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المؤتمر العالمي لتكنولوجيا المعلومات والاتصالات في خدمة ذوي الإعاقات وصعوبات التعلم
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Information Technology in Neuroplasticity Exercises for Learning Difficulties

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Abstract

Learning difficulties is a broad name for group of disorders. Thesedisorders are manifested in the form of weakness in listening, speaking, reading, reasoning and mathematical skills. People who have learning difficulties could suffer from one or more of these disorders. Children with learning difficulties are facing challenges in their educational process. The traditional class-based ways of education for children with learning difficulties could be tiring and boring. In this paper we explore the use of Information Technology (IT) in treating learning difficulties for the Arabic-speaking children. We provide a design of a software tool that includes exercises for reading, writing, memory and mathematics. These exercises are designed as games to make it more interesting for the child to develop his/her skills.

Introduction

Children with learning difficulties are sometimes neglected and/or left behind in the learning process at schools. In this sense these children are at disadvantages compared to their healthy peers. The traditional class-based ways of teaching/learning could be frustrating and difficult for those children. They need special, adaptable, and user-friendlier ways of teaching/learning for them to achieve their real potentials. It should be noted that children with learning difficulties are not stupid or dim. They only have brains that function differently than others. They have different ways of receiving and processing information and as such all what they need is to be equipped with the appropriate method(s) to deal with such peculiarities.

The treatment process of children with learning difficulties depends on training their brains to figure out ways to understand things. It has been observed that the human brain has the ability to develop new ways of interpreting and processing the received information. Given the appropriate learning conditions, the human brain has the ability to reorganize itself differently by forming new neural connections. These newconnections facilitate skills such as reading and writing that are not possible using

the old neural connections. This reorganization of brain connections is only possible because of a property called *neuroplasticity*, which is the brain ability to change through experience and learning. The required learning and experience could be acquired through specialized computer based systems that are developed specifically to activate the neuroplasticity phenomenon in the brain of a human [3].

Assistive technology (AT) is a sound platform, which can be used to assist children with learning difficulties. It helps them to function normally and to be self-dependent in completing their work with no external human intervention. Assistive technology does not improve any human biological skills nor does it cure/decrease disability it rather helps the brain of a child who has learning difficulties to circumvent the difficulties and accomplish any work assigned [5], [7], [9].
Alternative keyboard is one form of AT. It is based on dividing the keys into groups based on color or location with graphics. Another assistive technology tool is Abbreviation Expanders. This is a software program that enables the user to create, store and reuse abbreviations. It helps in word processing by saving time and insuring correct spelling. For people who have mathematical skill problems there is a solution for them through Electronic math worksheets. It helps people who have problem in solving mathematical problems using paper and pencil. Electronic math worksheets give them the alternative to solve math problems through the computer in more organized and aligned manner. It also reads the numbers on the screen aloud. Using assistive technology for children with learning difficulties could enhance their academic performance, helping them to depend on themselves, and augment their learning environment [10].
On the other hand, it may sometimes be impractical to use AT, such as in cases where assistive technology devices are importable to carry, or it could be highly expensive. In addition, a child could become overly dependent on AT devices to the extent that he/she can't function without.

Another type of technology that can be used in helping children having learning difficulties is the *educational constructional technology*. This type of technology focuses on improving the skills that the person has through a computer based system in order to make him/her self-dependent in the learning process [6].

It should however be noted that the use of some software tools (programs)may help improve the child's skills. These are called Constructional Learning Tools (CLTs). Some Examples of these programs include Reading Skill Builder, Early Reading Booster, and Basic Algebra Shape-Up. The first two tools help beginners to build their reading skills. The Algebra Shape-Up tool helps in building children's algebra basic skills. This kind of programs helps children to improve their skills and eventually to depend fully on themselves in the learning process [11].

In this paper we explore the use of Information Technology (IT) in helping children with learning difficulties and present an example of a software tool that can be used for this purpose. The software tool is designed in the form of simple games that are designed in a way to strength certain human skills such as reading, writing,

memorizing, and problem solving. It is a multi-level system that helps the patient to move up in practicing games that are incremental in the level of difficulty as he/she

continues to perform better in playing a given set of educational games. The improvement of the child is reported through a scoring system that keeps track of the improvement in time and score achieved by the child in conducting games.
The proposed software tool is introduced in the next section.

The Proposed System

Fig. 1 shows the user's view of the proposed system. The system is currently consisting of three games. The main page of the system contains three buttons each one allows access to one of the three games. Each game contains more than one level in a way that encourages the child to try harder to attempt the next level of difficulty.Every game contain a score and timer which count down time in minutes until the allowed time for the game is expired at which moment the score achieved is displayed for the child.

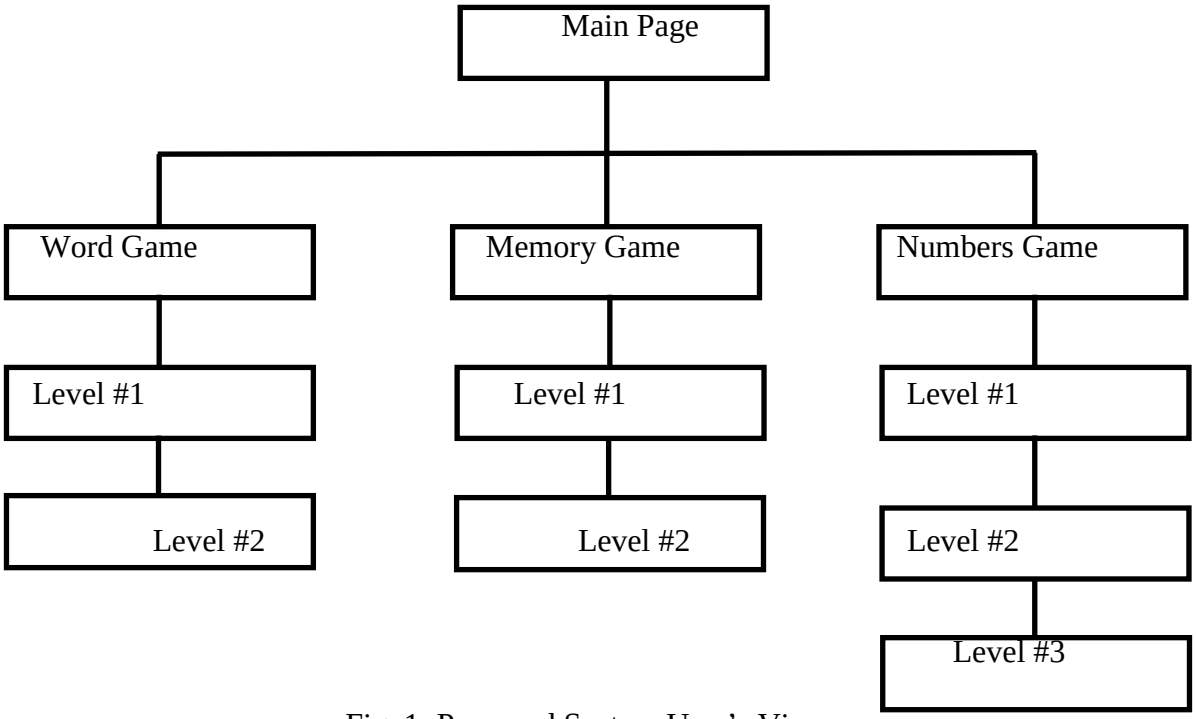

Fig. 1: Proposed System User's View

The main page of the system is connecting all games together. From this page the user could choose the game that he wants to play by clicking on one of the buttons that represents games.
Fig. 2 illustrates the main page of the system.

Fig. 2: The main page of the system

The three games that the system contains are *word*, *memory* and *numbers*. The idea of the word game is that two letters are displayed by the game and the user is asked to suggest a word that begins with these two letters. If the user enters the correct word the word will be displayed in *blue* color and the score will increase; otherwise the wrong word will be displayed in *red* color and the game continues. The main idea of the word game is to help the child to recognize word patterns, building vocabulary and improve his/her logic skills.
The second game is the memory game. When the memory game is started a simple figure of birds is displayed for a few seconds then disappears. The user should memorize the places where the birds were displayed and click on them to collect score and the game continues. The main idea of the memory game is to help the child improve his/her cognitive skills, stimulate the brain, and improves processing information. It also helps improve the attention span and the memory recall ability.

The third game is the numbers game. In this gamea form is display with a figure that represents a mathematical question for the user to answer. As long as the correct answer is entered by the user advancement to the next level takes place. The main idea of the number game is to help the child to improve his/her problem solving skills, and quantitative reasoning. It also improves the child's basic mathematical skills.

It should be noted that the input and output of the system is similar in all games where the input is the user answer and the outputs are the score with the time consumed.

System Implementation

The proposed system has been designed using Microsoft Visual Studio 2005. Itcontainsthree parts the Graphic User Interface (GUI), the application part, and the database part. The GUI was made as simple as possible for children to use.We intentionally made the graphic simple in an attempt to keep the child focus on the games rather than on the graphic around. The application part includes the three games as explained above. The database part is mainly used by the word game. The databasecontains tables of words that begin with the same first letter. We used the Arabic dictionary to build this database. When the user entershis/her guess of a word

the system consults the table whichis specified by the form and compares the word with the contents of the table. If the word matches a word in the table that will mean that the user's answer is correct; otherwise the answer is considered incorrect. Fig. 3 illustrates the three parts of the proposed system.

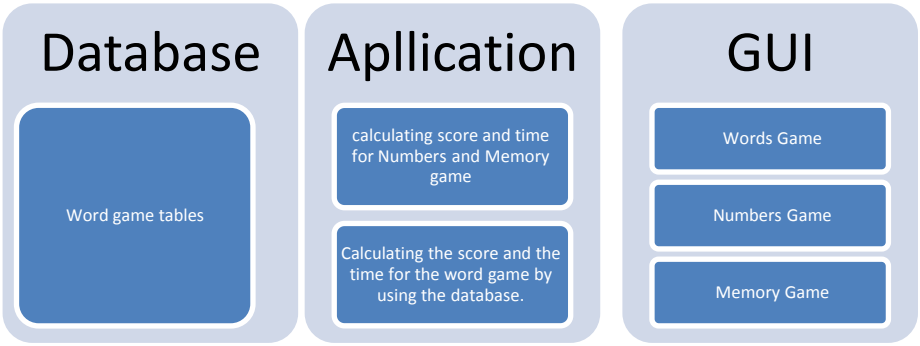

Fig. 3: System's components.

Example System Sessions

The regular treatment process of children with learning difficulties is most of the time mind numbing for the child, thus reducing the chance of obtaining successful results. For this reason, we developed a software tool that contains the regular exercises but with more interesting and motivating way for the child. The child can practice the exercises as games. Each game contains a timer and a score in a way that motivates the child to achieve higher scores in less time. In this way the child enjoying conducting exercises that help him/her to overcome his learning difficulties. The software contains three games *words*, *memory* and *numbers*. Each one of these games has multiple levels. These are explained below.

The Word Game

When a player starts the word program, he/she will be asked by the system to enter a word begins with two specific letters. When the user enters the word the program compares it to the list of words stored in the database. The database contains tables of words that begin with specific letters. If the word is found in the table the player score will increase and encouragement phrase will be displayed. This game helps in building vocabulary and fluency.

Fig. 4 shows examples of the Word Game.

The Memory Game

The memory game helps a child to concentrate better and to strength his/her memory ability. It has multiple levels such that a child could reach as long as he/she achieves better scores in less time. Numbers of blocks are displayed on the screen if the child clicks the start game button few blocks will show a flying bird and then disappear. So the player should remember the block that contain birds and click on it. Fig. 5 shows examples of the Memory Game.

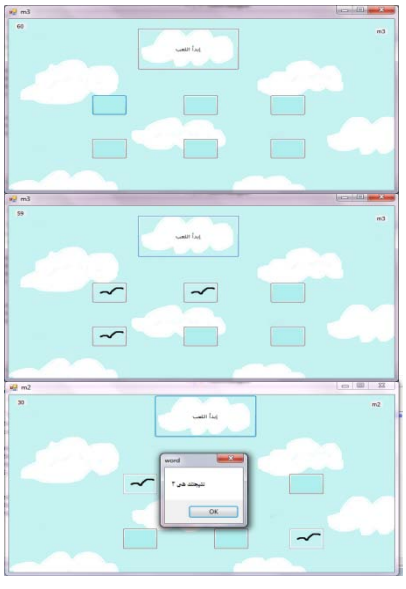

Fig. 5: Example Memory Game Session.

The Numbers Game

In this game the user solves simple math problems that increase gradually in difficulty as the player achieves high scores. This game improves the concentration and problem solving skills of a child. Fig. 6 shows an example Numbers Game.

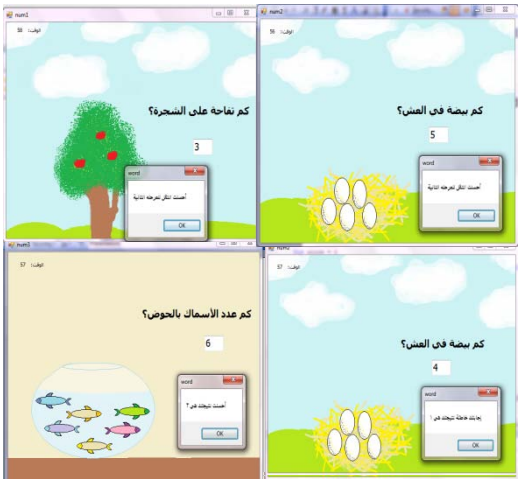

Fig. 6: shows examples of the Numbers Game.

Concluding Remarks and Future Work

In conclusion, technologies have been used in a number of ways in the learning process for children with learning difficulties. In this paper, we made an attempt to highlight the importance of using technology for helping children with learning difficulties. We have shown that by designing a software tool. This software can improve and enhance the learning process and be more interesting as a learning tool for children who have learning difficulties. The proposed system has been built based on the *Neuroplasticity*phenomenon which is the brain ability to change. The learning difficulties treatment process is done through exercises in order to enable children to find new ways to process the information. The traditional treatment process could be exhausting and boring for the child to continue. This could compromise the expected results of the treatment process. Through using the proposed software tools we apply the same treatment process, but through computer games that can be installed and run on a PC. It also could be used at school and/or at home.The games introduced in the system are designed so as to help improve certain cognitive skills of children. The words game focus on improving the reading and writing skills. The numbers game aimsatimprove the mathematical skills and the logic reasoning.

The memory game is an attempt to improve the information processing speed, and memory of the child's brain.

The proposed software tool can be developed further by enhancing its graphic design in a way that will make it more attractive for children. It is also possible toadd more games that are designed targeting certain other human cognitive skills.

Acknowledgement

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