Accessible School Textbooks for Students with Hearing Impairments

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Abstract. How can ICT (Information Communication Technologies) help in facilitating comprehension of school textbooks for students with hearing impairments?

Text comprehension is a very difficult task for students with deafness. Hearing impairments may hinder or impede (depending on the severity of hearing loss) the reception of acoustic signals, even of their own native language. Accessibility to available textbooks does not guarantee understandable texts: if this is the case, the obstacle occurs at the time the child with deafness learns to read. Instead, even if all children with deafness learn to read and write, many of them do not understand what they are reading and text comprehension often remains an unattainable goal. According to the Universal Design for Learning approach, learning is impossible if the information is not perceptible or difficult to comprehend for the student. In order to reduce learning barriers, it is important to assure that key information is equally perceivable for all students.

This research study has analyzed, through 177 support teachers, some textbooks and has defined the main obstacles in comprehension.

The barriers have been divided into three aspects: graphic, linguistic and cognitive. An analysis carried out on each obstacle resulting from the study, has led to a classification of each aspect in favor of improving the comprehension of available texts.

The study has shown that the adaptation of texts through the use of the most common word processor software, may already result in a simple solution to remove the most common obstacles.

Keywords: Accessibility · Reading comprehension · Student with deafness · Information communication technology

1 Theoretical Framework

In Italy, as in in other European countries, the attention paid by public institutions and the community at large towards students with disabilities has steadily grown in recent decades, which has resulted in a significant improvement in terms of health conditions, independent living and social integration. Policies centred on institutionalization and

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welfare have been gradually eliminated, to be replaced by initiating and promoting policies of participation and social inclusion, equal opportunities and good practice, thanks to which a progressive empowerment of institutions, associations and the private social sector has developed. The focus on inclusion has allowed for a widening of the perspective, shifting the focus from needs to desires, from assistance to care, and from rehabilitation to building a genuine life project, in a dance of mutual recognition and continuous reciprocal existential arrangements. "All citizens have the right, founded on justice, to enjoy all their capabilities, up to an appropriate threshold level: if people fall under this threshold in any capacity, fundamental justice becomes less effective, and how well they are able to exercise their other capacities is of no importance" [1]. It should be added that the Convention on the Rights of Persons with Disabilities (December 2006) emphasizes in the Preliminary article (e) that "disability is an evolving concept, and disability results from the interaction between persons with impairments and the attitudinal and environmental barriers that hinder their full and effective participation in society on an equal basis with others".

By 2050 nearly 2.5 billion people are projected to have some degree of hearing loss and at least 700 million will require hearing rehabilitation. Over 1 billion young adults are at risk of permanent, avoidable hearing loss due to unsafe listening practices. An annual additional investment of less than US$ 1.40 per person is needed to scale up ear and hearing care services globally. Over a 10-year period, this promises a return of nearly US$ 16 for every US dollar invested.

Over 5% of the world's population – or 430 million people – require rehabilitation to address their 'disabling' hearing loss (432 million adults and 34 million children). It is estimated that by 2050 over 700 million people – or one in every ten people – will have disabling hearing loss.

'Disabling' hearing loss refers to hearing loss greater than 35 decibels (dB) in the better hearing ear. Nearly 80% of people with disabling hearing loss live in low- and middle-income countries. The prevalence of hearing loss increases with age, among those older than 60 years, over 25% are affected by disabling hearing loss.

A person who is not able to hear as well as someone with normal hearing – hearing thresholds of 20 dB or better in both ears – is said to have hearing loss. Hearing loss may be mild, moderate, severe, or profound. It can affect one ear or both ears, and leads to difficulty in hearing conversational speech or loud sounds.

'Hard of hearing' refers to people with hearing loss ranging from mild to severe. People who are hard of hearing usually communicate through spoken language and can benefit from hearing aids, cochlear implants, and other assistive devices as well as captioning.

'Deaf' people mostly have profound hearing loss, which implies very little or no hearing. They often use sign language for communication [2].

In recent years, experimental research on deafness, developed in Italy and abroad, on effective and inclusive teaching practices for students with deafness, has been enriched by contributions from other know-hows such as ICT (Information and Communication Technologies), linguistics and glottodidactics. The Italian school system has welcomed an increasing number of pupils with disabilities. 2.3% of the total number of pupils with disabilities attending state and non-state schools, of all orders and grades, have a hearing

disability [3]. Independent of the choice of the oralist and/or bilingual method, research evidence within the framework of reading comprehension for people with deafness [4] indicates the need to treat the language of the country, in which you live, as a second language. The indications given to teachers suggests using the principles of glottodidactics. The support that ICT can give in this area is significant, not only to promote communication [5, 6] but also in the field of learning [7, 8, 9]. The latest data published by the European Agency for Special Needs and Inclusive Education [10] shows that the degree of inclusion of pupils with disabilities differs from country to country. With regard to the "inclusive system" Italy stands out with a low percentage of pupils with disabilities enrolled in special schools, the majority of students with disabilities attend the public-school system. The contribution provides an example of how it is possible to promote school integration of students with hearing disabilities by adapting school textbooks.

2 Research: Methodological Design and Results

The contribution proposes a review of the main obstacles faced by students with deafness with reading comprehension and the possible facilities that can be proposed, to adapt the school textbooks, through the help of ICT.

177 primary and secondary school teachers who attend the specialization course for support activities for students with disabilities at the University of Perugia (2017/2018), were involved in an analysis activity of the school textbook, intended as the main tool employed in daily educational activities, through the use of a pre-structured grid [11].

The grids have been compiled by teachers to analyse different textbooks and cover three aspects: graphic, linguistic and cognitive.

The teachers have compiled the grids by inserting, for each aspect, the elements of potential obstacle for the learning of students with deafness and possible facilities.

The grids were compiled in small groups of two or three teachers (to encourage comparison and discussion between them). The analysis of the collected data is qualitative and was carried out with the Nvivo software, first categorizing the answers in the three aspects and then calculating the frequency of the words used for each aspect. The criteria used for calculating the most frequent words are: minimum word length of 4 letters, exclusion of prepositions, verbs and adverbs, grouping by synonyms, and searching for the 50 most frequent words. The results identified the 10 most frequent words for each aspect.

Table 1. The ten barriers to reading comprehension in textbooks, for graphic aspects.

Graphical aspects	
Word	Weighted Percentage (%)
Images	4,39
Font	2,85
Text	2,26
Line spacing	1,89
Words	1,66
Graphic elements	1,31
Pages	1,31
Keywords	1,19
Dimension	0,83
Bold	0,71

As far as the graphic aspect (Table 1) is concerned, the use of images (4.39) and graphics (1.31) is often inappropriate, as is the graphic setting of text (2.26) and page (1.31). Even the font (2.85) does not always promote readability and there is a barrier in the failure to find keywords, (1.19) highlighted in bold.

Table 2. The ten barriers to reading comprehension in textbooks for linguistic aspects.

Linguistics aspects	
Word	Weighted Percentage (%)
Vocabulary	4,00
Glossary	3,70
Syntax	3,09
Text	2,06
Simplification	1,95
Shortness	1,60
Comprehension	1,15
Paragraphs	1,14
Subordinate sentences	0,91
Sub-paragraphs	0,34

Regarding the language aspects (Table 2), the vocabulary (4.00) is often difficult and without glossary support (3.70). Syntax (3.09) are also often complex and with too many subordinate sentences, (0.91) thus limiting understanding (1.15). Paragraphs (1,

14) are often too long and there are few sub-paragraphs (0.34). Simplification (1.95) and a reduction in text length (1.60) would be needed.

Table 3. The ten barriers to reading comprehension in textbooks for graphic cognitive aspects.

Cognitive aspects	
Word	Weighted Percentage (%)
Metacognition	3,36
Questions	3,02
Concept Maps	2,01
Information	1,34
Self-evaluation	1,01
Promote understanding	1,00
Reflection	1,01
Synthesis	1,01
Exercises	0,67
Inferences Control	0,50

Cognitive operations (Table 3) defect to activities that stimulate metacognition (3.36): questions (3.02), exercises (0.67) for reflection (1.01) and self-evaluation (1.01). More conceptual maps (2.01) and synthesis (1.01) would be needed.

3 Discussion and Operational Proposals

Although digital technologies specifically created for people with deafness impairments are not referred to in literature, this experience shows that ICT can help teachers adapt or build tools that not only provide access to information for students with hearing impairments, but also remove barriers to understanding texts within a classroom.

Even though the use of ICT is seen as an emerging opportunity for deaf students and their families [6], it is essential that the same barriers are not replicated in digital material, as already present in textbooks. The technology offers the possibility of customizing text from a graphic point of view (font, bold, line spacing), calculating the readability of a text (readability statistics), facilitating linguistic access and creating quizzes, interactive tests or conceptual maps.

Today, the most common word processor software is sufficient to not only adapt the graphic aspects of the text, but also to calculate the readability indexes in the accessibility settings and insert graphic elements. This type of software, grants the users the possibility to create their own formatting templates, allowing them to define a file in which the title, heading, paragraph, and other element designs differ from the standard templates.

Among its features, this software includes a built-in spell checker, a thesaurus, a dictionary and utilities for manipulating and editing text (see Fig. 1).

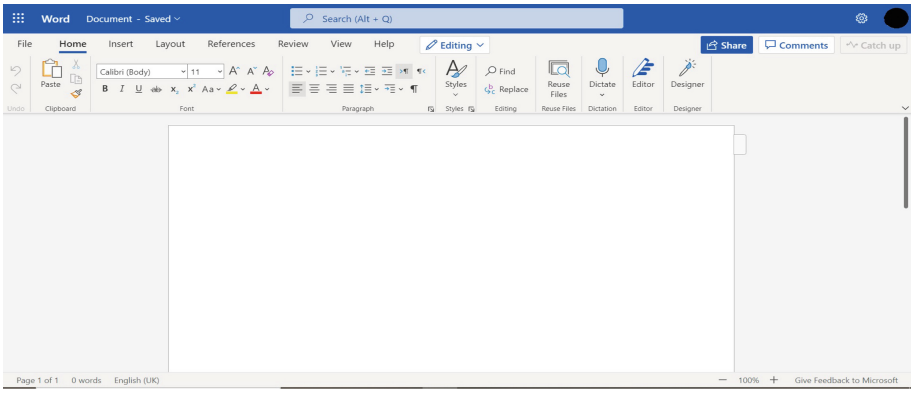

Fig. 1. Example about utilities for manipulating and editing text in Microsoft Word software.

Additionally, you can run the Accessibility Checker to make sure the content of your document is easy for all users to read and edit (see Fig. 2). This option identifies most of the accessibility problems and explains why each of them could be a potential problem for users with disabilities. It also offers tips on how to solve each problem.

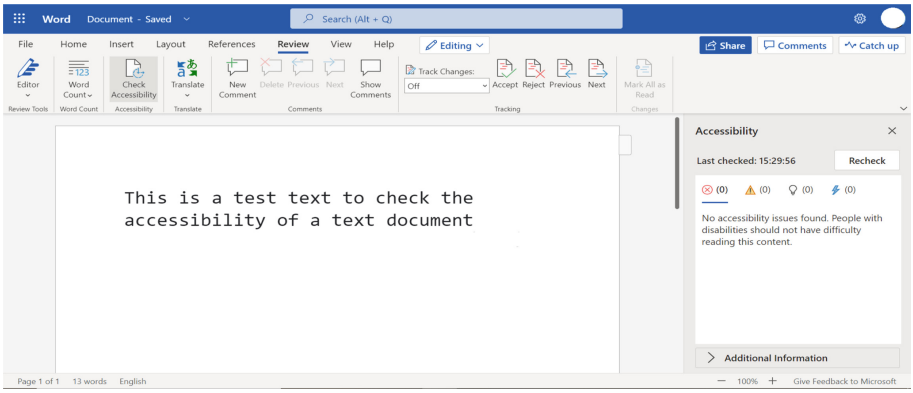

Fig. 2. Example about utilities for identifies the accessibility problems in a Microsoft Word document.

Finally, images, graphics and diagrams can be inserted in a document (see Fig. 3).

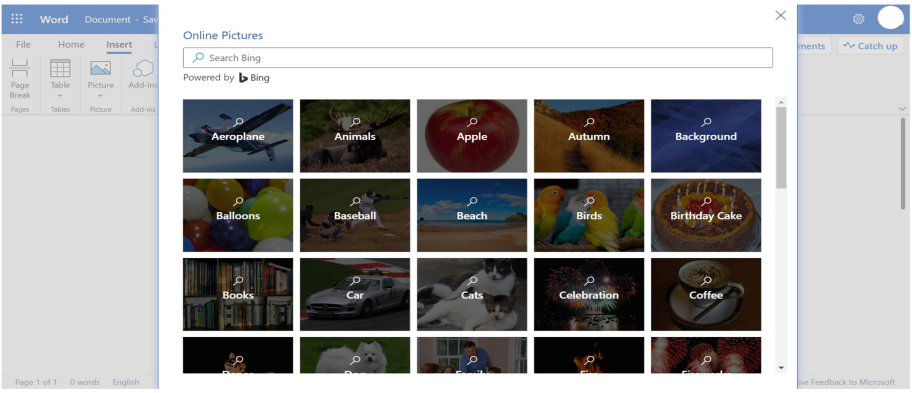

Fig. 3. Example about utilities for insert imagines in a Microsoft Word document.

This is the simplest example, just one of the opportunities that technology has to offer for adapting a text to facilitate its understanding.

The research study was carried out during the 2018–2019 school year, when didactic activities were primarily carried out in-classroom with the use of traditional textbooks. The Covid 19 pandemic and its subsequent school closures forced the adoption of new educational methods. On one hand, such methods have brought about a considerable use of new technologies, with more family participation on the other.

Therefore, many didactic guidelines in favour of learning for students with deafness [12–15] had to be transformed in order to guarantee online participation. The need for educational reform, throughout this pandemic, has undoubtedly led to contemplation on both in-class learning and online learning. In truth, online education has only drawn attention to the limits of traditional education, which is more oriented towards conveying information than facilitating the learning process. Thus, forcing us to rethink teaching, in a way that is more centred around the students and their involvement [16, 17].

Despite the guidelines set by the Italian Ministry of Public Education regarding inclusion and accessibility of content [18], students with Special Educational Needs (SEN) demonstrated the most difficulties during online learning. The scientific study carried out during this period [19, 20] has shown the main obstacles faced by SEN students represented by: technical family difficulties (37,7%), insufficient teacher training (28,3%), inadequate school organization (26,4%), lack of family support (18,9%) and teachers with technical difficulties (9,4%). Further studies [16] performed on elementary school teachers and online teaching management [21] have shown that all teachers used digital technologies during the pandemic period, regardless of the fact that (89%) of them had never used them before, thus further showcasing the strong lack of technological tools in the Italian school system [22, 23].

In conclusion, the importance of digital material is a transversal element that closely impacts many of the aspects mentioned above.

In fact, in view of further studies we are impelled to further elaborate on such topics, taking into consideration the creation of adapted material as a key competence for teachers, so to offer accessible content not only in class, but online as well.

4 Conclusion

In order to define itself as inclusive, school should be able to accept diversity and differences of each one, regardless of the presence or not of students with deficit and set accessibility and participation of all [24] as priority goals.

Research has shown that in most cases deaf students have difficulties in school results because they are placed in an inadequate communicative context and in a learning environment, that does not know how to implement strategies individualization and personalization. Future research perspectives could concern other types of disabilities and other available resources.

The didactic proposal, despite of numerous research evidences [25], often remains anchored to a traditional way of promoting learning, which does not take into account the different cognitive styles, interests, modulation of the curriculars proposals. Differentiating the teaching offer could then become necessary to allow each subject to have equal access to education.

"Differentiation is not a set of strategy, but rather a way of thinking about teaching and learning" [26]: the challenge is to help teachers build a methodology capable of providing differentiated learning opportunities.

The Universal Design for Learning (UDL) approach is now part of this framework, which aims to identify a set of principles that allow the construction of a curriculum able to ensure equal learning opportunities and at the same time allow all students to experiment themselves as competent actors.

In fact, the UDL [27] provides a model for the creation of objectives, methods, materials and assessment tools that take shape according to the needs and capabilities of targeted subjects. It overcomes the question of the retrospective accessibility of learning-teaching processes for certain categories of pupils, highlighting how every teaching that provides "a single level" raise, even if involuntarily, the barriers of learning for all.

The approach brings together some recent research in the neuroscientific and psychopedagogical field that for some time now, from a constructivist point of view, support the centrality of the recognition of subjective variability in learning.

Starting from these studies, UDL identifies the interconnected brain networks that take action in learning: the recognition network, the strategic network and the emotional network.

The principles developed by CAST derive from these networks to provide:

- multiple means of representation, options for perception, language, symbols and understanding;
- multiple means of action and expression linked to physical action, expressive skills, fluidity and executive functions;
- multiple means of involvement to arouse interest, to activate a sustainable effort and perseverance, to promote self-regulation.

UDL combines a systemic and constructivist conception of the teaching-learning relationship where success or failure do not depend only on the personal characteristics, commitment and deepening of the student, but also in a self-critical way from the didactic

proposal of work, to the relationship and the context within which the knowledge have been shared.

The Scaffolded Knowledge Integration approach [28] within this framework highlighted the importance of making knowledge accessible, also through different technologies but, at the same time, helping students to be aware of their thinking, to grasp the connections between ideas, to listen and learn from peers collaboratively, promoting forms of autonomous and lifelong learning.

This differentiated approach could certainly encourage the learning of deaf students and improve the quality of the educational proposal for all in inclusive terms.

Italian schools chose inclusive education at the end of the 1970s. All children attend the same educational spaces with the aim of reducing cultural, social and relational disadvantages, respecting and welcoming diversity in all its forms. Even so, staying in the same space is no guarantee of education: individualised and personalised interventions are needed to allow everyone to grow and develop their potential, regardless of certifications. Moreover, it is essential to build integrated projects between specific interventions and the ordinary proposal, between the activities of children with SEN and all the others.

The school today must assume a new responsibility in terms of recognition and action. "Responsibility is the ability to respond to various situations in life, without wasting energy blaming yourself, or blaming others for any mistakes made. It is important to be heard. Listen to what is said, the words you use, your own language. You cannot only be profoundly responsible for following a strict and constant commitment; there is also a need for genuine relaxation, a reconciliation with life. We need to be at peace with our own destiny. The most profound responsibility is not to 'be who you want to be', but to 'accept what you are'" [29].

The challenge of inclusive school is to promote opportunities for bricolage at multiple levels, which can be understood as the ability to harness the potential at the personal and contextual levels, involving the vulnerability of every individual and the system, and the agency role exercised by the individual and the community, in an inclusive system that the participants built together, beginning with the recognition of the dignity of every life project. And as part of this continuous construction, each individual "does not know exactly what will be produced, but still gathers everything that they find around them… Making do with scraps. Most of the time they are the outcome of a series of contingent events, the result of all the opportunities that present themselves to enrich their collection of odds and ends" [30].

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