Advances in Intelligent Systems and Computing 954

Giuseppe Di Bucchianico *Editor*

Advances in Design for Inclusion

Proceedings of the AHFE 2019 International Conference on Design for Inclusion and the AHFE 2019 International Conference on Human Factors for Apparel and Textile Engineering, July 24–28, 2019, Washington D.C., USA

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Advances in Human Factors and Ergonomics 2019

AHFE 2019 Series Editors

Tareq Ahram, Florida, USA
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10th International Conference on Applied Human Factors and Ergonomics and the Affiliated Conferences

Proceedings of the AHFE 2019 International Conference on Design for Inclusion and the AHFE 2019 International Conference on Human Factors for Apparel and Textile Engineering, held on July 24–28, 2019, in Washington D.C., USA

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Preface

This book has two underlying messages, the emerging importance of the social issue of inclusion and human diversity in contemporary society and the increasing awareness that there is no such thing as a 'standard human being.' The first question has to do with inequality and social disparity as a necessary milestone toward economic revival, among other things, while a vital role in the strategies adopted by the European Union's Horizon2020 framework program is played by the ones that focus on strengthening equality, participation, and accessibility for all to goods, services and what Dahrendorf called 'life chances.' What this means is that the issue of social inclusion of diversity and for equality is firmly on political agendas all over the world, not least because of increasing awareness that new visions, new strategies, new tools and new approaches are needed, if we are to tackle the challenges arising from recent phenomena of economic and cultural globalization, demographic change; economic migration from poorer countries and an ageing population in wealthier countries, a phenomena that are destined to upset the entire planet's micro and macro-economic and social structures in years to come.

The second issue tackled in this book is more technical in nature, since the paradigm change from 'designing for standards' and 'inclusive products and service design' to the enlightened awareness that there are no such concepts to fit the standard human being, this has immediate, direct repercussions on the specialized dimension of designing. The realization is at last taking hold not only that those individuals are physically, psychologically and culturally 'diverse,' but they also have widely diversified skills, abilities, aspirations, and desires that make each one of us unique and not at all replicable. Since the diversity of individuals is the rule, not the exception, it makes sense to consider it as a resource, not as a limiting factor or a restriction on design, while equality between individuals, communities and peoples should be treated as fundamental strategic inputs to the sustainable development of contemporary society, where everybody should have the same opportunities to experience places, products and services. Numerous design approaches have been adopted to facilitate social and cultural inclusion in recent decades: Design for Disability, Universal Design, Inclusive Design, and Design for All. All of these philosophies, approaches, and methodologies aim to build value on

all aspects of human diversity, from psychophysical to cultural issues, and to offer equal opportunity to everyone in order to experience places, products, services and systems. With this in mind, this book sets out to forge a climate conducive to discussion and comparison between these approaches, without any prejudice in favor or against any one of them, but attempting to identify the elements they hold in common and to build each one's heritage of originality, because we are convinced that the true resource of Design for Inclusion may well be found in this very diversity of opinions.

In particular, this book describes the state of the art of recent research conducted in a variety of fields that share the focus on Design for Inclusion and was presented in the fourth international conference on Design for Inclusion (AHFE 2019, Washington D.C.). On this occasion, the numerous research papers presented were collected together into two different thematic areas, articulated in six sections of this book:

Part 1 Design for Inclusion
Section 1 Designing for Inclusion in Learning Experiences
Section 2 Industrial Design for Inclusion
Section 3 Designing for Inclusion in the Information Society
Section 4 Public Spaces, Building Environment and Communities
Section 5 Global Perspectives on People-Centered Design and Cultural Heritage

Part 2 Human Factors for Apparel and Textile Engineering
Section 6 Design for Inclusion for Apparel and Textile Design

Special thanks to Gianni Montagna and Cristina Carvalho from the Lisbon School of Architecture, CIAUD for their valuable contribution and for co-chairing the conference track on Human Factors for Apparel and Textile Engineering.

Each section contains research paper that has been reviewed by members of the International Editorial Board. Our sincere thanks and appreciation to the board members as listed below:

Design for Inclusion

Human Factors for Apparel and Textile Engineering

July 2019 Giuseppe Di Bucchianico

Contents

Designing of Inclusive Learning Experiences: Preliminary Outcomes of a Pilot Project Tailored to SLD

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Abstract. Thanks to the knowledge related to Ergonomics in Design and Inclusive Design, the present work aims at finding and providing an opened and integrated approach to the disciplines of cognitive psychology, pedagogy and human-computer interaction by presenting field experiments on learning and case studies. The latter show novel co-design practices through the use of Human-Centered Design and Inclusive Design methods, which were pointed out by means of experiments conducted in collaboration with professionals, end users and people with Specific Learning Disabilities. Through the presentation of a pilot project dedicated to the SLDs, the final output of the work was to illustrate a developed inclusive learning platform and its operating rules. Moreover, the research highlighted the need for systems based on social networking, supporting not only accessibility but also autonomy, socialization and the ability to collectively build new meanings.

Keywords: Inclusive Design · Human Centered design · ICT · Social inclusion · Web accessibility · Learning

1 Introduction

Learning in the digital age means having user-friendly and interactive systems capable of creating a series of new relationships between man and technology. In this regard, the Design is called to face, more and more strongly, with different disciplines, from the engineering-informatics to the humanistic-social ones. Therefore, it is necessary to adopt a bottom-up multidisciplinary approach, within which the design field interfaces with increasingly complex design dimensions. In recent years, computer accessibility and aspects regarding the use, distribution and visualization of contents, not only informative but also educational, became issues of great importance within the technology market, particularly within the Educational Technologies sector.

The survey of the Italian National Institute of Statistics (ISTAT), dating back to 2004–2005, reported a percentage of people with disabilities for an absolute value of about 2,600,000 individuals. The latest unofficial estimates have raised this figure to three million. In 2009–10 there were 15,884 students with disabilities enrolled in the University, a figure that has now tripled compared to ten years before. With regard to

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Specific Learning Disabilities (SLDs), the statistical service of the Ministry of Education, University and Research (MIUR) provides relevant data for the 2014/2015 and 2015/2016 academic years. These data are organized by Region and school system according to the various levels, defined as pre-primary (3 to 5/6 years), primary (usually from 6 years to 11), middle school (age 11–14) and high school (from 14 to 19 years of age). In Italy, the statistical data for the academic year 2014/2015 state an average percentage of students with SLD of 2.1%. Excluding from the calculation the SLD diagnoses attributed to pre-primary school and its population, the percentage is 2.5%. The highest SLD values seem to be recorded in the middle school years. Comparing these results with those of the academic year 2015/2016, which has a predominant value of SLD certifications of 3.0%, an absolute increase of 0.5% emerges compared to the value recorded the previous year [1]. These alarming data are growing both in Italy and internationally. To face with this issue, within the framework of Educational Technologies, assistive and adaptive systems, including a broad range of technological devices (hardware, furniture, computer screens, software and so on), are usually employed to enable anyone to interact with more easily and effectively, regardless of any impairment or disabilities. Similarly, Learning Management System (blended Learning, E-learning, ecc.), born as electronic educational technologies, are largely used nowadays as networking environments to promote the integration and guide learning through flexible architectures based on current standards of web accessibility, platforms and content format [2]. However, it is noteworthy that the main limitation of these systems is ascribed to accessibility. This causes social exclusion, as it makes more difficult the access to information of people with different types of impairments. Despite the significant efforts, the accessibility of e-learning and web platforms and the use of assistive technologies are issues not entirely addressed yet. With this in mind, the present work studies how Design and related operational methodologies may support the process of analysis and development of complex digital products, which should be as much as possible inclusive. In particular, the preliminary outcomes of a pilot project tailored to SLDs, carried out in collaboration with experts and the C.R.E.D. center are presented. The main objective of the research was to design and develop a platform for inclusive learning dedicated to students over 11 years old. Summarizing, the work is therefore finalized to:

- assess the actual inclusive potential of technologies, in particular by analyzing systems designed for SLDs;
- technical aspects related to accessibility and use of contents;
- interaction styles (variability, transcoding, convergence, multimedia, hypertext);
- teaching and pedagogical aspects (organization, creation and sharing of teaching materials);
- didactic and pedagogical aspects for disables (universal access to information, organization of the study, didactic strategies, motivation);
- how to motivate and foster socialization (i.e. User Experience);
- design alternative scenarios.

2 Methodology

The design workflow was focused on the Human-Centered perspective, according to indications reported on the ISO standard (ISO 9241-210: 2010) [3]. The latter defines criteria for user-oriented design in systems based on human-machine interaction. The main criteria concern the clear knowledge of needs, tasks and contexts of use; the involvement of users in the design and development phases; the multidisciplinarity of skills and perspectives; the centrality of the evaluation phase; the iterative design process that provides for continuous steps and revisions ranging from consultation with users, to the analysis of needs, to the (re)definition of system requirements. In order to make available to users (People) who will use the system in specific contexts (Contexts) to perform certain activities (Activities) through appropriate technologies (Technologies), reference has been made to the PACT model (People, Activities, Contexts, Technologies) proposed by Benyon (2010) [4]. To explore all four categories of PACT, the research was structured in three macro-phases:

- Phase 1: Preliminary analysis and Understanding
- Phase 2: Evaluation phase
- Phase 3: Design and Envisoment

The first phase was dedicated to critically reviewing the reference literature and technical standards in order to get preliminary information about the educational sector, learning models and related technologies. It was also taken into account how and when Assistive Technologies (AT) should be used. Aspects related to the effectiveness and inclusive potential of learning technologies were subsequently investigated for evaluating the contribution of a combined approach between Inclusive Design (ID) and Universal Design for Learning (UDL) [5]. At the same time, the existing web accessibility standards and guideline (WCAG) [6, 7] and standards ISO[1] were analyzed and possible integrations with UDL approach evaluated. During the Understanding phase, qualitative procedures and tools were adopted to collect data on users' needs, but also to build a framework of habits and perceptions in terms of technologies. Usually the work of phase 1 precedes the experimental section (phase 2), since in the guidelines and good practices illustrated we find the necessary requirements to design a platform for inclusive learning. The methods applied were User Observation, Interviews and Focus Groups [8, 9]. The object of the evaluation was a hybrid platform developed by the research team through an Adobe XD interface simulator. The decision to create a platform for the simulation of activity was aimed at recreating all the best features identified in phase 1 and to verify the actual possibility, from the design point of view, to apply the technical standards of reference. Phase 2 was planned on the basis of the following objectives: (1) define the reference framework of the most widely used compensatory and dispensatory tools, (2) evaluate the instructional support that these

[1] It addresses software accessibility and usability (see also ISO 9241-110, ISO 9241-11 to ISO 9241-17, ISO 14915 and ISO 13407). Regarding AT: ISO/IEC TR 13066-3:2012 Information technology - Interoperability with assistive technology (AT) - Part 3: accessibility application programming interface (API).

tools are able to offer and their effective degree of inclusion, (3) measure the user experience and investigate organizational and motivational aspects of users (teacher-student-family), (4) define possible design scenarios.

The work activity of the last phase is an ongoing step. Preliminary functionalities for the development of a web platform will be discussed on the basis of the data collected in phase 2.

3 Results and Discussion

3.1 Preliminary Analysis

Currently on the market there are different types of products for SLD, some of these products are dedicated to specific categories of users, denoting a lack of tools effectively transversal. Looking at all that concerns the technological supports intended for subjects with SLD, it is possible to distinguish three categories of systems: compensatory, dispensatory and those used for the evaluation of the SLD degree. In our analysis we have taken more account of the first two. Compensatory systems aim to compensate for deficits due to SLD. In this category we find applications for both computers and mobile devices. Many of them consist of screen readers, software that, mainly in the field of dyslexia, through speech synthesis or with expedients to properly highlight words, assist the reading and suggest the correct decoding of the text. For example, in Italy there is "EdiTouch", a tablet that is proposed as a collection of the main compensatory tools for SDLs, such as an e-book reader, a calculator and a software for creating mental maps. Another Italian product is represented by the software created by Anastasis, which are computer programs mainly dedicated to the creation of mind maps, speech synthesis and support for study. The dispensing systems involve tools for dispensing some performances (reading aloud, taking notes), the possibility of organizing the study (personalized time of realization of the activities) and evaluation (the form is not evaluated but only the content).

These tools are not always available, some of them need to be paid and/or addressed to operating systems such as Windows. In a for all perspective, the possibility of the web to exploit the basic browsers is the most usable dimension and would also offer the possibility to monitor and implement the system over time. The same concept would also serve to improve the adaptability of AT (always and in any case necessary). Another feature found in the web is the ability to connect multimedia (such as YouTube platforms, and/or EVO, Fliker, SlideShare, Scratch by MIT, etc.) to the platform through the import or sharing of content. It was also found the ability of the web to promote socialization as well as to develop cooperative teaching materials. In terms of accessibility, the web also offers many indications at a regulatory level than the software market, which at the moment, especially in Italy, is poorly based on the study of accessibility in the broad sense.

In particular, ICT and network services have long been considered as an opportunity for growth and methodological-disciplinary reflection within educational and training environments. The substratum of ICT allows to significantly transform the articulation of productivity in a way that is no longer solely individual but cooperative

and collaborative. To define pros and cons related to the adoption of ICT, it was made reference to the survey carried out by INVALSI [10]. Below are some aspects considered relevant:

- possibility to create customized teaching materials also for pupils with severe disabilities;
- the increase in self-esteem;
- respond to the need for flexible and shared tools;
- customization of contents to facilitate learning;
- motivation to improve the speed of writing autonomy;
- the work shared between teachers and experts from the school and from the university.

The use of ICT for disability carriers in educational environments simultaneously affects educational-methodological and technical issues regarding the selection of devices to be used. ICT, for its characteristics, would seem to have strength for at least three aspects including "motivation, strictness, adaptability." The use of computer, thanks to its flexibility, allows the customization of specific training processes, playing a key role on learning styles and abilities of each individual [11].

As far as the project dimension is concerned, we have witnessed the development of new disciplinary areas and project approaches with respect to the themes of inclusive learning over the years. These mainly refer to the field of Instructional Design and Universal Design for Learning (CAST). In particular, they refer to sectors such as the User Interface (UI), interaction design and User Experience, which are contributing to the growth of this disciplinary sector in qualitative terms [12]. While usability assessment methods allow us to measure the actual level of accessibility, HCD and UX methods can provide us with qualitative parameters on emotions and pleasantness (strategic aspect with regard to the educational dimension). Inclusive design and, above all, in the field of information technology and education, Universal Design, are today treated as disciplines of Instructional Design. Within the field of educational technologies, the UD (Universal Web Design Principles and guideline) approach and the educational studies of the Universal Design for Learning (UDL) emerge more clearly [5]. The UDL approach, combining the principles of UD and neuroscience-related research on different ways of learning, formulates the following principles (CAST, 2011):

- support models of recognition learning and at the same time provide multiple and flexible methods of content presentation;
- supporting strategic learning through flexible methods of expression and training;
- support affective learning and provide multiple and flexible options to stimulate engagement.

The UDL provides an interesting perspective and a solid foundation allowing to state that it is possible to pass from the concept of "special adaptation" focused on disability to universal design (for all), by valorizing individual differences and taking advantage of the potential of inclusive technologies [13, 14].

Identified in the UDL a viable base of operations to define strategies for planning and structuring learning in accessible way, it is noteworthy that WCAG, Universal Web

Design Principles and guide line and UDL have in common the attention to customize how to display the information, the availability of alternatives to the audio and visual content through the use of different media (even in support of understanding), the readability and comprehensibility of texts and compatibility with assistive technologies.

These aspects were verified and considered in the development phase of the platform for the simulation of activities and by the functions of phase 2.

3.2 Evaluation Phase

In the evaluation phase, web platforms for supporting learning at school and at home were analyzed. The sample of users considered foresaw the involvement of users aged 11 to 13 years and teachers involved in formal and informal training. As this is an experimental research, the aim of this work has been to define an intervention strategy implemented over time, which is expected to be extended to schools and universities. The sample analyzed concerned 5 teachers and 25 students (70% of these SLD).

Step 1: Preliminary Accessibility Review (Expert Evaluation): Checking conformance to guideline and Standards (UD, UDL and WCAG, ISO). In this phase, direct observation sessions were carried out with the involvement of a small sample of users and with the support of experts. In this way it was possible to make a preliminary analysis of the most popular platforms for reading and understanding the text. In particular, through the Task Analysis (TA) [15], the interactions on the teacher's side and then on the student's side were modeled. Once the architecture and functionalities of the platforms had been defined, Nielsen's Usability heuristics, Sheinderman's 8 golden principles of goods interface design were applied [5, 9–16]. The objective of this phase was to validate the correspondence and potentiality of the UDL guidelines and the technical and operational standards identified in phase 1 and to define the objectives of the following phases.

Step 2: User-Based Evaluation: Methods applied were Interviews and Focus Groups. Object of the evaluation at this stage was a hybrid platform developed through a simulator of Adobe XD interfaces. The choice of recreating a simulator was made to outline all the best features identified in phase 1 and the actual possibility from the design point to apply the technical standards of reference.

The aspects observed with respect to the process of organizing the teaching and monitoring of the path by the teachers were: (a) organization of the contents and planning of the training course, (b) creation and sharing of the teaching material, (c) monitoring and personalized support.

The aspects that were observed with respect to the students' learning process were as follows: (d) Access to the information to be studied, (e) understanding of the text, (f) re-elaboration of the information, (g) storage, (h) retrieval of the contents.

To evaluate these aspects a platform that allowed to simulate the functionalities present in Udl Editors, UDIO of the CAST was designed. It also includes open source compensatory tools with functions for speech synthesis Clip Claxon, LeggiXme and Balabolka, for text decoding (Memory for images and words by C.R.E.D and Super-Quaderno di Anastasis, LeggiXme_Jr_SP etc.), mental and conceptual map processing

tools (Super Maps, Cooperativa Anastasis, Super Maps EVO, C-Map Tools) and for lesson creation (Facile Facile web platform by C.R.E.D). Figure 1 illustrates some of the functions of the platform created.

The hybrid platform has been tested through direct observation sessions, and each session included the support of experts. The test sessions were structured following the same flow of activities.

Subsequently, on the basis of the data emerging from the evaluation sessions, 2 Focus Groups were organized, one aimed at the teaching dimension and the other at the students. Semi-structured interviews were carried out within the Focus Groups. In particular, this article contains the considerations that emerged and the design requirements identified and discussed with the teachers and experts involved in the survey.

(d) Access to the Information to be Studied: 40% of the observed users read the text several times highlighting a difficulty in the legibility of the font. The presence of textual indexes highlighted and subdivided in a coherent and repeated way in the screens (the title, the images, the subtitles, the words highlighted) have emerged as fundamental. The ability to select the level of difficulty was seen as negative before the test of almost all users observed. Although at the end of the session they reported that they had taken advantage of the possibility of being able to select difficulty levels; 25% said that this feature stimulated them to improve. Voice synthesis is 70% a strategic element and a support to understanding, the same for the dictionary. The dictionary should be revised because the size of the text and external links (Wiki, Translator, etc.) have not been perceived as exhaustive.

Design Ideas: Introduce topic without reading the entire text, possibility to customize the font (OpenDyslexic, Dyslexie, Read Me!, Bianconero, EasyReading) and the line spacing. Introduce the possibility to select text and activate speech synthesis in a more dynamic way through an enhanced tool. Possibility to integrate the notes taken in class to the text being studied. Insertion of verification tools in the form of gaming (scaffolding and tutoring system). This would allow the exchange and sharing of the study experience with others or with a tutor. Create the possibility of integrating content with extra material created by the student.

(e) Text Comprehension: For an LSD student, understanding a text read on its own is often very complex. This can be explained by the fact that, considering the problems in the reading process, all his attention is channelled into reading correctly, leaving out the meaning of the text. The observations made by the teachers and experts were as follows:

- the possibility of dividing the text into smaller parts, giving the possibility of analyzing one part at a time of the text;
- presence of the priming, i.e. providing questions to be read before proceeding to the reading of the text, in order to focus their attention on the salient points;
- possibility to insert and/or identify the key words first in the question and then in the text;
- possibility to highlight the keywords in the text during the reading.

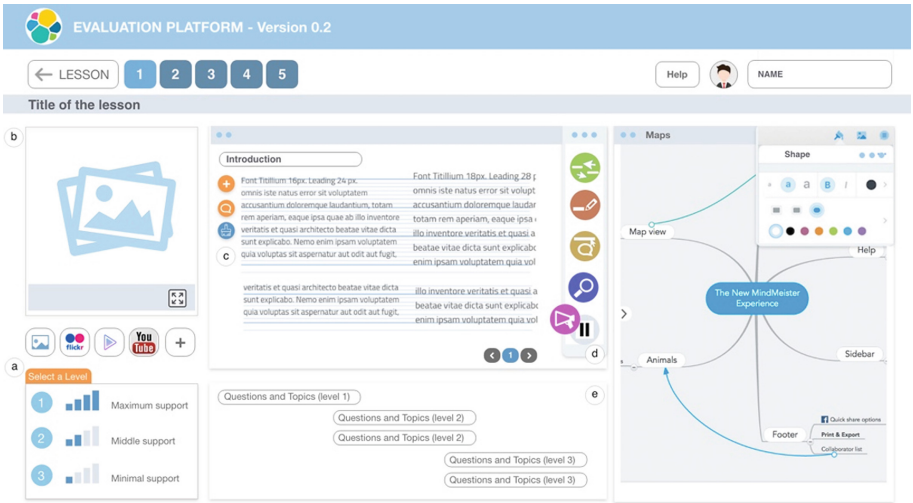

Fig. 1. Screen shot of the hybrid platform - student version 2.0: (a) Selection of the levels of support to the reading (b) Multimedia resources (c) Link window to select support levels and text line spacing (d) Text HELP Toolbar (e) Table of Contents.

Remarks: This phase has been linked to the evaluation phase involving teachers (a). The teacher expressed the need (as on Facile Facile) to create the contents himself and not find all the topics already packaged. This presupposes that the platform is conceived on the one hand for the teacher and on the other for the student. The teacher side, in addition to the usual registration phases, should allow the teacher to insert all the chosen elements necessary for the construction of the teaching units. This is especially strategic for the pedagogical aspect and to follow the student throughout his learning path. Consequently, a significant aspect is the possibility to include learning verification functions.

Design Ideas: Create a structured teaching area that allows you to organize the teaching units by topics and objectives. The architecture section of the functions must be connected to the student section, the teacher follows a format and obligatory operational phases. Consider the possibility of creating a register of the activities carried out by the student and the possibility of activating customized tutoring tools. Stimulate collaboration and sharing of material developed by individual teachers through a shared space.

(f) Re-elaboration of Information: Content reworking is fundamental for learning, and completes understanding by preparing for memorization. The deeper the processing of the information received, the easier it is to store and retrieve it. There are many ways to elaborate what you study, that is to reorganize and manipulate the contents of a text, and what certainly gives more results for a DSA is the construction of a conceptual map, that is a scheme, that visually organizes all that is to be studied and memorized. The dimension of the graphic representation of the contents has been tested, in which the key words previously highlighted are inserted, linked together by

arrows and enriched by images to facilitate visual memory. The maps were made by the student (this aspect is fundamental) and not already provided by the teacher or the system, precisely because it is the graphic representation that allows the cognitive stimulation of the student. From the focus group activities it emerged that each user has developed his own personal version in the organization of the contents. The users highlighted the need to develop the map on paper before making it on the platform. This aspect opens a reflection on the aspects related to the manipulation and tangibility of learning that should be considered during the development of the system.

Design Ideas: Possibility to create maps simultaneously and provide the possibility to import paper maps convertible into interactive digital format. Today, there are products that in this direction could increase the link between technology and disadvantage (see: Osmo™, Sifteo Cube). If you access the platform via tablet, you can use the drawing tool through digital pensil.

(f) Re-elaboration of Information: Content reworking is fundamental for learning, and completes understanding by preparing for memorization. The deeper the processing of the information received, the easier it is to store and retrieve it. Here are many ways to process, reorganize and manipulate the contents of a text, and what certainly gives the most results for a SLD is the construction of a conceptual map, that is, a scheme, that visually organizes everything that is to be studied and stored. The dimension of the graphic representation of the contents has been tested. The key words previously highlighted are inserted, linked together by arrows and enriched by images to facilitate visual memory. The maps were made by the student (this aspect is fundamental) and not already provided by the teacher or the system. It is the graphic representation that allows the cognitive stimulation of the student. From the focus group activities emerged that each user has developed his own personal version in the organization of the contents. The users highlighted the need to develop the map on paper before making it on the platform. This opens a reflection on the aspects related to the manipulation and tangibility of learning that should be considered during the development of the system.

Design Ideas: Possibility to create maps simultaneously and provide the possibility to import paper maps convertible into interactive digital format. Today, there are products that in this direction could increase the link between technology and disadvantage (see: Osmo™, Sifteo Cube). If you access the platform via tablet, you can use the drawing tool through digital pencil.

(g) Storage: The analyzed users requested to view the information acquired in the previous sections within all the tabs. Users also had difficulty remembering certain words or topics. The navigability for horizontal tabs was more functional than the vertical scrolling of traditional web pages as well as the ability to deepen the content through the viewing or listening to multimedia material.

Design Ideas: To offer a simple reiteration of the information sought during navigation. Support the association between the information to be remembered and familiar elements through the activation of symbols and/or photographic material and/or the possibility of highlighting portions of text or image in an alternative way, compared to

the functions hypothesized in point (e). Possibility to organize the information on the basis of those previously stored. To make possible the transformation of a complex information into a simpler one through a keyword in order to generate a process of meta-cognition.

(h) Recovery of Contents: Once users have created their own concept map and therefore started the memorization process, it has not been possible to verify in an exhaustive way the learning, especially if the user does not have the possibility to expose it to others or recover it from the memory. Some students said that they are used to repeating out loud the contents of their map or the text they have read. Repeating the subject they learned to someone else was also useful for getting feedback about their ability to expose themselves.

Design Ideas: Evaluate the possibility of recording your own voice and hearing it again to encourage self-correction within the platform with the possibility of being able to listen to it again, or to make video calls with your friend or school friend.

Note: If the user has difficulty in repeating what he has represented in the map, this means that the map is not adequate to support him in learning and then in exposure; consequently, it will be necessary to make some changes that the student himself will have to make to understand which concepts are missing, which keywords can help him and which links can facilitate the memorization of the speech.

In addition to the above, other considerations emerged, which were fundamental for the development of the pilot platform. These included the need to include tools and functionalities for the organization and management of time, which was found to be critical for SLD students. Moreover, some hardware tools such as the PC keyboard were more difficult to use than touch devices. This opened up an interesting question and the need to investigate more on the interaction modes. Multimedia material and hypertext revealed to be strategic for SLDs, although a current and ordered layout is necessary to prevent cognitive crowding. This is a determining aspect in the phase of content creation by the teacher. Compensatory tools have not been effective if not used consciously. Automation practices must therefore be preceded, the tool is effective only if it takes the abstract form of a communicative bridge, built in a conscious way.

The systems of self-correction and verification of learning favor meta-cognition, at the same time it is necessary to pay attention to how this agents are administered (the user does not like to be corrected by an adult or by a teacher). The subject understands why he is wrong, and through it the sense of what he is doing is amplified (significant learning). Therefore, it is in this phase that the conscious and non-automatic use of the instrument allows to generate strategies in the name of autonomy. The subject thus has control of what he does and consequently experiences modes of learning until the identification of the preferred practice.

The use of collaborative platforms allows to operate in an inclusive perspective. Any student, regardless of their condition, can learn in a dynamic and collaborative way thanks to others.

In conclusion, the aspects related to the design dimension of the teacher-side content have been the subject of the preliminary design phase, while those of the student-side learning support will be explained in the next paragraph.

3.3 Phase 3: Design and Envisoment

On the basis of the data collected in phase 2, a web platform is currently being developed with a horizontal layout for supporting and sharing learning. The objective of the preliminary project was to develop a conceptual version that allows to evaluate from a technical and graphic point of view the project ideas that emerged in phase 2. The platform will aim to support the following functionalities:

- Organization by degrees of learning support (maximum, moderate, minimal) selectable and modifiable at any time by the user
- Presence of pedagogical agents who support readers in understanding the text through contextualized explanations, operational suggestions and guided questions. These are supposed to be customized by the student through the development of features: Create your own Avatar.
- Presence of text-to-speech technology. Through this tool it will be possible to activate on request the translation of foreign language words. This tool will be provided through audio and text formats to facilitate correct pronunciation allowing for in-depth analysis of words and phrases with direct searches on the Google engine;
- Presence of reading supports such as synthesis and images
- Presence of indications on the correct ways to achieve a careful and effective reading at the level of understanding and appropriation. The strategies proposed consist in predicting, asking questions, visualizing and summarizing the contents of a narrative;
- Tools for creating interactive maps. It will be tested the possibility of importing maps made through digital media that allow you to store the gestures of the drawing - tablet/scanner
- Presence of feedback on several levels to promote self-correction and to encourage problem solving
- Insertion of content manipulation tools. Predict, ask questions, view and summarize content.
- Presence of external links for in-depth analysis (teacher side and student side)
- Integrated comprehension support tools, including a multi-media glossary that can be linked directly from the text for more difficult terms
- Collaborative section activated by a specific icon and activated by choice connected to a section that provides for the exchange and collection of processed materials, rather than dialogue through the chat
- teaching area that allows you to organize the teaching units by topics and objectives. The function architecture section must be connected to the student section, the teacher follows a similar format and operational steps for all. This is to avoid the creation of uneven teaching material.

The platform is currently under development and, as mentioned in paragraph 2, the beta platform will be re-tested and implemented on the basis of the criticalities that will emerge during the evaluation phase.

4 Conclusion

The aim of this experimentation was to define, through the development of a hybrid pilot platform, the functionalities that favor the autonomy process and the problem solving strategies in learning. The experimentation has shown that doing "problem solving" means developing a critical sense (also through others). Active interaction with teaching material within a web container favors these practices and is a positive aspect from the pedagogical point of view. In this sense, the most significant tools are those for the development of concept maps that allow to rework concepts by strengthening key aspects, voice reproducers, tools for the organization and structuring of content and programs of temporal organization. Within this framework, the experimentation allowed to identify strategic aspects in order to support SLDs in the learning process, with a broader approach that addresses all regardless of their capabilities. The future objective of this work will be to extend the observations to the dimension of visual, auditory and cognitive disabilities. In perspective for all, the success of this experimentation will lie in its ability to be compatible with assistive technologies as well as supporting all teachers and students, regardless of their condition.

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DICHIARANO

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