# USING ICT TO DEVELOP UNIVERSALLY DESIGNED EDUCATIONAL MATERIALS FOR STUDENTS WITH DISABILITIES

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**Abstract**

The Institute of Educational Policy, seeking to realise inclusive policies and practices planned the project: "Design and Development of Universally Accessible Educational Material." Its objectives are the development of universally designed digital educational materials for nursery and primary school students with disabilities or special educational needs. The project focuses on developing new open source digital educational material and software for special education in Greece, adopting and using the popular platform OpenEdX of asynchronous e-learning that allows the organization of Massive Open Online Courses (MOOCs), aimed at distance learning and training of the teachers of general and special education

*Keywords:* ICT, Universal Design For Learning, accessibility, disabilities

**Introduction**

This paper intends to present a significant education project whose results are to be delivered to the educational community in Greece concerned with the design and development of digital educational material for teaching students with disabilities. In seeking to realise inclusive policies and practices, (UNESCO, 2006), the Institute of Educational Policy, has organized the following project: "Design and Development of Universal Accessible Educational Material," whose deployment is still in progress. The project objectives are the development of universally designed print and digital educational material for primary schools (nursery schools and from the third grade to the sixth grade of primary school) for all students with disability or special educational needs. Students of the Special Education School Units (SMEAE) and the Special Vocational Education and Training Workshops (EEEEK) of Secondary Education can also use this specific material. Through this material, students with disabilities can access the National Curriculum and maximize their participation in school. This way, equal rights to education for students with disabilities are ensured.

The project is a continuation of the action "Design and development of accessible educational and visual material for students with disabilities" (http://www.prosvasimo.gr/el/) where all school textbooks for the subjects of the first and second grade of primary school were adapted to become accessible to students with disabilities (Kourbetis, 2016). These materials concern the education of students with: (a) visual impairments (blind and amblyopic students, (b) hearing problems (deaf and hard of hearing students), (c) mobility problems, (d) intellectual disability, (e) autism spectrum disorder,

(f) special learning difficulties, and (g) problems of attention and concentration.

This particular project focuses on a) the development of new digital educational material, b) the recording of the existing educational material and software for special education and c) the creation and use of the asynchronous e-learning popular platform, OpenEdX.

The developing education materials can be also used by students with general educational difficulties or by students of the general school and will be developed in print and digital form. These education materials will be widely available to teachers, parents and students. All the material and information concerning the project and its progress are available on http://www.prosvasimo.gr.

Since this material will become a supportive tool for the education process, it is imperative that the publicity of the project should be a priority in order to keep teachers and everyone involved in the educational process informed.

## Theoretical Framework

The project design and development are based on the principles of Universal Design for Learning (UDL) and on the fact that ICT has become a major means for the education of students with disabilities. In parallel, the general and educational characteristics of students with all kinds of disabilities should be considered.

### Basic Principles of the Universal Design for Learning

*Universal design* means that all educational contexts (natural, social and educational) are designed in such a way that empower all learners, irrespective of specificity and identity, to become able to participate as much as they can in the education and learning process (Izzo & Bauer, 2015). The design presupposes and concerns overcoming obstacles inside the artificial environments (the resources infrastructure), the curriculum, the educational material and the teaching methods. UDL was created in order to allow students with disability to access the curriculum. Universal design is related to introducing into the teaching process inclusive elements during the stage of planning and not adapting already existing conditions. It draws on the following basic principles: (a) multiple ways of representation as there does not exist a single way for everyone to understand and interpret information, (b) multiple ways of expression as students react to learning stimuli differently, and (c) multiple ways of involvement as students are motivated or involved in learning in different ways. The term *universal* recognises the fact that every student is unique and so there is the need to include all specificities while designing the learning process by creating opportunities for participation (Rose & Meyer, 2002).

According to CAST (2011) the guidelines and principles of design that developing digital educational materials abide by, are:
- *In relation to the multiple means of representation:* (a) the provision of alternative choices in order to facilitate perception, such as the presentation of varied pieces of information (audio, visual information

concerning language, mathematical expressions and symbols, etc.), (b) the clarification of vocabulary, symbols, syntax and structure, and the support in order to decode texts, mathematical expressions and symbols, etc., and (c) the provision of alternative choices to assist comprehension, such as the activation-supply of a cognitive background, the highlight of patterns, important notions and relations, the guidance so as to process information, the visualization and handling, the maximization of transferring and the generalization of learning.

- *In relation to the provision of multiple means of action and expression:* (a) providing alternative choices for physical action, varied methods of responding and navigating in addition to maximizing access to tools and supportive technology, (b) the provision of alternative choices for expression and communication such as the use of multiple means of communication and tools in order to structure and compose learning, and the provision of graded support for practical training and performance, and (c) the provision of alternative choices to activate executive functions, such as guidance, support for the development of strategies and the handling of information and sources, and also the ability to monitor progress.

- *In relation to the provision of multiple means of involvement:* (a) the provision of alternative ways to attract attention, to develop opportunities for personal choices and autonomy, to eliminate threats and distractions, (b) the provision of alternative choices so as to assist student effort, such as the promotion of the importance of goals, the provision of multiple challenging sources, the strengthening of collaboration and feedback, and (c) the provision of alternative choices for self-regulation, such as the promotion of expectations and concepts that enhance encouragement, the facilitation of personal skills and strategies to deal with difficulties, the development of self-evaluation and reflection.

**The Contribution of ICT to the Education of Students with Disabilities**
The dynamic relationship between universal design and ICT comprises a powerful means towards inclusive education as technology supports accessibility and differentiation of context, materials and the educational environments (Smith & Throne, 2007; UNESCO, 2011). Within the context of new literacies (multimodality, multiliteracies), ICT present an alternative view of literacy, teaching and evaluation, and by being multimodal, they assist communication, the exchange of information in multiple ways, language development, knowledge, thinking, and the acquisition and enhancement of various skills. In addition, they encourage dialogue, reasoning, and the expression of questions, while also strongly promoting oral communication, social networking and collaboration. The use of ICT can enable increased student participation and motivation in different ways to create interest for children, who for various reasons do not participate in the traditional educational process. As long as the new technologies are critically handled under the guidance of teachers, especially in the case of very young children, these new kinds of literacies can allow the students to have many choices to broaden their cognitive horizon. Scientific studies render technology the role of *literacy server*. The contribution of ICT is multiple as it supports students, teachers and generally everyone involved in the educational process (Istenic

Starcic & Bagon, 2014; Passey, 2013**;** Smith & Throne, 2007; UNESCO, 2011). In the case of students with disabilities or special educational needs, the utilization of ICT can often be the only solution for them to access knowledge, information, the General Curriculum and the learning process (UNESCO, 2006). Despite the contribution of ICT in promoting inclusive education, its improper use may lead to a further widening of social inequalities and the creation of a 'gap', if not all students, without any discrimination, properly utilize ICT.

## Methodology

The project has followed the principles of universal design for learning not only for the initial design of educational material, such as the 5$^{th}$ grade Mathematics of Primary School, the Social History, etc., but also for adapting the existing educational material of general education, such as the textbooks.

A mixed-method approach has been employed because of the nature and magnitude of the project. It exploits elements of qualitative and quantitative methodology (Creswell, 2012). In addition, it utilizes elements of the emancipatory research as it involves disabled students in the development and evaluation of material (Barton, 2005). The content of the materials resulted from day-to-day educational actions after its pilot implementation in the classroom by its initiators. In order to choose the best material, expert teachers recommended samples of educational material where the best was chosen in accordance to measurable and objective evaluation criteria. Elements from the methodology of "Design and development of accessible educational material" (Kourbetis, 2016; Gelastopoulou & Kourbetis, 2014) are used, while at the same time additional new features are introduced according to the needs of the project, such as the revision of the specifications applied to the previous project, the exploitation of new methods and approaches for the development of the material (social histories, etc.). A specialist group of scientists-consultants was put together to provide scientific and pedagogical validation, while experience gained by the already existing and accessible educational material was employed to develop new resources. The specific software, and the digital educational material for all students will be compatible with the platform of the Digital School (The Greek online repository for educational materials & learning designs, http://dschool.edu.gr/p61cti/) and open for upgrading. What is also expected within the context of the project is the pilot implementation of the material, the provision of training for its use and its evaluation from expert consultants.

## Project Description

This particular project, comprising universally designed digital and print educational material, not only caters for the development of supportive technologies for the education of students with disabilities, but also for the training/education of the teachers and others involved in the educational and learning process. What follows is a brief description of the basic pathways of the project: (a) New universally designed educational material **and** (b) Adapted education material for the general school.

**New Universally Designed Educational Material**
These materials (adapted, digital textbooks, teachers' guides, resources for cognitive, emotional, social and life skills development) concern students with disabilities and special educational needs of the third and sixth grades of the primary School, and students of the EEEEK, while, for the first time, it provides the development of accessible material for the nursery school. A brief description of the materials follows. Depending on the disability involved, the materials will be developed in alternative, multimodal modes. Indicatively, the modes concerned are audio (performed by a human speaker), visual, tactile, braille code, simplified text, etc., a sample of which is illustrated in Figure 1.
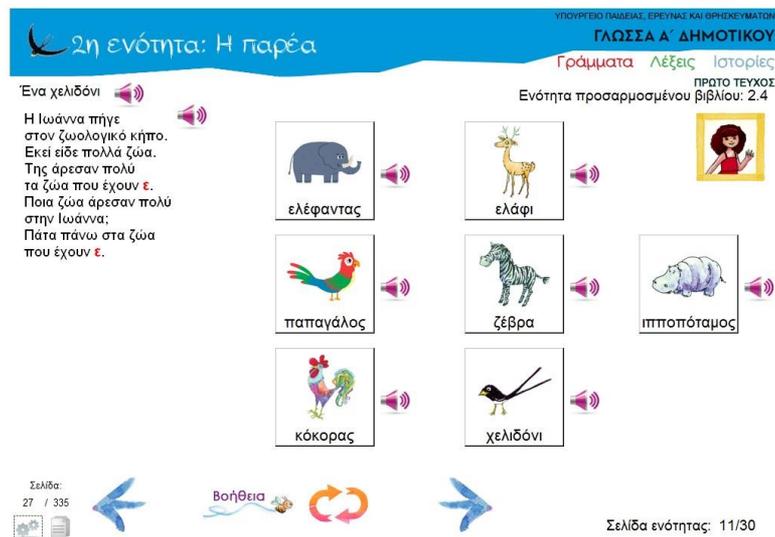


*Figure 1.* Multimodal sample (audio, visual and simplified text).

**Educational material aiming at sensitizing all stakeholders involved in matters related to the acceptance of disability and diversity and also for the development of inclusive culture in schools.** The stereotypical and deeply rooted views and prejudices that concern matters of accepting diversity and how disability is perceived, as well as the long established traditional teaching practices used by teachers together with the lack of appropriate training constitute a basic hindrance in the implementation of inclusion and the realization of the UN International Convention for the Rights of People with Disabilities (2007).

Overcoming prejudice, changing attitudes, sensitizing everyone involved in inclusive education towards a development of inclusive culture constitutes doubtlessly a vital necessity for the creation of "One" school for all students. The developing material (used inside the classrooms and everywhere else at school) will concern teachers, students, parents and society at large. The pursued objective will be reached through (a) fairy tales, stories or other literary texts concerning diversity and disability in the afore-mentioned modes, (b) the arts and experiential activities, and (c) music-mobility activities aimed at the sensitization and acceptance of diversity.

**Educational material for the development of social, emotional skills and skills related to everyday life and autonomous living in the form of social stories.** This material (to be developed in all the afore-mentioned modes) is related to personal and social development and the understanding of social conditions, and to the management of dangers and crises for the safety and health of students with disability. The social stories constitute a contemporary approach for the teaching of social attitudes in order to facilitate children to adopt the appropriate attitudes, behaviour, and social skills, and as such to manage social interaction and create relations with their peers or other people and so integrate in the social context (Gray, 2010).

**Illustrated conceptual dictionary for students with disability and comprehension problems for the teaching of core concepts and themes that are taught at the Nursery and Primary General School.** The development of educational material in the form of an illustrated conceptual dictionary, having an alternative and multimodal character supports the understanding of basic notions, the teaching of thematic units and the development of vocabulary, values, attitudes and knowledge of students with disability. It consists of a printed and digital material for personal and social development in the Sciences, ICT, Mathematics, the Environment, History, and Physical Education as well as in Language and the Arts. The content of the dictionary and its vocabulary, besides adopting an appropriate pedagogical structure, will be accompanied by images, sounds recorded by a native speaker, video animation corresponding to the theme and the relevant vocabulary when needed, video in the Greek sign language, a presentation with the use of large size letters and Braille.

**An educational guide for students with Autism Spectrum Disorder (ASD): Appropriate practices for their school inclusion.** It is a digital educational material, currently under development, that concerns appropriate practices (alternative modes of communication such as pictograms, images, sketches) for the education of students with ASD and case studies of primary school students with ASD. An early sample is illustrated below (Figure 2).
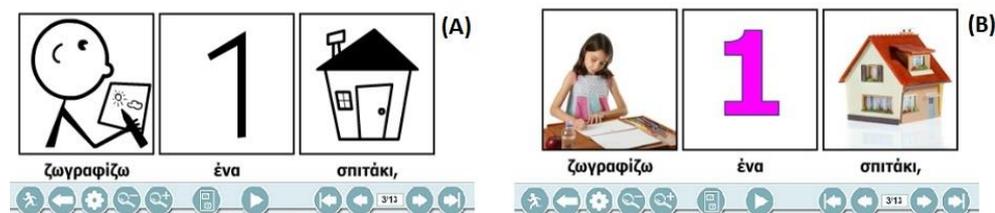


*Figure 2.* Alternative modes of communication (pictograms and images).

**Printed and digital material of educational interventions for students with Attention-Deficit/Hyperactivity Disorder (ADHD): Teacher's guide for ADHD students' school inclusion**. It concerns digital educational material (currently under development) that refers to suitable educational guidelines for students with attention and concentration deficit and to case studies of relevant primary school students.

**Accessible material for students with mobility problems.** It concerns multimodal applications of educational material in the afore-mentioned

modes. It includes various kinds of activities for the 3rd to the 6th grade of primary school, currently under development, such as self-care, emotions, traffic education, sequencing time, observation skills – concentration-attention focus, visual perception, cause – effect, social life and exploring the environment.

**Art educational material for primary school students with disability.** These include multimodal art activities and visual exercises, individual or group projects (currently under development) that can creatively link various educational sectors and concern all the visual and applied arts, such as painting, sculpture, etching, ceramics, plaster arts, animation, origami, etc. Students with disabilities will approach the curriculum aims and objectives through these arts.

**Universally designed digital education resources for Mathematics for the 5th grade primary school students of general and special education.** The book will be available in the following formats: plain text, rich text format, accessible mark-up-XML, DAISY, audio support, Braille-ready text, Braille raised text, large-print-ready, large-print books, tactile (raised) shapes, and videos with subtitles in the Greek Sign Language.

**Digital education materials for students with visual impairment.** The knowledge and use of the Braille code by visually impaired people is a decisive factor for the development of basic and functional literacy, which will allow them to acquire a comprehensive school education and have equal opportunities for participating in lifelong learning and education. It is an educational material concerning the curriculum of teaching blind students Braille reading and writing and exposing them to Mobility Education, Orientation and Daily Living Skills (see Figure 3).
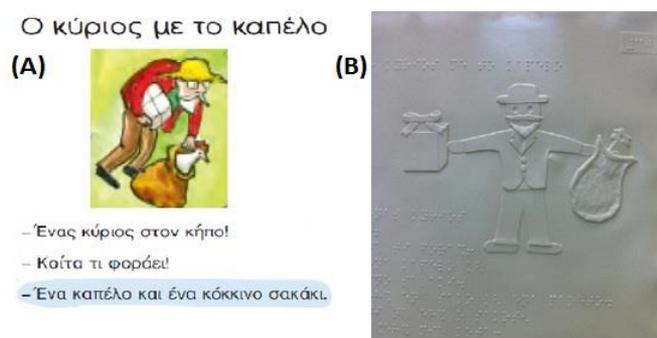
Ο κύριος με το καπέλο

(A)

– Ένας κύριος στον κήπο!
– Κοίτα τι φοράει!
– Ένα καπέλο και ένα κόκκινο σακάκι.

(B)

*Figure 3.* Initial text (A) and adapted in audio and Braille code (B).

**Material for the tactile sign communication for blind students with multiple disabilities and deaf-blindness.** This is the first time that tactile sign communication material has been under development in Greece. It is a dictionary of tactile sign language and an evaluative list of communicative vocabulary. The structure of the book includes: grouping concepts in units that will be printed in different volumes, depicting each notion with a tactile sketch and the meaning in tactile form, writing down every notion in both sighted people writing and Braille writing, and offering instructions of how to express every tactile meaning. At the same time, the total number of notions and

tactile concepts will be also available in electronic from (videos), while guidelines for the teachers and parents will be included.

**Digital education material for students of the 3rd and 4th primary school classes with hearing impairment for the teaching of the Greek Sign language as a first language.** It concerns the creation of multimedia eBooks for all school subjects in addition to digital and printed textbooks for the teaching of the Greek Sign language as a first language to the 3rd and 4th classes of primary school.

**Adapted General School Education Material for Students With Disabilities**

In this category the existing school textbooks will be adapted in order to be accessible to students with disabilities. More specifically the following will be developed.

*Accessible* digitalised and printed material (easy to read texts for all students) from the textbooks (3rd and 4th primary school) – enriched, adapted and modified (simple text structure, simple vocabulary, visualized text, avoiding abstract notions etc.) according to each case. The adaptations follow the principles of the method easy to read (ECIE, 2009) for the reading comprehension of students with intellectual disability or reading difficulties. This method is illustrated in Figure 4.



*Figure 4.* Simple text structure, simple vocabulary, visualized and audio text.

*Accessible* digitalised material for all subjects of the 3rd and 4th grades of the primary school with the use of the Greek Sign language. All the textbooks of these two classes will be adapted and delivered in the Greek Sign Language by sign language native speakers through video as shown in Figure 4.

*Accessible* audio material recorded in natural speech for all subjects for the 3rd and 4th grades of the primary school. This material will support the education of students with special and general learning difficulties and disabilities, and also students who according to their learning profile receive and understand information easier through auditory learning (Gardner, 1999).

**The open source platform of asynchronous e-learning OpenEdX.** The creation and use of the popular platform of asynchronous e-learning OpenEdX allows the organisation of massive open online courses (MOOCs) aiming at

developing distance learning and training for the general and special education teachers in order to assist them with their professional enhancement. Distance learning is defined as the education process where a substantial part of the learning process occurs from a distance, and as such it is quite flexible and happens in areas that are not traditionally connected with formal education. Therefore, it is an educational process that depends on education material that can be accessible anytime and anywhere. The project provides tuition through a MOOC course that offers video seminars, quizzes and regular assignments.

This platform has been written in Python with Django as the web application framework and it uses many tools of the latest technology such as Ansible, Vagrant in order to facilitate the development and its installation on a large number of machinery. OpenEdx was developed by the non-profit organisation edX, founded by the universities of MIT and Harvard, and it is the platform behind the popular service https://www.edx.org. The OpenEdX is an Open Source Software (OSS) and is available with a double license AGPL and Apache. Yet a platform with the technology, which covers the functionality need and aesthetic form of OpenEdX, sets by itself high demands of education quality from the course subjects it hosts.

## Conclusions

The contribution of ICT in defining inclusive practices and ensuring accessibility is indisputable. Taking for granted the rapid growth of technology, the school ought to create the necessary conditions that will allow every student to understand the role of new technologies, use them, exploit them as much as possible and have access to them. The use of the above-mentioned digitalised material creates opportunities to widen the use of information and communication technologies and familiarises students with them. Furthermore, it provides teachers with training activities on the suitable use of technology in the classroom and promotes accessibility and inclusive education.

The effectiveness and sustainability of the project is associated with the fact that it contributes to all stakeholders involved in the learning process of students with disabilities (students, parents, teachers and others), with its durability and with the possibility to upgrade it. Moreover, it has a major contribution to the realisation of the international convention of the UN for the rights of people with disabilities and to the promotion of the principles of inclusive education.

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