relevant information. Moreover, manageable amount of colors could be used to direct autistic child's attention, and reduce the visual amount of search required. Since autistic children need to be taught in sequence, and step by step, incorporating numbers could have a

strong effect on them. Furthermore, autistic children require reinforcements and rewards to motivate them. The tasks designed for autistic children must consider their age, and level of difficulty. Visual materials emphasize on autistic children paying attention, comprehending, and using language in play mode.

6. System Design

This system design is divided into three parts of Conceptual Design, Low Fidelity Design, and High Fidelity Design. First of all, the conceptual design is performed to transfer whatever gathered in the analysis of a conceptual model. The conceptual design is done to provide a preliminary drawing of the system showing the design idea that is required to be considered. After preparing the conceptual design, the next step was to prepare the low fidelity design. The low fidelity design is built based on the conceptual design, and simply shows the interface on paper considering the identified design issues. The final step was to prepare the high fidelity design which was the final and improved prototype. Figure 2 illustrates the considered design issues in one section of the application:
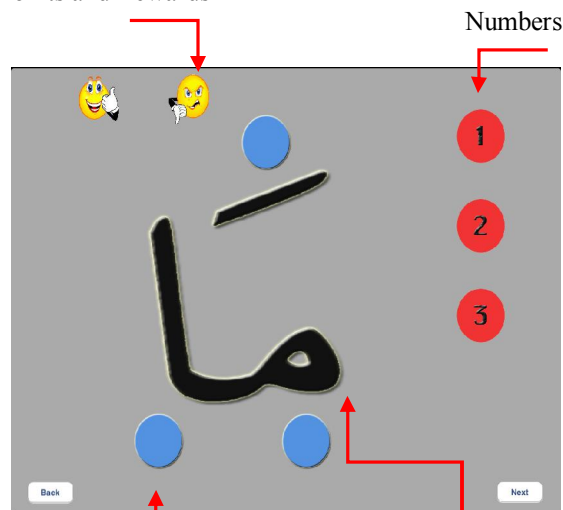
Figure 2. High Fidelity Design - iPad Screen 1

The system goal is to place all of the numbers at the correct place that shows the students could understand which sound of the Arabic word is placed correctly. Placing the number 1 at the correct place, there will be a feedback shown on the correct answer. The feedback is showing the happy smiley face gives 1 point, and also a green tick will appear on the screen. In addition, an excellent sound and a cup of cake are provided as the autistic child's

motivation incorporating with other feedbacks. The blue color circles on the screen shows that this place is empty and a number must be placed there. Identifying the place makes it visible for the autistic child to place it (See Figure 3).

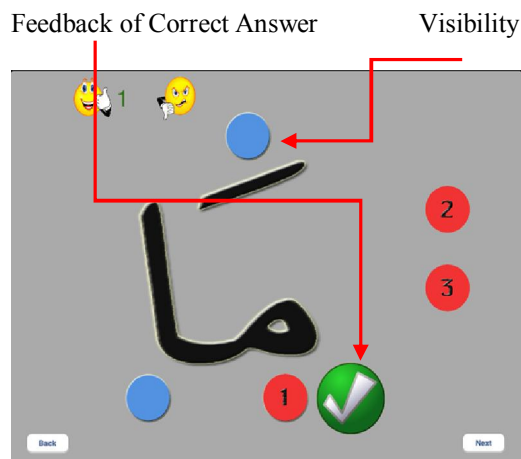Feedback of Correct Answer   Visibility

Figure 3. High Fidelity Design - iPad Screen 2

After placing number 1, the autistic child must take number 2 and place it at the correct place. Imagining that the child had placed it in a wrong place, one negative point will be given as the feedback of the system. This process is continued for all of the words included in teachers learning list. The system will keep a record of all students log, during their interaction with the application (See Figure 4).
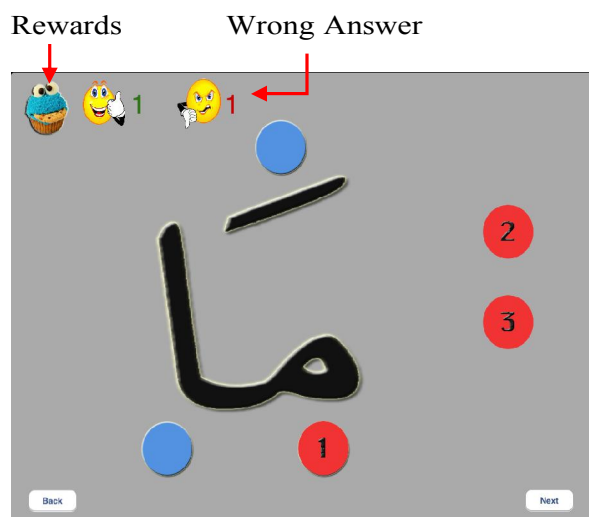
Rewards   Wrong Answer

Figure 4. High Fidelity Design - iPad Screen 3

Therefore it could be concluded that the system design incorporates numbers, and colors, provides rewards, teaching step by step which is leveling, and a clear structure to avoid split attention and redundancy. Besides, the design principles such

as visibility, consistency, feedback, affective aspects, and style are used for the autistic children to make them focus more on learning.

7. Conclusions and Future Enhancements

This paper presents the user interface design specification among autism spectrum disorders considering their difficulties.The significant point of this research is to motivate and help the autistic children have better learning, and understanding especially in the Quran. Another concern is to reduce autism challenges in their life by using visual supports since autism are visual learners [26, 27]. Due to the autism spectrum difficulties, managing and facilitating their split attention while interacting with the computer was one of the main objectives of this study. The identified design issues aims at preparing teaching instructions for the autistic children in learning to make them focus attention, and avoid splitting attention using computer based intervention in teaching Quran. The future enhancement of this paper is to evaluate the effectiveness of the designed system on the autistic children's split attention, and improve the lacks of user interface design specification for them.

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7/8/2013