Abstract
The paper tackles the issue of the accessibility of educational software products as a means for fostering the full inclusion of all students in mainstream educational systems. Educational software tools offer a strong potential for avoiding any kind of discrimination among students but may also pose new “technological barriers”. School inclusion, on the contrary, necessarily requires the adoption of suitable and barrier-free educational tools. The paper presents a live DVD called “So.Di.Linux for All”, which has been designed and implemented following the basic principles of the “Design for all”. Such a DVD contains and provides full and immediate access to a collection of 140 Open Source software products for education, whose accessibility features are fully described. The DVD has been produced in the framework of a research project aimed at assessing the accessibility of educational applications and is now available online.

Keywords
E-Inclusion, Educational Software, Students with disabilities, Open Source Software [1],

1. INTRODUCTION
School inclusion is one of the big challenges of present times [1] [2]. ICT tools are worldwide considered as valuable means to foster inclusive practices in schools [3] but, in some cases, they may also pose relevant obstacles to students with special needs [4].

The paper focuses on Educational Software, which represents an important and very specific subset of the wide range of ICT tools presently used for educational purposes. It aims at suggesting a practical approach to Educational Software choice, thus helping teachers and educators to fully exploit the educational potential of software products, in an inclusive perspective.

Teachers have, in fact, a crucial role at these ends, their deep and convinced involvement is essential and the educational effectiveness of any inclusive educational intervention mainly depends on the choices they make [5]; nevertheless, the school inclusion process also entails the adoption of effective educational tools, which should be accessible and usable by all students, irrespective of their actual abilities/disabilities [6].

Highly customizable software products, designed and implemented following the basic principles of the “Design for all” [7] are the most suitable tools at these ends. Accessibility, Usability and Personalization (both of the pedagogical plans and of the tools at hand) are the emerging key ideas which have progressively contributed to put aside the well established practice of using different educational tools for responding to different educational needs.

In the following, the specific issue of the accessibility of Educational Software products is tackled by presenting the DVD “So.Di.Linux for All”, which has been produced in the framework of a research project aimed at assessing the accessibility of educational applications; the DVD, which has been designed and implemented following the basic principles of the “Design for all” [7], contains and gives full and immediate access to a collection of around 140 Open Source software products for education, whose accessibility features are also fully documented.

2. THE SO.DI.LINUX PROJECT: BRIEF HISTORY AND RELEVANT FEATURES
The So.Di.Linux (Software Didattico1 for Linux) research project started in 2003, under the auspices of the Italian Ministry of Education; it was a joint cooperation between ITD-CNR2 (the Institute for

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1 Software Didattico Italian for Educational Software; the acronym So Di sound also like “I am expert in …”
2 Public research institute http://www.itd.cnr.it (Retrieved on January the 1st 2008)
The research project aimed both at fostering the use of OS (Open Source) software and at responding to a number of research questions such as: "Does the availability of the code/source of the educational programs represent a significant added value for teachers? Is the quality of the existing Open Source educational programs comparable to that of the commercial ones? Is the panorama of existing educational Open Source products wide enough to respond to a reasonable number of different educational needs? What are the advantages/drawbacks of using Open Source products in the classroom?"

Before starting actual school experiences, thus trying to give an answer to the proposed questions, a number of significant technical problems had to be solved, mainly due to the very circumscribed availability of the Linux operating system in Italian schools (while the very great majority of the educational OS software is actually Linux based). Teachers, in addition, showed limited knowledge and capacity to use environments and platforms other than those they were accustomed to, and it was immediately evident that such an attitude could result in a true obstacle for the project development. The only possible choice was then to skirt the problems caused by the necessity for the teachers of becoming confident with the Linux operating system. This was done by creating a Live CD, that is a CD containing (together with the educational programs to be used during the school experiments) also the operating system which is executed on boot, without installation to the hard drive. Such a Live distribution doesn’t alter the operating system installed on the computer and doesn’t require any specific expertise by the users. Thanks to this live CD, the use of the Linux operating system is to be almost transparent for the teachers who can run the required software products very simply and very easily, only by paying attention to set the computer boot from CD (not from Hard Disk).

The first CD of the So.Di.Linux series was delivered in 2003. It was based on the Linux distribution Knoppix and contained about 40 different educational software programs, pertaining to different educational areas and devoted to different school levels. The promising results of the first school experience have suggested to go on with the project and to enlarge the number of educational products made available; two more CDs, then, followed, each including 40 different products, and, subsequently, a DVD was created comprising all the previous products (globally around 130).

The idea behind the development of the So.Di.Linux CDs and DVDs was, as said before, to provide teachers with a simple and effective tool to be used in schools for testing and assessing the quality and the usability of Open Source educational products. In this perspective, the CDs and DVDs also provide a simple and effective tool to be used in schools for testing and assessing the quality and the usability of Open Source educational products. In this perspective, the CDs and DVDs also provide a simple and effective tool to be used in schools for testing and assessing the quality and the usability of Open Source educational products.
contained a data base providing an extensive documentation of each educational software product made available: master data, educational features, technical requirements, screenshots, executive summary, additional material (Fig.1).

While carrying out a number of school experiments (which are not matters of discussion here) the issue of the actual accessibility of the educational software products included in the So.Di.Linux DVD and CDs, came to light. The teachers involved in the experiment expressed their need for specific information about the accessibility of the software products: this facility would lead them to make an appropriate and informed choice among the available software products, thus avoiding excluding students with disabilities from the computer – based classroom activities.


The subsequent step of the So.Di.Linux research project was, then, almost obliged: it was necessary to update the DVD in the light of the teachers' requests and in compliance with the new law in force. This led, from one side, to improve the DVD interface following the main principles of the "Design for all" and, from the other side, to increase the data base fields by introducing new elements describing and evaluating the actual accessibility features of the educational software products described/made available. The DVD So.Di.Linux for all was then created (fig.2)

![Fig.2](image)

*Fig.2. The three steps of the So.Di.Linux project: from CDs to DVD and to the DVD "for All"*

3. **THE DVD SO.DI.LINUX FOR ALL**

The So.Di.Linux for all DVD provides teachers with a comprehensive and easy to use collection of Open Source software products to be used in schools and /or for educational purposes but it should mainly be regarded as a means for fostering the school inclusion; it, in fact, provides teachers also with the necessary information about the products accessibility so to let them adopt and use only those software tools that really meet the educational needs of all students in the classroom.

3.1. **TECHNICAL FEATURES**

Since the ease of use was one of the main requirements indicated by the teachers involved in the experimental project, particular attention has been paid to the DVD's technical features both in order to meet their expectations and to comply with most of the computers actually present in Italian schools. As said before, “So.Di.Linux for all”, is a Live DVD based on the Ubuntu 7.04 distribution

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6 in order to offer ORCA suite’s facilities, it was required to change over from the Knoppix to the Ubuntu environment
(Feisty Fawn, DVD version), developed by Canonical Ltd, it can be run by booting directly from the DVD drive, nothing is automatically installed on the hard disk (if not explicitly required by the user). Once removed the DVD from the drive, the computer’s functions are not altered. It runs on computers with Microsoft operating systems but doesn’t work with Apple computers. All the educational software products available on the DVD are licensed on the basis of the GNU Public License, while the underpinning database is licensed according to the Creative Commons Attribution-NoDerivs 2.5 License. The DVD can be downloaded for free from the page: http://sodilinux.itd.cnr.it/index.php?option=com_weblinks&catid=13&Itemid=30

The system requirements are the following: CPU Intel compatible (Pentium 3 or faster); 512 Mbyte memory; DVD Drive standard for booting or, as a further choice, a floppy disk (for booting) and a standard DVD (IDE/ATAPI or SCSI); graphic card SVGA compatible; standard mouse, or PS/2, or USB IMPS/2-compatible.

3.2. CONTENTS

“So.Di.Linux for all” main contents are:

1. The Orca suite, which is designed to work with applications and toolkits that support the assistive technology service provider interface (AT-SPI). This includes the GNOME desktop and its applications, Open Office, Firefox, and the Java platform; the Orca suite, provides a number of “assistive technologies” such as screen reader, magnifier etc…

2. The Open Office 2.2.0 suite of programs. Such programs are widely used in education and work also in conjunction with the assistive technologies mentioned above.

3. 137 software products for Education; the available educational software programs pertain to the great majority of educational subject areas and to the various school levels as detailed in Fig.3.

![Software products by subject](figure1)

![Software products / School Levels](figure2)

Fig.3. Educational contents of the DVD by subject area and school level

In addition to the formerly mentioned programs, the DVD “So.Di.Linux for all” also includes a number of standard applications such as the Internet browser, Instant Messaging and VOIP tools, a number of standard games together with multimedia and other graphic standard production tools.

3.3. ACCESSIBILITY FEATURES

The 2007 Version of the So.Di.Linux DVD has been given the name “for all” because of the authors’ intention of producing a tool aimed at meeting the needs of the widest possible variety of end users [12], thus avoiding the exclusion of those with disabilities/special needs.

The database interface has been designed and implemented following the basic principles of Universal Access to ICT tools [13]: it offers, in fact, some major functions aimed at widening accessibility such as the full keyboard access and the possibility of a number of alternative visualizations (fig. 4), including an entirely non-graphic, textual version.

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In this perspective, it should be also noted that the DVD provides full and immediate access to some of the most effective assistive technologies presently available for the Linux environment, namely the screen reader, the magnifier and the Braille compatibility tools contained in the ORCA suite; in order to offer this facility it was required to change over from the Knoppix to the Ubuntu environment.

The most innovative aspect of the So.Di.Linux for all DVD is that it provides detailed information about the accessibility features of the educational software available (the arrow in fig. 4 shows the actual link to the accessibility page, in the database) the accessibility evaluation is performed through a standard accessibility test based on an ad hoc created evaluation grid [14, 15].

As shown in fig. 5, the accessibility test, carried out on the basis of the law 4/2004 which actually is the Italian law in force, takes into account two different but complementary aspects:

a) The overall compliance of the product with the requirements of the law in force.

b) The actual accessibility by students with different types of disabilities.

The results of the accessibility test of the educational product Atomix, shown above, are presented in Fig. 5. At the top of the screen it is shown that such a product is compliant with the Italian law in force as to almost all the requirements (only two of them, namely requirement n° 3 and n° 5, are not fulfilled).

The bottom part of Fig.5 shows the outcomes of the evaluation process with reference to the different types of disability. Further information is, there, supplied about the specific kind of disability that may encounter problems in accessing and using the product at hand (conversely, also the eventual full or partial accessibility for other categories of disabled students is underlined).
Assessing and documenting the compliance of each product with the regulation in force is, in fact, important but it appears not to be enough to give an effective answer to all the teachers/potential users. Typically teachers require, in fact, an answer to the basic question: “Is this product accessible for deaf (or blind, or dyslexic, or even…) students?” To answer such questions, the correspondence between the law requirements and each specific type of disability has been also investigated. The idea behind this kind of further analysis is that, even if a product is not fully compliant with the law, it can well be considered fully accessible for some specific categories of disabled students. The product given as an example is fully accessible for deaf and motor disabled students, while it may cause problems to those who are blind or with low vision (the reasons why this happens can be found by exploring the evaluation grid and especially by paying attention to which requirements are not fulfilled). Details of the evaluation outcomes can be viewed by accessing the evaluation grid (Fig. 6).

![Evaluation Grid](Fig. 6. Details of the accessibility test of the software Atomix: upper part of the evaluation grid)

### 3.4. THE PRODUCTS AND THEIR ACCESSIBILITY

As it has been shown above, “So.Di.Linux for all” is aimed at spreading knowledge on accessibility issues and it is oriented to provide extensive documentation about the crucial aspects related to the accessibility of the educational products. This, unfortunately, doesn’t mean that the products the DVD makes available are fully accessible, it only means that teachers can rely on a number of products whose accessibility features have been studied and are extensively documented. The following graph (Fig.7) is meant to provide a comprehensive view of the accessibility level of the educational products contained in “So.Di.Linux for all”. As it is evident, only 4 products meet all the 11 law requirements, the great majority (93) meets 6 requirements: this entails that the way on towards full accessibility has been traced but also that much is still to be done in this field (specific comparisons with other commercial non Open Source educational programs have shown a similar, or even worst, situation).
4. CONCLUSIONS

The “So.Di.Linux for all” has been primarily conceived as a tool for teachers. The embedded database, along with the available documentation on software programs, has been designed and realized by having in mind teachers’ needs and their specific requests: it is meant to foster the pedagogical planning of inclusive classroom activities.

Nevertheless students are, actually, the real end users of the educational software programs made available by the DVD. The fact that the DVD can be distributed for free, that it is easily downloadable from the net and, last but not least, the fact that it can be used on most computers, being independent from the Operating System at hand, offers a significant added value for students: it can in fact be used both at school and at home for exercise and/or in-depth studies.

On the basis of the present DVD “So.Di.Linux for all” further editions of the So.Di.Linux collection are in preparation, aimed at fulfilling the needs of students with specific disabilities (namely: visual, auditory, motor, or learning disabilities).

On the basis of the accessibility evaluations made for the “So.Di.Linux for all”, a first selection of the products that meet the needs of specific categories of disabled students will be performed. The selected products will then undergo a further selection through a sort of specific assessment based on the actual use of the products by students with a single specific kind of disability. In the new DVDs, each entitled to one single specific disability, the results of such a field testing will be added to the accessibility evaluation section, thus providing teachers/educators with the possibility of gaining a deeper insight into the actual accessibility/usability problems or advantages posed by each specific product, also grasping the difference among the single products with respect to different types of disability.

Nevertheless, “So.Di.Linux for all” can also be regarded as an useful tool for software developers. As it is well known, Open Source Software products are constantly “in progress”, at any time they can be modified and improved to better suit the intended final users’ needs.

Very frequently a “community of developers” arises around a product, and, generally, it is very “open” to external contributions and keen on accepting ideas for improving the product. Improving Open Source educational products from the point of view of their accessibility appears to be an important step forward (especially if we look at the accessibility evaluation results shown in fig.7).

An important side effect of the work done in the framework of the production of “So.Di.Linux for all” can, then, be considered that of providing the Open Source developers community with new indications/stimuli for modifying the products in the direction of a wider accessibility.

Fig 7. Accessibility of the 137 products available in the So.Di.Linux for all
References


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