

Society@school: Towards an e-Inclusion App for Social Reading

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Abstract. Society@school, a Telecom-Italia Social Reading application designed as a tool for education (presented in its first version at HCI International 2013) turned out to be a useful tool for students with Specific Learning Disabilities (SLD). Social reading could be a way to compensate some SLD, such as dyslexia, allowing a real inclusion of these students in the school system. The design process, aimed at including specific design requirements for SLD students with a user-centered design approach, is presented.

Keywords: Social reading, User Experience, School, User Interface, Social, Inclusion, SLD, Constructivism.

1 Introduction

Society@school is an application for social reading running on IOS, Android and PC Systems. With social reading we refer to the possibility of sharing opinions and annotations inside a community-based group with similar reading interests (such as high-school students of the same course and readers of the same book or reading genre). By using society@school, students and teachers can also find and produce new multimedia contents. In this way, students can be active actors of the educational process, by constructing their studying materials and, in the end, building new knowledge. This process makes reading a social and shared experience.

The theory underlying our app is Constructivism (Vygotsky, 1978), according to which the goal of education should be to become creative through conceptualizations and synthesis of prior experience to create (or construct) new knowledge. According to Vigotsky (1978) every student has a "zone of proximal development" which is the distance between the actual development level, as determined by independent problem solving, and the level of potential development as determined through problem solving under adult guidance (i.e. a teacher) or in collaboration with more capable peers. Therefore interaction and active collaboration between peers is an essential part of the learning process.

In a first trial we asked one secondary school (2 classrooms: 42 students, 3 teachers) to test Society@school in their daily educational activities for 6 months (Guercio et al. 2013). On the base of the feedbacks collected during this trial, we inserted some specific extra tools, such as vocal recording and reading, cognitive maps and text customized format. Furthermore, by testing society@school in the context of use, we realized that our app could be very useful also for students with specific learning disabilities (SLD), an emergent problem in the Italian education system, due to the increasing number of SLD students. Epidemiological data report that 10-20% of school-age population has learning difficulties. In particular, children with Specific Learning disabilities (SLD) are about 5% of the school population (Stella et al., 2009).

Therefore, the goal of the present study is two-folded, being focused on both customizing society@school by defining the appropriate user requirements for SLD students, and improving the social reading experience for the class group as a whole (i.e. students and teachers). By adopting a user-centered design approach, we consider the designing process as an iterative process, in which users' involvement is requested in every step of the designing process.

We started to define user requirements with both an analysis of scientific literature and a review (and consequent analysis) of the existing tools designed to support SLD in the education system. The second step consisted of a heuristic evaluation of society@school carried out by our UX team, integrating Nielsen's (1993) heuristics with WCAG guidelines for accessible web interfaces. Then we run a participative heuristic evaluation by asking 15 users (i.e. teachers, psychologists, students with developmental dyslexia and their parents) to test the application and to refer their User Experience. Users were let free to use the application with the help of an expert, who was also collecting and stimulating their comments and suggestions, referring each comment to the correspondent heuristic (such as navigation, familiarity and so on).

The comparison between expert and participative heuristic evaluations brought to define the designing requirements. Through a quick Balsamiq prototyping, society@school became a cloud-based solution, including not only annotations and notes, comments and links to multimedia extra-contents, highlights and sharing options, but also new functions, which are intended to be useful for both SLD and typically developed students.

2 State of Art

2.1 Dyslexia and Specific Learning Disabilities

Developmental Dyslexia is usually defined as a neurodevelopmental disorder characterized by slow and inaccurate word recognition (e.g. Lyon & Shaywitz, 2003). Although usually considered of constitutional origin, its actual mechanisms remain the subject of intense research endeavor in various neuroscientific areas and along several theoretical frameworks. Developmental Dyslexia causes small but significant anomalies in brain sites involved in the organization of linguistic and cognitive

functions of reading (Consensus Conference, 2007) and present a high rate of comorbidity with other SLD (such as dysgraphia, i.e. difficulty in writing, and dyscalculia, i.e. difficulty in calculating) as well as attention deficit hyperactivity disorder (Stella, 2004).

To date it is possible to identify at least four major theories, identifying different causes for developmental dyslexia:

1. Phonological deficit theory - the basis of reading disorder is a persistent impairment of the module for phonology, which pervasively affects various aspects of phonological processing (Catts, 1989);
2. Theory of automation deficit (cerebellar) – the lack of automation would be determined by a cerebellar dysfunction which compromise a more general automation of skills, not only for reading, but also for other motor sequences and, in general, for implicit learning. In addition, this hypothesis seeks to explain the general difficulty shown by dyslexics in performing two tasks at the same time;
3. Theory of visual/auditory impairment (magnocellular) – an impairment in the coordination of visual and auditory stimuli causes a difficulty to respect the correct sequence of letters in a word (as is the case of "cursor", which becomes "rucsor");
4. Theory of attention deficit – The automatic orienting of spatial attention, and in particular a deficit in selective spatial attention, may distort the development of phonological and orthographic representations that is essential for learning to read. In a recent study, Franceschini and colleagues (2012) demonstrated that pre-school children with visual-spatial attention problems are the same who later develop dyslexia. A relevant paper for our goal (Zorzi et al., 2012) shows that in-creasing the space between the letters of a word (and between words in a sentence), improves the speed and accuracy in the reading of dyslexic children. This study confirms the importance of using a specific font for dyslexics and the possibility to customize the page layout of an eBook.

2.2 Compensatory Softwares for SLD

The difficulties arising from dyslexia can be compensated with the help of specific tools. In last decades, a plenty of such tools have been developed for the educational system.

Compensatory software allow people with SLD to achieve a good degree of autonomy, and overall they guarantee to SLD students the opportunity to learn and communicate without depending on a mediator (Peroni et al., 2010).

Below the most common compensatory tools for the Italian education system are reported.

- the "*Talking Calculator*", a calculator with a speech synthesizer that reads numbers and operation signs as you type;
- specific software for writing and reading with lexical prediction and spelling corrections. Most of the existing text editors (such as *Office Word*, *OpenOffice Writer*, or *Writer Libreoffice*) have these functionalities too;

- Digital Voices (synthetic voice like *Loquendo-Nuances*) designed to "read with ears", help dyslexic children by decreasing the cognitive load they usually have when reading;
- Audacity is the best solution to record lectures. It has a free portable version and allows users to record, edit the audio file and save it as MP3;
- *Aplusix* is a French commercial software for arithmetic assistance, available in Italian as well. It helps students in solving calculations by guide them step by step, indicating whether the each single step is carried out correctly;
- *Berlitz* is a useful plug&play program for translations from foreign languages: it instantly translates each single word in 5 different languages (including English, French and Spanish) and is also equipped with speech synthesis;
- the visual organizers to create maps, charts and diagrams (for the study and the summary of written texts) are considered very useful: *SuperMappe Anastasis* with all its useful features is the most used instrument for dyslexics in Italy;
- the "easy to read" books are becoming increasingly popular: those books have typographical choices that make them much more readable, such as big characters, special fonts, increased spacing, not justified alignment, no hyphenation and all key elements for the easy reading;
- *Anastasis* and *Erickson*, two of the most influential educational publishers in Italy, makes available for schools audio books and spoken books read by a human voice and distributed on CD, tapes or MP3.

3 The Design Process to Integrate SLD Requirements in Society@school

After testing society@school in a trial in the city of Trento (Guercio et al. 2013) and according both to the benchmark on the available software and the analysis of literature about dyslexia and SLD, we realized how important it would be to develop society@school towards a real inclusion of all the students in the learning process.

For this reason we focused our analysis on the development of design requirements for SLD students, using the User Centered Design approach, i.e. an iterative process that puts the user in the center in every step of the designing process, from the collection of user requirements to the final evaluation

In particular, we started from a heuristic evaluation of society@school to evaluate if our app, thought for general consumers of the educational world, would be usable also for people with especial needs. After the expert evaluation we interviewed 15 individuals involved at different levels with developmental dyslexia, to find out specific requirements for that type of users. Users' requirements were transformed in designing requirements and inserted in a new low fidelity prototype of society@school. This new version was tested with SLD users before the final implementations.

3.1 Heuristic Evaluation Results

In the heuristic evaluation, we analyzed the application according to the guidelines of both heuristic analysis (Nielsen, 1993) and accessibility. Main results were related to:

- Visibility and feedback: there are no violations of the heuristic of visibility. Moreover, the application is easy to interpret, with good feedback for each user interaction. However, text formatting is not usable for SLD students and a violation of the WCGA principle of visual presentation has been identified: there is no left alignment of the text and there is no division into paragraphs;
- Consistency and standards: the application is consistent and icons are overall intuitive. However, for students with SLD the Text To Speech functionality is too mechanical and without intonation;
- Familiarity and Control: the "back" function is always available and respect "standard de facto" for tablet applications; all the icons are well positioned;
- Navigation: In two cases some weakness were highlighted. In the first case, when the touch screen is tapped to select the text there is no feedback, which left the user with the idea of not having performed the action correctly (a serious break of the principle of visibility and feedback). In the second case, after selecting the text, the context menu could appear at the top or at the bottom of the screen in a random way;
- Flexibility, style and friendliness: in general, standards of flexibility and efficiency for a good usability are respected. Features are simple and designed to avoid technological breakdown. The user interface makes the interaction easy, reducing user's cognitive load by the use of very intuitive icons.

3.2 User Interviews and Test of Application Prototype

To collect specific user's need of SLD needs, we interviewed 15 individuals: four students (three attending high school and one college), three educators, three teachers (one teaching at high school and two at "middle-school", i.e. a school for children aged from 10 to 13 years old), three parents and two psychologists. The interviews were face to face and were different according to the interviewed individual; each interview lasted on average 55 minutes.

Each interview was structured in five different steps. The first step was dedicated to collect information about the role each individual have in the "SLD world". In the second part the questions focused on the most frequent needs of SLD students, on their difficulties and on their learning requirements. The third phase was aimed at collecting information about the most used tools for compensating SLD weaknesses. In the fourth phase each interviewed was given a tablet with society@school, asking them to use it and to refer comments and criticalities to the interviewer. Then the interview was concluded by the last phase, consisting in 15 questions regarding the collaborative learning, aimed at having information about the core of society@school and its possible improvements.

3.3 Main Results and User Requirements for SLD Students

The main needs emerging from interviews involve support in reading, writing, calculation and recovery of grammar and arithmetic rules. In particular, it was highlighted that SLD student should be supported during both homework and exercises at school, with the help of grids for reading, forms, summary tables and mind maps.

It emerged the need for a single solution, which can simultaneously compensate the SLD students' difficulties and integrate the learning process for the whole classroom.

The features requested by the majority of respondents are:

- The app should be ease to use and designed to avoid cognitive overload;
- The app should be synchronized in all devices so that one can write down on his tablet, view and make quick additions on his smartphone, and then double check all on his personal computer at home;
- Readability is a crucial requirement: a specific font should be available; a change in text format (overall enlargement) is requested; justified alignment has to be avoided. Dyslexics prefer to read with left alignment of the text and spacing should be at least 1.5. It should be possible also to change the color of both text and background, as well as screen luminosity, which base-level should be low, to avoid eyes tiring during the reading;
- Collaborative learning and the presence of a social network are two important requirements: all participants think that it could be useful to integrate in society@school some specific features of the most popular social networks (i.e. Face-book) like groups, private conversations, group working, and so on. However, according to teachers, these functions should be used under their supervision given that, as a teacher said during his interview, "too much freedom could destabilize students". On the contrary, students prefer autonomy and self-organized study;
- Encyclopedia (like Wikipedia) is requested: the whole sample agrees that a vocabulary can greatly help individuals with SLD;
- All the interviewed claimed that personalized study path is necessary and that users should have the possibility to activate or de-activate each different tool, because things change during the year, and some deficits may be compensated;
- Mind and conceptual maps are fundamental functionalities to be introduced;
- Speech synthesis is a significant enrichment: once again, all the 15 participants agree that the use of speech synthesizers can be a valuable aid. It would be optimal to use the synthesizer while surfing the web, taking notes or translating to different languages (without having to change application or system settings). Such a software could be useful for everyone, not only for SLD students. A requested requirement of speech synthesis is "a human voice": robotic voices are disliked by students, who do not use tools with such voices;
- Finally, last requirement was the possibility to record lessons and to translate them in written text.

3.4 From User Requirements Towards a Low Fidelity Prototype

Every collected user requirement was “transformed” in graphical element or navigation option of the App prototype.

- Accessibility for all (Fig. 1): a simple mode to access the App by a friendly GUI has been created. In particular, we have added an icon button to change the default text format (spacing, alignment left, pronounced edge, special fonts, etc) into a simplified format. By pressing this button the whole preferred options set is available with one click. In this way SLD students could save their set without feeling “different” from the rest of the classroom;



Fig. 1. Activation of simple reading mode

- Multiple devices: Society@school will have a total synchronization between tablet and PC. In fact, all the work done on the tablet, will be visible on the PC and vice-versa. This also allows users not to choose a specific platform (iOS vs Android);
- Modularity: default settings are provided, but they can be modified by the user;
- Readability (Fig.2): text is not justified, line spacing is set a 1.5 at the minimum, the possibility is given to change the space between words and letters, and fonts are sans serif or special (preferably EasyReading, certificated by AID - Italian Association of Dyslexia). Background and text colours are set black for text on a parchment-colored background, which makes reading more relaxing;

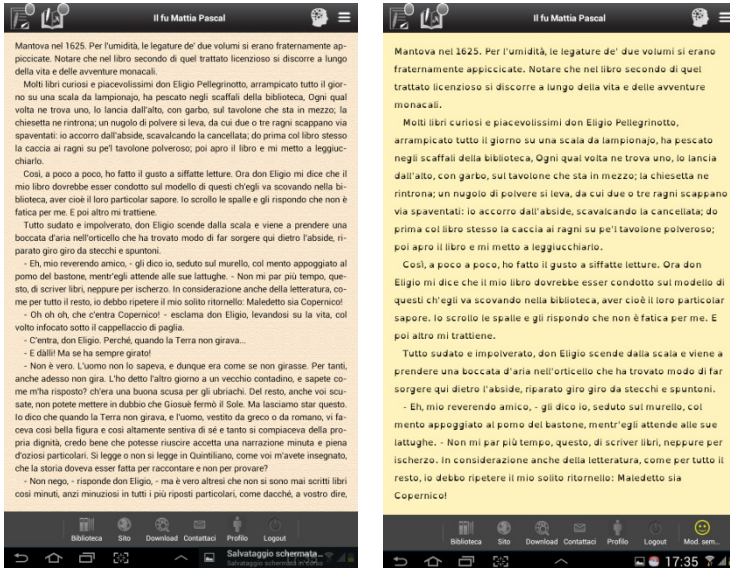


Fig. 2. Text before and after the activation of simple reading mode

- **Interactivity:** Interactivity has been already present in the first version, to give the possibility to upload and share both text notes and media files (video youtube, image / photo, audio). In the new version users can also create mind maps and summaries as well as underlining, create notes and new text about the reading experience. We have added a translator and a fast link to Wikipedia;
- **Speech synthesis:** Users could convert text to speech voices. The functionality of audio book has also been included.
- **Access Privileges and different interaction for students and teachers:** the validation of both textual and multimedia materials is necessary. Teacher, or more in general the administrator, has the role to guarantee safe contents, by deleting notes if they're considered not relevant or dangerous.

3.5 The High Fidelity Prototype

After the design of a low fidelity prototype with Balsamiq (a tool for rapid prototyping) and a short user test with DSL students, we designed the final functionalities and code for a new version of society@school. Below some screenshot of our application, which maintains all the features of the low fidelity prototype.

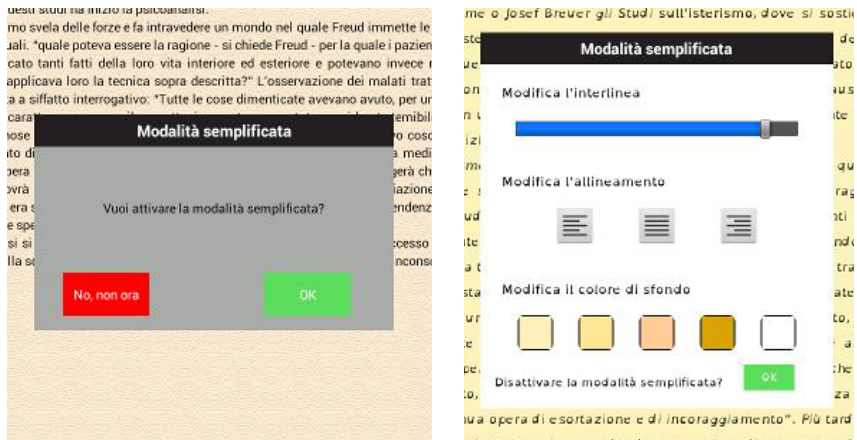


Fig. 3. Activation of simple reading mode and text customization



Fig. 4. Creation of a mind map

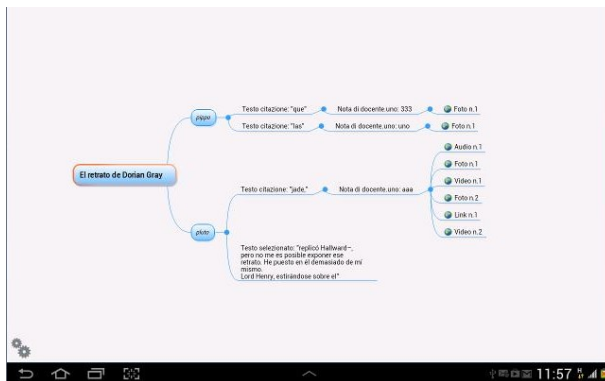


Fig. 5. Mind map visualization

4 Conclusion and Next Steps

The user centered design process seems to fit nicely with the developing process of Society@school for both SLD and typically developed students.

We're particularly focused on students attending high-schools and colleges. At this age (i.e 14-25 years old) the relationship between peers is particularly relevant and the possibility to share opinions and alternative studying materials is thus particularly important. For students at this age a social-reading tool could be very effective and useful. Furthermore, in the Italian education system special attention is dedicated to SLD first-grade students, without any particular program for the inclusion of older SLD students. A dedicated study about students of this age would be addressed in order to identify specific needs and define customization or a completely new tool for this target of students.

The real challenge would be the inclusion in the testers panel of several high-schools and universities. In particular the collaboration with the University of Modena & Reggio-Emilia is particularly relevant: the trial is starting on a university course with heterogeneous group of students (SLD students and typically developed), in order to verify the real benefits of this type of learning approach and the increased level of inclusion of students with SLD.

Our aim is to validate all the choices made in the design process and to develop a version of *society@school* that could be useful for all students, including SLD, without the necessity to label them as "dyslexic".

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