

TOWARDS A METHODOLOGY FOR EDUCATING STUDENTS WITH SPECIAL NEEDS

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Abstract: Educating people with special educational needs (SEN) is a hot topic these days. Many multimedia educational tools have been generated with the support of ICT to assist children receiving SEN education. Teaching supported by new technologies should guarantee contents accessibility. However, these tools are not 100% suitable because the adaptation process they implement does not take into account all pupils' educational needs. In this article, we argue that SEN teaching can be improved with a) better curriculum adaptations, and b) a better definition and use of accessible multimedia tools. We also think that it would be interesting to use semi-automatic tools to help educators to create or select adapted programmes of study for pupils with SEN. We present a framework to support teachers and multimedia educational tools developers in educating SEN pupils and its application to *Proyecto Aprender* (Learn Project).

Keywords: E-learning, web accessibility, software accessibility, education.

1. Introduction

Teaching pupils with SEN is a complex task. It involves implementing a teaching process and providing access to materials suited to pupils' skills. This depends on each individual's educational needs. For each pupil, this entails establishing a special-purpose and individualized programme of competencies selected from the standard curriculum. This is called "curriculum adaptation". Additionally, pupils need to be given tools and materials adapted to their needs.

Curriculum adaptation does not focus exclusively on learning objectives and contents. It also sets out all the access alterations required for curriculum development, like the environmental, material and personal conditions that improve the teaching process. We refer to such alterations (environment accessibility, materials, methodology, assessment, etc.) as "accessibility measures", and they also need to be considered as part of the teaching/learning process for amendment. Additionally, remember that this adapted curriculum is sometimes far removed from the standard curriculum. It is a statement of the minimum abilities and skills that a pupil should/can acquire, with the necessary assistance, to be able to lead an autonomous life.

Curriculum adaptation, and consequently the education of people with SEN, clearly involves many elements from the physical and social context. The integration of this context information would give educators of SEN pupils a reference for designing curriculum adaptations and provide intelligent systems with a source of reasoning, explanation and decision making for curriculum design. These ideas have led to partial solutions in this field like (Alonso et al., 2001), (Cantón et al., 2006).

Digital media are a very useful tool for teachers to exploit in the classroom to educate SEN pupils. They offer multiple representations and manners of interacting with the content. However, there are few tools today that take into account all the factors involved in curriculum adaptation. Therefore,

many educators have elected to amend their own materials, whereas others have even carried on teaching without accessible materials. This is an outmoded and costly situation in which educational communities grow based on individual knowledge rather than collective and collaborative experience (Stahl, 2005).

We believe that the best way of tackling and overcoming the numerous weaknesses present in SEN pupils' educational process is to take into account all the factors involved in the education of these pupils and the interrelations between all the elements.

In this scenario, there are, from our experience-based viewpoint (Alonso et al., 1995), (Alonso et al., 2001), (Cantón et al., 2006), (Frutos et al., 2000), (Fuertes et al., 2005), two major problems:

- Provide educators with tools for (1) guiding them through curriculum adaptation, (2) selecting which materials to use, (3) which assistive technologies (hardware and software) to employ and (4) how to go about teaching depending on the pupil's characteristics and the skills and the knowledge to be learnt.
- Provide software developers with a methodology to develop materials, tools and multimedia applications to improve the skills and knowledge of the SEN community.

The first point targets educators and will consist of a knowledge-based system that will provide recommendations and guidance for successfully undertaking the learning process with the pupil. The second point obliges us to formulate a special-purpose methodology to achieve, through the use of ICT, an overall and comprehensive improvement of the entire educational process for pupils with SEN. This methodology will cover all the necessary steps from curriculum adaptation to the generation of ICT tools to support curriculum development in the classroom.

In this article, we will give an overview of elements that are relevant for curriculum adaptation. This way, we will be able to develop adapted resources that have a good chance of being successful. In conclusion, we will explain the results of applying our development philosophy and how to use the acquired knowledge to build an expert system designed to make recommendations for educators.

2. Related Work

Some solutions, ranging from curriculum adaptation to accessible hardware and software tools selection, have been developed to support the teaching process. Up to now though, all of these approaches are partial solutions. None of them connect the whole process or share knowledge from one step to the next. They solve one or more (but not all) steps of the teaching process. All of these tools work independently. This is the main problem facing education for people with SEN.

2.1. Curriculum adaptation

Curriculum adaptation is a key requirement for people with SEN to access education. For instance, changes in how the higher education curriculum is designed in the United Kingdom are discussed in (Stefani, 2002). Several research institutions and groups have worked on the "Teachability project", a guide for academics specifying what aspects should be adapted to get an accessible curriculum for students with disabilities that meets their learning needs.

2.2. Educators' support tools

Proaci (Proaci, 2006) and Albor (Alonso et al., 2001) are prominent software tools related to this subject matter. Proaci is a computer program aimed at helping teachers to design individual curriculum adaptations and generate the necessary documentation (recording an argued proposal by the pupil's tutor, proceedings of the meeting to decide whether or not a curriculum adaptation should be devised, the pupil's level of curriculum competency, amended attainment targets, amended assessment criteria, sequencing of amended contents and proposed activities).

Albor (Barrier-Free Computer Access) is an intelligent system that searches for assistive technology solutions to give disabled people access to computers. Not only can it be used to evaluate how a SEN

pupil's physical, hearing, visual and cognitive abilities can affect computer use, but it also weighs up and suggests which of the many assistive technologies are the best option, taking into account the pupil's computer access abilities.

3. ICT-based framework approach for improving the education of pupils with SEN

Ordinary curricula, materials and methods are evidently not directly applicable for teaching pupils with SEN. To be able to teach SEN pupils, educators will need a curriculum adaptation, an amendment of the methodology to be applied and an alteration of the materials to be used for teaching. Teachers have need of assistance to decide on all the questions related to this process and assure that the pupil's educational process is all-inclusive. To do this, we first have to identify all the elements that are involved in the process (see Figure 1). The conjunction of all elements defines a philosophy and/or methodology for devising and modifying individual teaching for pupils with SEN. Let's outline the teaching process based on these elements.

First of all, we have to adapt the curriculum. This is when the learning objectives and methodology best suited for achieving the stated objectives need to be selected. If the selected methodology uses ICT for development, it will also be necessary to select the application or applications enabling the pupil to use ICT. This modification of the teaching/learning process should be carried out for each pupil individually and for all the process situations (specific activities, educational levels, etc.). Do not forget that the cornerstone of our approach is the actual pupil and the skills to be developed.

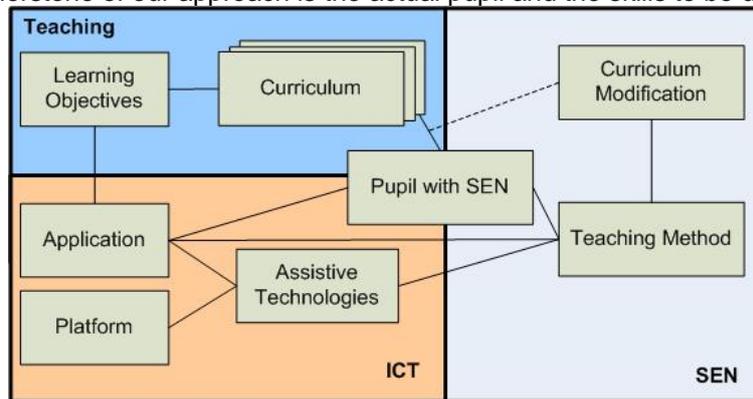


Figure 1 Elements involved in the teaching process of SEN pupils using ICT

To be able to establish the criteria for selecting and combining each element involved in teaching, it is necessary to establish a taxonomy to classify and correlate the different types of educational needs. In the following sections, we describe each module in detail and then propose a taxonomy of SEN types.

3.1 Pupils with special educational needs

Pupils with SEN are defined as pupils that require, during a period of or throughout their entire schooling and particularly as regards assessment, some specific educational support and assistance because they have physical, mental or sensory disabilities or severe personality or behavioral disorders. The education system will provide the resources required for pupils with temporary or permanent special educational needs to attain the targets established generally for all pupils.

A method is a set of logically coordinated times and techniques that target pupil learning towards certain objectives. The method is what unites all the teaching and learning steps, essentially as regards the presentation and the preparation of the subject matter. Methods and techniques aim to make learning management more efficient. Thanks to them, pupils can more easily build upon knowledge, acquire the skills and internalize the ideals and attitudes that schools aim to transmit to their pupils.

The methods for pupils with SEN and learning using ICT are delimited, specifically defined and substantially conditioned in both directions.

3.2 Teaching

After selecting the characteristics of a specific SEN community, we must adapt the curriculum and learning objectives. We must also determine what learning objectives can or cannot be aimed at depending on each pupil's (dis)abilities. To do this, it is important to establish relations between specific needs and adaptations to these needs by defining a SEN taxonomy. The proposed SEN taxonomy is described later.

3.2.1 Curriculum: Curriculum is a structured programme of subject contents. It is a structured series of learning objectives that are to be attained. The curriculum prescribes (or at least anticipates) the outcome of instruction. We will need to define different ways of structuring a curriculum in order to ease selection and later adaptation depending on the pupil's characteristics. The most important point is to determine what can be taught, what cannot be taught and what can be taught with curriculum adaptations depending on the characteristics of each individual pupil. This decision will be founded on the SEN taxonomy and expert knowledge.

3.2.2 Learning objectives: Learning objectives are separate, self-contained, reusable parts of content for instructional purposes. These blocks are fitted together to build an adequate teaching process.

3.3. ICT (information and communications technologies)

ICT are what will implement and instrument the teaching method defined for the learning objectives required to achieve the selected targets in the programme of study. The incorporation of ICT will provide a set of applications that will serve as tools to support learning. The pupil will require assistive technologies (AT) to be able to use these applications properly. The application-assistive technologies mix will only be available on a particular set of platforms. Therefore, a process needs to be set up for selecting the best assistive technologies for each particular situation.

3.3.1 Assistive technologies: To be able to use ICT as a teaching aid, pupil-system interaction will need to be adapted. This adaptation will depend on the pupil's abilities, the platform's possibilities and the defined teaching methodology. Assistive technology refers to all those technological elements that aim to improve the abilities of people whose performance is, for any reason whatsoever, below average for the population of the same age and sex as a whole. Within the framework of ICT use by pupils with SEN, these assistive technologies are defined as tools that enable and/or improve the use of ICT by pupils for the purpose of learning. They can be hardware or software technologies and be just as wide-ranging and diverse as pupils' needs and levels, and applications are. The selection of the best technology calls for a thorough and complex decision-making process to assure proper and effective use by each pupil.

3.3.2. Application: An application or system will be devised for use as a tool to improve or ease the learning of one or more attainment targets associated with a curriculum (Cantón et al., 2006). These applications should have been developed in compliance with recognized accessibility and ergonomics standards (ISO, 2002). This way assistive technologies can be customized for an individual pupil.

3.3.3. Platform: The platform model describes all the computer systems that can run a user interface. The platform model contains information about the capabilities, constraints and limitations of the target platform (Menkhaus et al., 2003). When developing applications for disabled people, not only must the application be ISO/TS 16071 compliant (ISO, 2002), but it should also provide special-purpose interaction techniques in order to be better able to meet the needs of a specific group of people. For instance, children with cognitive problems or autism perform better using a conceptual keyboard. In this case, keyboard combinations need to be provided for every element of the user interface.

3.4. SEN (special educational needs)

The curriculum will specify what to teach and what cannot be taught depending on the pupil's characteristics. It will also establish the prerequisites for embarking on certain learning objectives.

3.4.1. Curriculum adaptation: To be able to use a curriculum properly, it is necessary to establish “how” the “whats” defined in the curriculum are to be attained. This process is what is referred to as curriculum adaptation, and its goal is to define the best teaching method for a SEN pupil’s innate characteristics.

3.4.2. Teaching method: It is not the aim of this paper to define the applicable teaching methods. Teaching methods are the different techniques that make up the resources required to conduct the teaching process in an ordered, methodical and adequate manner. These methods should be used to make learning more efficient. Therefore, their inclusion in the **curriculum adaptation** is a must.

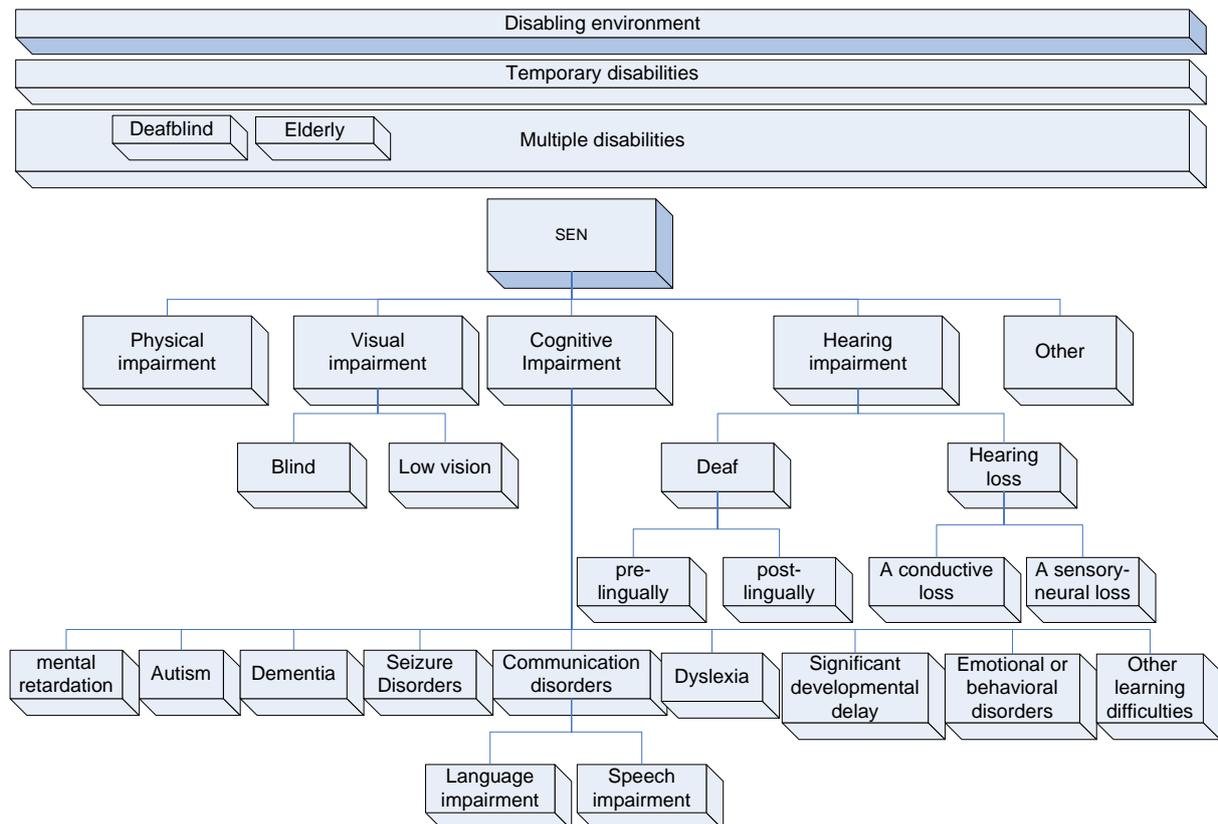


Figure 2 Proposed SEN taxonomy

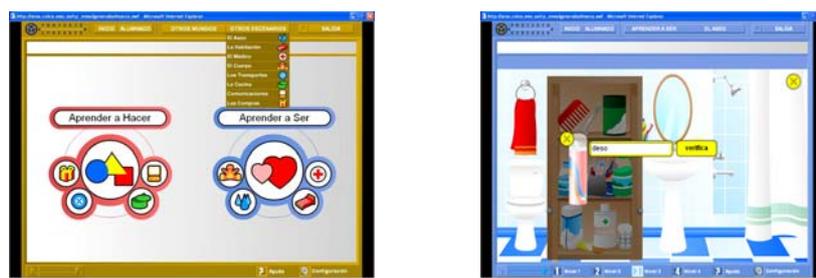


Figure 3 *Proyecto Aprender* screenshots

3.5. Taxonomy of SEN types

A number of authors (ISO, 2002), (Tiresias.org, 2007), (Jackson, 2005) have classified the SEN that can influence a pupil’s teaching and learning. We propose our own taxonomy (Figure 2) based on the classifications put forward by the above authors and on our experience in developing tutoring software systems targeting people with SEN. Our aim is to cover all users with some disability and to neither over-generalize nor over-specialize by assuring that group members are similar enough as regards the curriculum adaptation that users require. The specific types of disabilities identified as relevant for building a curriculum adaptation are suspended from the SEN box. All user groups that have a

combination of two or more disabilities (*multiple disabilities*) or do not have any specified disability (*temporary disabilities* and *disabling environment*) have been placed apart at the top of the figure.

4. Case Study: Proyecto Aprender (Learn Project)

Based on the philosophy described in this paper, we have developed *Proyecto Aprender* (Cantón et al., 2006). *Proyecto Aprender* is an educational resource targeting children with learning difficulties. This case study was developed by taking into account the pupil's needs to customize the resource (see Figure 3). Also, a methodology for creating multimedia resources was defined and applied to the *Proyecto Aprender*. This project was developed for the Spanish Ministry of Education and Science. It involved developing an accessible online resource targeting children with special educational needs. It includes an alternative curriculum adapted to learners' needs.

This project involves developing an accessible website targeting teachers and the public (parents, families, researchers...) generally, and learners in particular. The whole process of design, preparation and construction was conceived to meet learners' special educational needs.

5. Conclusions

Educating people with SEN is a complex task even for experts and educators. Each pupil's education should be individualized depending on his or her characteristics and abilities. This would enable a more effective use of platforms and software tools built for educating people with SEN. Unfortunately, none of previous works connect the whole teaching process or share knowledge from one step to the next.

In this article we have identified the elements and relations that denote the educational needs of SEN pupils. The philosophy and ideas described here are based on previous research (Alonso et al., 1995), (Alonso et al., 2001) and have been applied to develop several projects aimed at educating people with SEN, *Proyecto Aprender* (Cantón et al., 2006) and its continuation *Internet in the Classroom* (Internet, 2007). As part of these projects we are creating a formal methodology for developing accessible applications that materialize the ideas defined in this paper. A model like this would give research institutions and groups a common framework covering all the elements and relations between them that are part of the context information for educating people with SEN.

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