Computer graphics applications in the education process of people with learning difficulties

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Abstract

This paper describes the use of Real Time graphic applications as educational tools, specifically oriented to working with people who have certain learning difficulties. We first focus on identifying the most relevant traits (from a psychological point of view) of those disorders, then we continue by analysing the advantages of graphics in Real Time in this context, and how they can be used to complement the conventional teaching methods. Finally, we review the main characteristics of two applications belonging to this category, which serve as a practical example of this encounter between education and technology.
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1. Introduction

Nowadays, the area of computer graphics is widely used in a variety of applications for specific purposes. We can find information about virtual simulators for training in driving vehicles, like cars, buses or trains; 3D representations of future buildings or houses most of the times only with the objective of visualization; computer and console games with high-quality graphics, where the player can live a different experience inside the virtual world; or film scenes and characters that are generated using computer graphics. Simulation, training, visualization and entertainment are environments where the use of computer graphics is very popular.

In this context, the possibilities of using computer graphics applications for education are opening an important research area. The technology is every day nearer to children, not only at home but also at school.

There are scholarly subjects only related to technology and there is a common interest in all schools to introduce new computer-based programs and applications, for teaching specific concepts included in the school curriculum.

In the area of people with special needs, the application of new technologies is starting to produce good results in the education and intervention process. The idea of creating useful applications for teaching and training specific concepts (such as academic, social or communicative skills) seems to be of interest to all associations and special schools. There are efforts to describe the characteristics and possibilities of the use of new technologies (TIC) in the education of students with especial needs [1]. The idea of TIC is defined as "technological instruments for the compensation and help in the intervention of students with special needs" [2].

This paper is based on the idea of using new technologies, in our case, computer graphics applications, for people with special needs. The projects described in this paper try to promote the use of computer graphics to create helping tools for teachers and professionals in special education, in their intervention and educational process for people with special needs. In our context,

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"intervention process" can be understand as the daily work with people with learning difficulties developed by professionals in psychology and special education, to work on the specific skills in which these people have difficulties.

In the following sections we describe the group of people to whom the graphic applications developed are addressed, the state of the art in computer graphics for education, advantages of the use of computer graphics applications as educational tools and the description of the two projects developed in this area. Finally, we present a conclusion and the possible future work.

2. Learning difficulties

Concepts like special education and people with special needs are very general and in most of the cases it is difficult to structure a tool that is useful for every kind of disability. It is important to specify the public to whom each of the applications to be created is oriented.

First of all, we want to introduce the concept of "learning difficulties", that in our case, describes the group of potential final users of our applications. We speak about "learning difficulties" to make reference to those whose origin stems from a biological impairment rather than socio-environmental factors.

Learning difficulties are impairments that limit development and put into practise communicative and/or academic and/or social abilities. The degree of development in this set of abilities is intimately related to the degree of autonomy and community integration (social, educational, labour) that the individual reaches, and it is also related to their quality of life.

The kind of condition referred to here fits well with what is named "mental retardation" (MR), formally defined in the Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association [3] as a developmental disability that first appears in children under the age of 18. In this manual, it is defined as an intellectual functioning level (as measured by standard tests for intellectual quotient) that is well below average and significant limitations in daily living skills (adaptive functioning) are present.

A closer definition and concept for the subject of this paper is one of "learning disability", defined in the "Individuals with Disabilities Education Act (IDEA)" of the United States as a "disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell or to do mathematical calculations." (Public Law 101-476, IDEA, USA).

Among all the "labels" mentioned above for this condition, we prefer that of "learning difficulties", as it is not pejorative and it is the most positive one in the sense that it transmits the idea that "very much can be done to overcome these difficulties", from an educational point of view.

Down syndrome is an example of this condition. These people present deficits in attention, perception (with better visual perception than auditory), language and in different cognitive aspects.

Another condition often associated with learning difficulties are autism spectrum disorders (hereafter referenced as "autism"), as three out of every four individuals with autism show mild–severe learning difficulties (MR). The American Psychiatric Association defines this disorder as the presence of a triad of impairments in social interaction, communication and restrictive, repetitive and stereotypic patterns of behaviour, interests, and activities (see DSM-IV, 1994 for more details and [4]).

The enormous attraction that people with learning difficulties (down syndrome and autism) feel towards computers has been one of the sources of many developments in this field.

3. State of the art in computer graphics for people with special needs

The most popular software and tools available for special and mainstream education are based on 2D graphics and web pages, with interactive content organized depending on the specific area of knowledge to work with. Most of these applications have interactive games to work in most of the areas included in the school curriculum. In most of them you can find contents in these four topics:

- *Tools to work on social skills*: In this area it is possible to find games or interactive lessons to learn about personal cleanliness, products for personal cleanliness, external appearance, clothes, kitchen utensils and the rules and usage of kitchen utensils.
- *Tools to work on cognitive skills*: In this area there are applications to learn about colours, shapes, basic concepts, objects classification, order, likenesses and differences.
- *Tools to work on written language*.
- *Tools to work on numeric skills*: Where you can find concepts like decimal numeration, addition and subtraction.

Some examples of these kinds of applications are SEDEA Program, a computer application for the intervention process in the development of the hearing and language of children [5] (see Fig. 1); PEAPO, a web site with an easy to use resource that tries to promote the communication and autonomy capabilities in people with Austism Spectrum Disorders (ASD) [6]; EDU356, a web site with multimedia activities oriented to promoting and reinforcing the educative contents for children of different ages [7]; Hola Amigo, an educational graphic interface for learning non-verbal communication using the language of SPC (or Pictographic Symbols System for non-verbal communication) [8].