TEST Engineering & Management

March-April 2020
ISSN: 0193-4120 Page No. 1374 - 1379

An Interactive Math Curriculum for Autistic Children

[1]Ala'a Mohammed El-Dada, [2]Safia Abdul-Rahman Kahen, [3]Azza Abu Zeid, [4]Houria Oudghiri

[1,2,3,4]College of Engineering, EFFAT University, An Nazlah Al Yamaniyyah, Jeddah 22332, Saudi Arabia

[1]aeldada@effatuniversity.edu.sa, [2]skahen@effatuniversity.edu.sa, [3]azzaabouzeid@yahoo.com, [4]houdghiri@yahoo.com

Article Info
Volume 83
Page Number: 1374 - 1379
Publication Issue:
March - April 2020

Article History
Article Received*: 24 July 2019*
Revised*: 12 September 2019*
Accepted*: 15 February 2020*
Publication*: 14 March 2020*

Abstract

In fact, there is no exact treatment that can cure from autism; however a strategic educational plan may play a significance role in the development of the social, communicational, and educational skills of people with autism. Through investigation and observation, it was noticed the fact of having no curriculum especially designed for autistic children Autism is a mental, emotional, and behavioral disorder that appears on early childhood. This work was designed for the purpose of grabbing the attention to a group of people who can hardly be part of the social life not because they refuse it, but it is due to a type of disorder called the Autism Spectrum Disorder (ASD). In fact, the idea of the project went toward the development of an interactive educational curriculum that helps children with autism develop their functional academic skills in the mathematics subject.

Keywords: *Autism; maths; children; asd*

1. Introduction

Autism spectrum disorder (ASD) is highly considered by thousands of networks and communities all around the world. Psychologists, sociologists, and physicians are exerting effort and time trying to understand the nature of autism, figure out the main causes of the autism disorder, and come up with the best and most useful techniques to interact with autistic people [1].

No one can verify the exact causes of autism. Most experts state that autism is mostly caused by a combination of genetic and environmental factors. Those experts do not have a definite answer other than that they are guessing [2]

According to the Autism Society of America, autism occurs in as many as 1 in 500 individuals, this what makes autism disorder the third most common developmental disability [3,4]. In fact, there is no specific effective treatment-other than well designed educational programs based on behavioral analysis for people with autism.

It is important to understand the way autistic people are thinking in order to find and create a suitable environment and a best way to teach them. [4] Autistic people in general are visual learners, they think visually. This is for the reason that the part of the brain associated with visual tasks is more active beside the fact that the language centers in the brain are not as synchronized as those with no autism disorder [5]. Thus, long verbal phrases should be avoided because autistic children have difficulties in remembering many steps or word sequence [6].

Therefore, to have an autistic child understanding the learned lessons, a combination of pictures and words should be presented. As visual thinkers, autistic children often show close relationship to a particular object or picture. Therefore, it is recommended that the teacher incorporates the same object into most of the lessons [7]. As visual learners, children with autism process visual information easier than auditory. Therefore, a combination of pictures and word are recommended to be presented to help autistic children in understanding the learned materials.

According to Moore et al.[8] computer- aided education and computer interactive systems may help autistic people to develop and improve their emotional understanding This may be due to the fact that most of autistic people are 'visual learners", they organize information and communicate with people using pictures, images, and colors. Thus, computer systems are part of

March-April 2020
ISSN: 0193-4120 Page No. 1374 - 1379

the daily life for people with autism especially in the educational programs of autistic children. Study conducted by the staff of The Early Childhood Comprehensive Technology System and funded by the U.S. Department of Education concerning the response of five autistic preschool children to computer concluded that the behavior of children was changed after using the computer [9]; they begin to socialize, share, communicate, and learn the computer [10].

Lately, Arab societies showed more attention to this group, however this interest considered to be small compared to the progress witnessed in that field in other parts of the world [11-13]. With regard to the rapid improvement in computational science, the educational and social learning strategies for autistic people especially children in the Arab society show lack of technology involvement.

In spite of the existence of many schools and organizations specialized in educating autistic children and enhancing their communication and independent life skills. Yet, there is no curriculum specially designed to be compatible with autistic children needs and characteristics. Instead, the same curriculum designed and used for normal children is also used for autistic children with the difference in the learning objectives and activities. In fact, after visiting two schools for autism in Jeddah, it was found that the books provided by the ministry of higher education for normal children are the same books used for autistic children. All activities related to the educational plan are designed manually by the instructor of the course and using a special system of pictures called the board maker.

Thus, it was requested by the Jeddah autism center for girls to design and build an interactive math curriculum for the first grade students using the board maker software which has a database of pictures work as graphical representation for most of the words used in a daily basis. The interactive curriculum will help children to enhance their mathematical skills at schools as long as home for those who are home learners or those who need more practice.

2. Software Design

2.1 System Architecture

This section presents the architectural design of the application. It shows the general structure of the system, the system components or building blocks, and the relations between the different components. In general, the architecture design of the system consists of three levels of components. Starting from the highest components' level and moving down to the lowest components' level of the system, the three components of the system are; the chapters, the activities, and the sub activities. The number of activities and sub activities presented in each chapter is determined based on the learning objectives of each presented chapter. Moreover, each sub activity has its role in serving the objective of the higher level component “activity” which itself has its role in serving the general objectives of the higher component "chapter". All chapters together have their role in assisting the development of the Math functional academic skills of autistic children. The following illustrates the overall architectural design of the system besides the component structure of each component of the system. Figure 1 shows the system architecture.

Figure 2 shows architecture design for chapter one. For the presentation component, it has the goal of teaching children the shape and the pronunciation of numbers from one to nine. It has three different sections: listen to number from one to five, listen to numbers from 6 to 9, and finally an enjoyable video presentation of all numbers. Figure 3 shows Presentation’s Sections.

For the education component, this component aims to deliver the concept of numbers in an educational form. The activities section consists of three sections. The first component composes the educational activities that use the selection technique to solve problems related to numbers from one to five. The second component is similar to the first one but for the numbers from 6 to 9. The last section presents the educational activities for all numbers from 1 to 9, it uses the drag and drop technique to solve the presented task.

For the game component, its purpose is to embed fun in learning the numbers. So the child can enjoy learning. There are two different types of games. First, drag and drop the correct number corresponding to the number of starts in the sky.

March-April 2020
ISSN: 0193-4120 Page No. 1374 - 1379

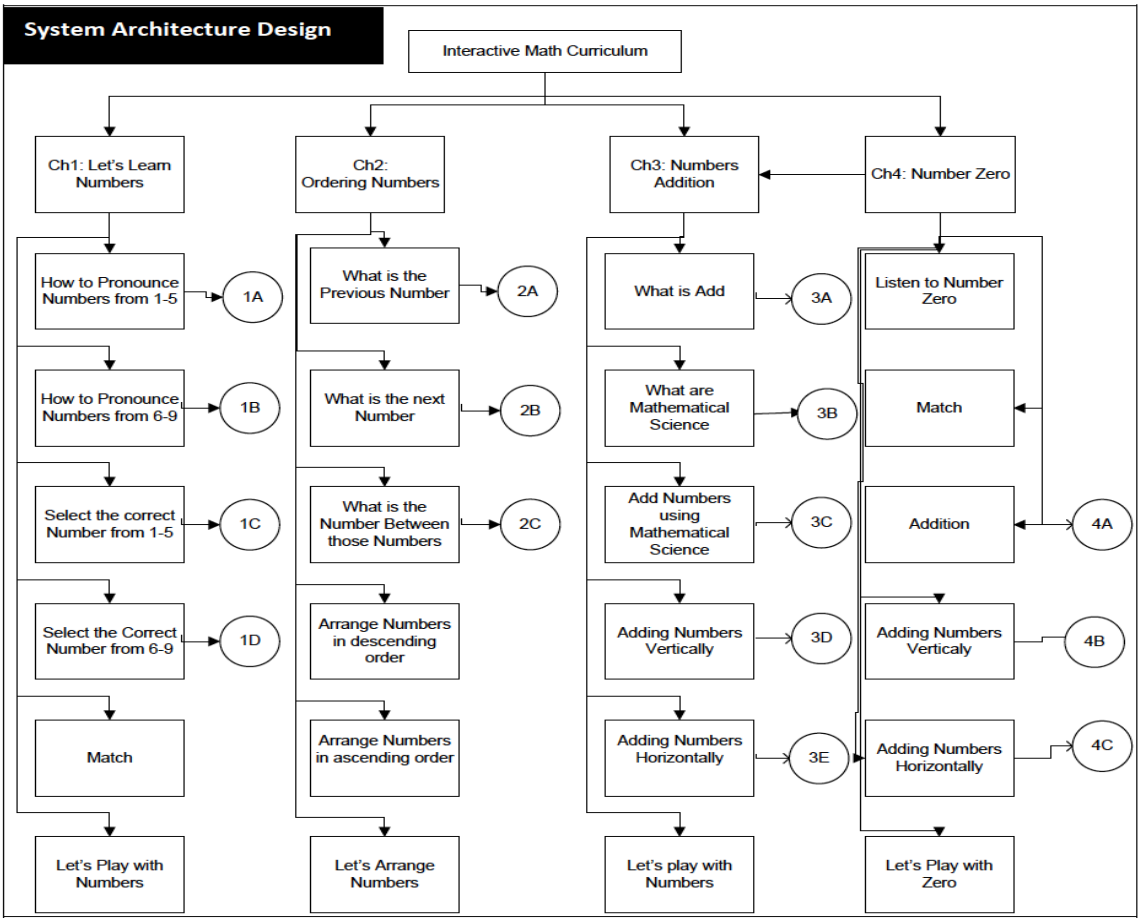

Figure 1: System Architecture

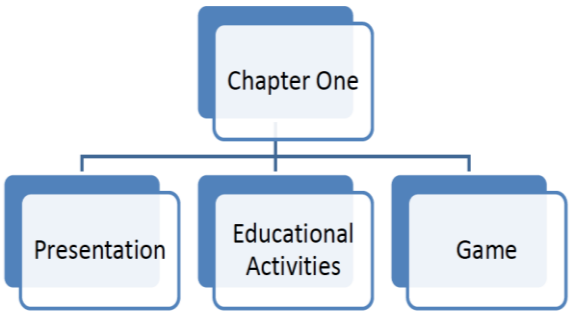

Figure 2: Architecture design for chapter one

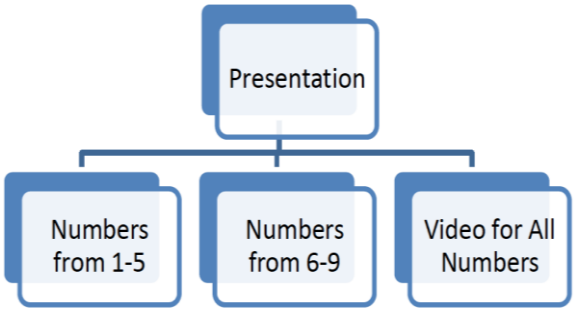

Figure 3: Architecture design for chapter one

2.2 User Interface

In the first page, welcoming words spoken by the 3D character are presented. A button to start the application is also included. This button will be associated to a flashy color to give the child a hint to click it. After clicking the start button, the program will display the Home page. The Home page includes a list of clickable icons presenting the curriculum chapters. The character gives a hint to the child to select one of these chapters. At the bottom side of the page, there are two buttons, the home page button used to navigate to the home page and the exit button used to quit the application. The Architecture Design of the chapter was designed to have three main components; these are the presentation, the educational Activities, and the games.

2.3 Data Model

The data model of the system in a form of an entity relation-ship diagram. The main entities are Chapter, Activity, Sub activity, Task, Board maker symbols, Voice, and picture. The sub entities are: Task-picture- and Activity-question.

March-April 2020
ISSN: 0193-4120 Page No. 1374 - 1379

3. Implementation

3.1 Developing the Application

Implementing an interactive math curriculum for autistic children requires two main elements; these elements are the attractive interface and the curriculum content and activities. It requires the development of an eye catching interface that attracts the attention of the children and encourages them to complete the different type of the educational activities and the games. In fact, the content and the educational activities were designed and implemented to enable the adoption of any further and future modifications, deletions, or additions in the educational curriculum The Architecture Design of the chapter was designed to have three main components.

Basically, two tools were used to develop the software; these tools are the Flash MX and the Microsoft Visual Studio 2008. It was essentially at this stage to use both tools efficiently and effectively to achieve the desired goal of implementing an interactive curriculum. Thus, the first step in implementing the software was to identify the components of the application to be developed in flash and others to be developed using Visual Studio 2008 (visual basic). Since the application was designed to serve the objective of adopting the addition of many activities and / or chapters, the dynamic feature needs to be implemented using a database design. Therefore, the sections of the application that contains dynamic content which required interactions with the dynamic database were designed and implemented in Visual Studio. In fact, the educational activities and the matching game are the dynamic components of the application that were implemented using visual studio. The educational activities were implemented in Visual Studio due to the necessity of retrieving data such as the activities' pictures, the board maker symbols, and the activities' questions dynamically from the application database. Similarly, the matching game requires dynamic retrieval of pictures from the database. Implementing and designing the educational activities in visual studio was for the purpose of enabling the process of making frequent further modifications in the content of the educational activities without the need of re-implementing the activities, only small modifications in the SQL queries that were used to retrieve the data is to be done when the content of the activity (i.e. Pictures, Board Maker symbols .. etc) is to be changed. It is important to mention that the design of the activities' background was performed in flash for the purpose of increasing the attractiveness of the application.

However, the layout of the activities was designed in VB. In contrast, the components of the interface, which are static that neither require further modifications in the future, nor interactions with the database, were designed and implemented using the flash software. Interface components which were designed using the flash MX software include the following: the home page, the chapters page, the activities page, the presentation activity page, the games home page, the educational activities home pages, and "drag the item presenting the number corresponding to the number of stars in the sky" game page and its tutorial, the exit page, the negative reinforcement page, and the positive reinforcement page

3.2 User Interface Development

The home page contains the chapter buttons. They are four buttons which are numbers, ordering numbers, adding numbers, and the zero. In the button design there are the chapter name, some numbers and shapes to represent the idea of the chapter, and some decoration. Figure 4 shows the developed interface.

Figure 4: First page of the application

Clicking on the arrow in the first page will allow the child to navigate to the home page. The home page has doors as buttons representing the chapter. To show the concept of the chapter, the same technique of the previous design was used. The character will introduce the child to choose one of the chapters presented. Also, there are two buttons for navigation between the pages; one to return for the same home page and it has a home shape, and the other is to exit the program and it represented as an opened door.

If the child clicks on the chapter one button, this screen will appear to allow the child to select one of other three buttons. The first button has a television shape and it takes the child to the listening section. It has a board maker symbol that displays the hearing concept. The second button that appears as paper holder contains the educational activities of the chapter and uses the select symbol of board maker as it is one of the activities that will appear. And the last button is a game box that leads the child to the game section, and which is also a board maker symbol as shown in Figure 5.

March-April 2020
ISSN: 0193-4120 Page No. 1374 - 1379

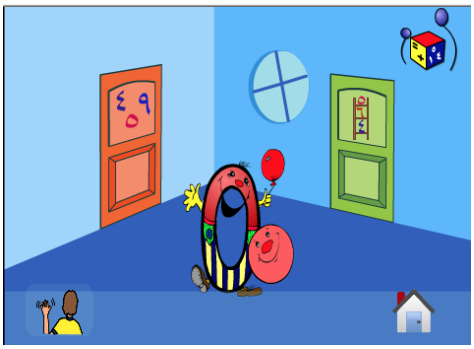

Figure 5: Home Page

Clicking the TV button will navigate to the presentation page. In this page, there are three listening sections that teach the child the shape and pronunciation of numbers. The child can repeat as much as needed. The buttons are representing the activity idea using board maker symbols. At the bottom of the page there are three buttons to navigate throw pages; one for home page, second for exit page, and the third for chapter page Figure 6 shows the chapter one page.

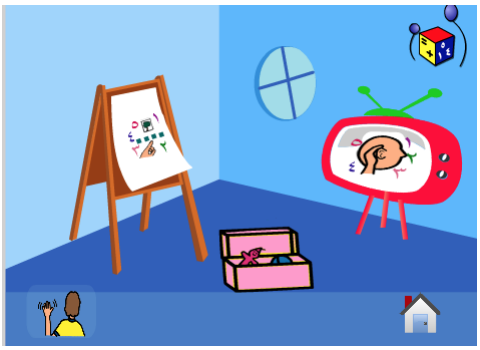

Figure 6: Chapter one page

The first button in the presentation page represents numbers from one to five. Clicking the button will display in the screen area the question and the associated board maker symbol with all sound needed. For each number page there are two buttons; one to reply, and the second to go back to the numbers page. Figure 7 shows the presentation interface.

Figure 7: Presentation Interface

4. Testing

After completing the implementation part of the software, verification and validation processes must be conducted. The verification process determines whether the application functions correctly and the errors and defects that occur during run-time. The validation was done based on True/False output. Table 1 shows the testing result.

Table 1: The Testing output

Scene	Control	Input	Output	True/ False
Start	Enter Button	Mouse Click	Navigate to inner scene	True
Inner	Home Button	Mouse Click	Navigate to the page	True
Room	Presentation Button	Mouse Click	Navigation to the presentation scene	True
Activity	Activity Button	Mouse Click	Navigation to selection	True
Presentation	Section one	Mouse Click	Display numbers from one to Five	True
Game	Numbers & Stars Game	Mouse Click	Navigation to the game	True
Exit Page	Exit Button	Mouse Click	Out of application	True

5. Conclusion

Math is one of the most important subjects that each child should have a solid foundation on it. Since it help children to identify, count, and add numbers. This project is about developing an application that offer teachers at schools as well as mothers at home aiding math tool that teaches autistic children some basic math concepts that first grade child must master.

References

[1] Verhoeff, B. (2012). What is this thing called autism? A critical analysis of the tenacious search for autism's essence. *BioSocieties*, *7*(4), 410-432.

[2] Baron-Cohen, S., Scott, F. J., Allison, C., Williams, J., Bolton, P., Matthews, F. E., & Brayne, C. (2009). Prevalence of autism-spectrum conditions: UK school-based population study. The British Journal of Psychiatry, 194(6), 500-509.

[3] Elsabbagh, M., Divan, G., Koh, Y. J., Kim, Y. S., Kauchali, S., Marcín, C., ...& Yasamy, M. T. (2012). Global prevalence of autism and other

March-April 2020
ISSN: 0193-4120 Page No. 1374 - 1379

pervasive developmental disorders. *Autism research*, *5*(3), 160-179.

[4] Autism and Developmental Disabilities Monitoring Network Surveillance Year 2008 Principal Investigators. (2012). Prevalence of autism spectrum disorders—autism and developmental disabilities monitoring network, 14 sites, United States, 2008. *Morbidity and Mortality Weekly Report: Surveillance Summaries*, *61*(3), 1-19.

[5] Gillott, A., Furniss, F., & Walter, A. (2001). Anxiety in high-functioning children with autism. *Autism*, *5*(3), 277-286.

[6] Schaaf, R. C., Toth-Cohen, S., Johnson, S. L., Outten, G., & Benevides, T. W. (2011). The everyday routines of families of children with autism: Examining the impact of sensory processing difficulties on thefamily. *Autism*, *15*(3), 373-389.

[7] Erdődi, L., Lajiness-O'Neill, R., & Schmitt, T. A. (2013). Learning curve analyses in neurodevelopmental disorders: are children with autism spectrum disorder truly visual learners?. *Journal of autism and developmental disorders*, *43*(4), 880-890.

[8] Moore, D., Cheng, Y., McGrath, P., & Powell, N. J. (2005). Collaborative virtual environment technology for people with autism. *Focus on autism and other developmental disabilities*, *20*(4), 231-243.

[9] Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., ... & Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of autism and developmental disorders*, *45*(7), 1951-1966.

[10] Cardon, T. A. (2012). Teaching caregivers to implement video modeling imitation training via iPad for their children with autism. *Research in Autism Spectrum Disorders*, *6*(4), 1389-1400.

[11] Hussain, A., Mkpojiogu, E. O. C., Musa, J., Mortada, S., & Yue, W. S. (2018). Mobile experience evaluation of an e-reader app. *Journal of Telecommunication, Electronic and Computer Engineering*, *10*(1–10), 11–15

[12] Hussain, A., Abdullah, A., Husni, H., & Mkpojiogu, E. O. C. (2016). Interaction design principles for edutainment systems: Enhancing the communication skills of children with autism spectrum disorder. *Revista Tecnica de La Facultad de Ingenieria Universidad Del Zulia*, *39*(8), 45–50

[13] Salhia, H. O., Al-Nasser, L. A., Taher, L. S., Al-Khathaami, A. M., & El-Metwally, A. A. (2014). Systemic review of the epidemiology of autism in Arab Gulf countries. Neuroscience*19*(4), 291.

[14] S. V. Manikanthan, T. Padmapriya, "Relay Based Architecture for Energy Perceptive for Mobile Adhoc Networks", Advances and Applications in Mathematical Sciences, Vol. 17, Issue 1, November 2017, pp: 165-179.