

# Filling the Digital Divide Gaps in Learning 2.0 with Special Needs

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**Abstract**— In recent years, different projects, companies and different research institutions have been researching about the digital divide, privacy issues and the integration of new services 2.0 in the learning processes. Big improvements have been done in the different fields. However, they are usually tackled independently and clear gaps come up during the research processes. In this paper, we present an overview how to fill the gap in the integration of social networks in the learning processes with special needs. We integrate Facebook in their social/learning life allowing the guardians to participate in this process.

**Key-words:** *learning 2.0; disabled; Facebook; visualization; text-to-speech; chi; accessibility*

## I. INTRODUCTION

The Learning 2.0 comes from the integration of Web 2.0 which enables collaboration and interaction in learning processes. However, mentally disabled people have problems to access these technologies, because the interaction is targeted for the general public. However this target requires special attention, since learning is a basic right in our society. The goal is to create an application that will help these people and improve their skills.

The device to run the application is the iPad. This device is chosen for several reasons: (1) it has a long battery life, (2) you can turn it on instantly, it is mostly in standby modus, (3) the applications always run full screen hence there is less distraction than on a desktop computer, (4) it has a touchscreen which takes away the thinking of bringing a mouse arrow to the button you want to click on. This is a great improvement for people that have lesser motoric skills which a lot of people with a mental disability have and (5) the attention span is lengthened because they enjoy working on it more [1].

## II. RELATED WORK

### A. Literature

Most of the literature concerning this topic can be categorized in two big parts: (1) Literature about education and technology, and (2) literature about mental disabilities and technology.

### 1) Education and technology

A considerable amount of papers exist about using technology in education. For this topic especially the use of Web 2.0 tools and tablets are interesting. Like already said in the introduction Web 2.0 tools changed the way we use the Internet. This also has an influence in education. Education changed from being about distribution to reflection and collaboration [3,4].

The “tablet classrooms” are more and more a fact because of the huge advantages. Students will always have updated information, no outdated textbooks. It promotes active, engaging learning thanks to the interaction that is made possible. Another major advantage for education, that is seen as something negative for productivity though, is the limited multitasking. One application always fills up the entire screen, therefore unlike on a desktop computer, there is less distraction possible and the teacher has more control over the classroom. The problem sometimes with other technologies is the teacher, since it is the skill and attitude of the teacher that determines the effectiveness of the integration of new technology. The teacher must learn to use it and must be open for changing his pedagogical approach. The latter has to do with character, but in comparison to some other technologies, the iPad (and other tablets) are very intuitively to use. The touch screen has extended Human Computer Interaction (CHI) in a way that mimics human gestures. Thanks to all these advantages, these devices will bring the classroom into the digital era [2,5,6,7].

### 2) Disabilities and technology

For people with a mental disability, a considerable number of papers are about guidelines on how to improve accessibility for them. These guidelines are important since the power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect [15]. These guidelines are not just for people labeled as disabled, but also for senior citizens who might need a font slightly bigger, thus making the font changeable takes a little time of the developer but helps the user significantly [14]. The most important guidelines for developers are [13,17]:

1. Use pictures, graphics, icons and symbols along with text
2. Use clear and simple text

3. Use consistent navigation and design on every page
4. Use headings, titles and prompts

Though these guidelines exist it does not mean that every developer keeps these in mind. Social network sites for example still have a lot of problems for people with a disability. This is mostly a problem for screen readers used by people with a visual impairment, but also used by people who have trouble with reading [11]. Facebook has a short guideline though for accessibility and assistive technology which explains how to use screen readers on their website [18].

There is already research done by schools to check whether ICT tools can help students with a disability to create more equal opportunities in comparison to other “normal” students. Most of this research is for people with dyslexia where the usefulness of these ICT applications has already been validated [8,9].

Articles about people with a mental disability that use an iPad show that the “invention” of the iPad improved their life standard significantly. This is especially because of the new AAC (Augmentative and Alternative Communication) possibilities (examples in *B. Existing applications*) thanks to the touchscreen of the iPad. It is really rare that a mainstream technological device like the iPad is so embraced by the disabled. Normally it is the other way around, that items designed for disabled people are adapted for general use (GPS devices speak directions out loud, curb cuts from street to sidewalk are for example also used by mothers pushing baby carriages or by cyclists) [1,10,12,19].

More general for youth at risk, there is a lot of evidence that ICT, and in particularly Web 2.0, can contribute to positively support the needs of excluded people [28].

### B. Existing applications

Again we can categorize existing applications into two major parts; applications for education and applications for people with a disability.

#### 1) Educational applications

Most educational applications are LMS, which stands for Learning Management System like the mobile Blackboard application which allow the organizing of schedules, grades, documents, tasks etc. [20] Other common educational applications are attendance checkers to quickly be able to check if all the students are present, these were already used on pocket pc's [21]. The application TeacherPal on the iPad is an example of a simple but helpful application to organize classes and students, and allows the teachers to track the attendance, grades and behavior of students [22]. Besides LMS and attendance checkers there also exist a lot of small learning games, digital interactive textbooks (like Dynamicbooks and Inkling [23]), math exercises and many more. A particular type of applications, which will probably get more and more integrated, is the voting applications. They allow anonymous interaction that keep classes interesting but at the same time avoid the stress that interaction causes for some people. At the moment there always has to be extra hardware since not all students have a compatible portable device. This extra hardware is expensive

and therefore not ideal and not frequently used since such hardware does only one thing: vote. Another problem with the specific hardware is that since it has buttons does not allow for other input like a number. This is where the smart devices really come in handy with applications like Eclicker [24]. In 2003, the university of California already had an application called ActiveCampus for a pocket pc. It focuses on the learning community using different functionalities such as a map of the campus, a buddy system and an application to ask questions [25].

#### 2) Special needs applications

For people with a disability there exist applications for various purposes. Reading applications for people who have trouble reading and writing, like Kurzweil and Sprint for desktop computers. On the iPad there also already exist some applications specifically for people with a disability. One of the most popular ones is the communications solution Proloquo2go [26]. This allows people who have trouble with speaking (for example autistic people) to make sentences by tapping icons and then letting it speak out loud. Most of the applications specific for people with a disability are AAC applications. Other applications for disabilities are mostly simple learning games.

An important application is VoiceOver which is the built-in text-to-speech in iOS, the operating system of the iDevices of Apple, that solves the reading problems of the users. The problem discovered with VoiceOver is that it changes the use of the device completely, making it less intuitively. Opening an application, for example, is now a double tap instead of a single tap since at the first tap it selects and speaks out loud and then tapping it again opens the application. This is for everything you can tap. It is clear that this was really designed for people who have a visual impairment and not for people with reading problems but good sight.

## III. MOTIVATION

### A. Interviews

As a part of the software engineering process, we did two interviews aiming to get specific requirements in the field. The first interview was with two teachers of a school for people with mental disabilities, De Sprankel in Mechelen. The interview was interesting because they already use ICT tools for people with disabilities Not yet in the classroom though but they have ICT-lessons where they use these tools. For example they use Sprint which is normally used by people with dyslexia but is also very useful for those with a mental disability. They pointed out that this is not the ideal way though. Sprint focuses more on normal gifted people with dyslexia. The problem is that there is just no alternative. There are many opportunities in this field that could help people with a mental disability and allow them to have a higher life standard. They also use Wai-Not, this is a private social network where the students can chat and send e-mails to each other [27]. This is specially made for people with mental disabilities and uses BETA- and sclera pictograms. It also has auditive support so the students can let it speak everything out loud. The problem with it is that it is really limited. Sometimes the students just want to let one word or

sentence be spoken out loud and that is not possible. It also does not show which word where in the text is spoken while this is something that stimulates and improves their reading capacities. The other big problem is that this is a private network as a result it is secure and avoids abuse but on the other hand they are again separated from other people without a mental disability. Having a mental disability does not mean you do not have friends without one.

The second interview was with a person with a mental disability and his mother. The main conclusion from this interview was that the person with the disability really wants to be able to read. The mother also pointed out that he really understands everything but just cannot read and that he needs some control because the risk of abuse is much higher because her son is like a younger child more naïve than others of the same age.

## B. Application

### 1) Original idea

This idea consists of two parts, a Teacher application and a Student application.

The teacher application would have multiple features like:

- An attendance checker: Checking whether any student is absent, this should go very fast and the results could be used to send to the secretariat hence they do not have to go to every class.
- Task checker: Automatic check at the beginning of the class whether every student has made his or her tasks.
- Grade and problems visualization: Some graphs of the grades and also visualizing the problems that students have, but more details on this when we talk about the student application.
- Interaction during lessons: The teacher should be able to quickly start a poll hence every child can anonymously vote or answer. The teacher will instantly be able to see graphs of the answers.
- Quick announcements via Twitter: With a specific hash tag the teacher could quickly post something short like “Don not forget the 5 euros for tomorrows trip! #SchoolClass1011”.
- A calendar with events such as courses and tasks.

The student application on the other hand would have the following features:

- Tasks on iPad instead of pen and paper.
- Protected Facebook class group: From the related work and interviews it was clear that social networks are really important therefore integrating a social network can have multiple benefits. It can be used to have a class group where courses could be discussed, activities,... and all this on a non-private network thus they do not have to feel different. But since the risk of abuse is still there the application will only give some safe features of Facebook.
- Simple text-to-speech: The students should be able to just select the words and press a button to speak things aloud. Simple, but effective for them. This

can be used when making tasks, browsing the Facebook class group and more.

- Gathering the data of the text-to-speech: The words that were selected by the students can be used by the teacher app to visualize problems, like certain words that are repeatedly selected. The teacher could then focus on those words to help that student improve.

The data of the text-to-speech could also be used by other applications. For example for risk evaluation of websites. A search engine could then suggest or discourage certain websites because there are a lot of words in it where that person has problems with.

### 2) Final idea

After some iteration, where the methodology and the interviews were discussed, we detected different weaknesses in the original idea:

- This work aims to enhance the iPad functionalities to reduce the digital division that affects to people with mental disability.
- To validate this approach, we need to evaluate this work. At this end, we have defined a spiral methodology where every iteration needs to be evaluated before going to the next step.

This paper focuses on one specific part of the original idea. It aims the integration of people with mental disabilities in the social networks. For this purpose, we create an application that integrates Facebook based on the requirements of our specific target reducing the existing digital divide. The social aspect of ICT is very important though and necessary to fully participate in the society [29]. However, the big problem with social networks is the risk of abuse. People with a mental disability mostly have problems with the distinction who to trust and who not. It has nothing to do with intelligence it is just something they do not see as logic: Why would anyone want to lie to them?.

This application will have the next features:

- Text-to-speech: The users of the application should be able to let everything be read out loud easily like statuses, comments, etc.
- Gathering of text-to-speech data: Again the data that the users have selected will be gathered hence it can be used in other applications to help them.
- Pictograms: Since many people with mental disability have trouble reading, there is much more need of pictograms.
- Protection from abuse and “bad” social behavior. There should be options that certain features can be enabled or disabled. For example that they are not allowed to accept friends.

This application will allow people with a mental disability to independently participate better in the social life, which is now more and more happening online, without their guardians worrying about it. There are three big levels of persons with a mental disability in this application: (1) A person who can read and understand perfectly but has problems such as knowing who to trust or not and what is good online behavior. In this case, the parent or guardian will be able to restrict the possibilities of Facebook hence

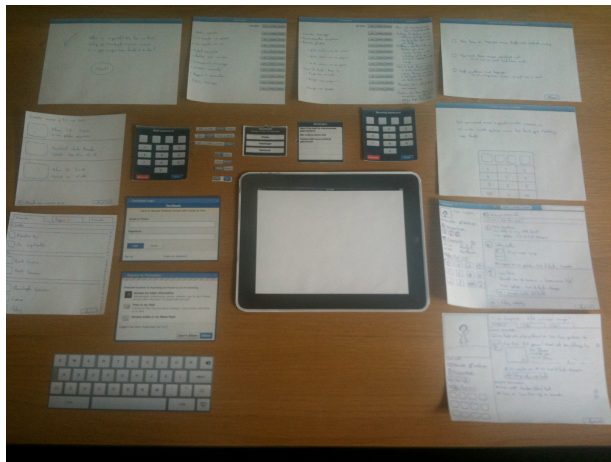
they do not have to worry about those things anymore. As you see most of the features are standard things you can do on Facebook but with a different interface. The power of the application will be in the ability to block certain features. (2) For the people with a disability who have problems with reading but are able to understand (almost) everything, there will be, like planned in the original application, text-to-speech options. The idea is that there will be a speaker like icon where the person can tap on and then select the words or buttons that s/he does not understand and those will then be spoken aloud. (3) The last category will be the people with a disability who have problems with understanding the words. For them it should be possible to convert statuses etc. to pictograms. Next to the levels the guardians of the person with the disability will be given the possibility to set the application in a way that is best for that person since every person with a disability has other needs and skills [16].

#### IV. DESIGN

In this section we will explain the two iterations already done for the first part, the Facebook application for people with a mental disability.

##### A. Iteration I

For this iteration, a paper prototype (Figure 1) was made where the test users had to follow some given scenarios on. After the scenarios some questions were asked to the test users. The paper prototype is not very different from the storyboard that was already made apart from one change. At the permissions, instead of just being able to enable or disable certain features of Facebook, the options On, Hide



**Figure 1: Photo of the paper prototype used in Iteration I**

and Block are available. These mean the following:

- On: Will enable the feature.
- Hide: This will really hide that feature in the application hence the person with the disability will not be able to see it exists. The reason for this is that some people with a mental disability can get really frustrated if they see that they are not able or allowed

to do something. To avoid this the feature can just be hidden instead of only blocked.

- Block: This will allow the person to see everything and for example allow to type a new status but when it really wants to commit the action then a prompt will be shown to type in the guardian password.

The goal of the evaluation was to check whether the application is usable by: (1) Persons who might not have any experience with multi touch devices and/or social networks and (2) Persons with a mental disability. It was a think aloud test, the test users had to say what they were thinking, why they were doubting about something etc. to better understand why they did certain things.

There were two categories of scenarios, for the parents and for the persons with a disability. The scenarios for the parents were:

1. Login for your child and set that s/he is capable of reading and writing but needs control.
2. Set at the permissions everything that has to do with placing comments on "Hide".
3. Go to the next screen (not a straightforward way).
4. Set a password and continue.
5. Change the settings so the child cannot create groups anymore.

The scenarios for the persons with a mental disability on the other hand were:

1. Who was the last one that posted something on your wall?
2. Update your status (this is set that the person is not allowed to do this hence there will be a popup asking for a password, what is the reaction?)
3. Start a new Facebook chat.
4. Make a new Facebook group.
5. Make a new Event.

After doing the scenarios the test users were asked to answer some questions about their experience with Facebook, other social networks, touchscreen devices, etc.

For the parents test, five parents were willing to help age 30-45. There were some general trends. For scenario 2, 4 out of 5 users tapped hide for every "place comment" type instead of the general button that would hide them all at once. The reason they said was that it was not really clear that they were grouped. Some suggestions were putting the titles in bold, setting the margin for the subtypes more to the right, put them inside lines or in squares. 2 out of 5 did not find the solution for scenario 3 (they had to swipe to get to the new screen). When we told what the solution was they said that they just had not thought of that because it was on paper. On the device they might have tried that but they were not sure of it therefore it is definitely something to check. The interesting here was that the three that found it, already had used an iPad and were able to put the link. A solution might be to put a button for the next page permissions or a popup somewhere with some explanation of basic iPad controls for parents who do not have an iPad themselves but want to set the one of their child. 2 out of 5

did not find the settings. Feedback was that the icon was not that clear to them but if it was more a button they would probably have noticed it.

The test persons also gave some great suggestions for the application like:

- Possibility to add standard texts, like for example wishing someone a happy birthday. This way they can be proud they did something on their own and the parents do not have to worry about it. This could be extended to status updates, like some smileys with a text next to it like I am happy, sad, etc.
- In the application child is not really a good word. It is also for a grown-up with a mental disability.
- It might be better to move the application settings like permissions, to the general iOS settings. Otherwise the child can still see that it does not have access to it. This might be a concern for some persons with a mental disability.

The test for persons with a mental disability was a little bit disappointing; the problem was that the paper prototype principle was not really that clear for them. The biggest issue was that the paper prototype was not visual enough for them. It was mostly in the same color, perhaps not a very nice handwriting and drawn pictures. Seeing the difference between what is a button and text, does that represent a picture? And more like that were difficult for them. For this reason a test was done with two children without a mental disability to see whether basic Facebook functionality was still clear. All the children had some experience with Facebook. The evaluation went well apart from some small remarks.

## B. Iteration II

The original idea for this iteration was a second version of the paper prototype but since the evaluation with people with a mental disability failed, the conclusion was that a mockup on the iPad might be a better idea. The mockup is made in the Xcode Interface Builder therefore it will look as much as possible like the eventual application and this way no double work will have to be done. The only requirement was that first a good Controller-View diagram had to be made since it will be reused for the implementation of the application. After implementing this diagram, creating all the different views and adding some screenshots from Facebook (for example the wall) we got the results in figure 2.

Some new scenarios were added to test the mockup to check whether the text-to-speech buttons were clear enough and also to test how the persons use them intuitively, without saying at the beginning how it works.

1. Who was the last one that posted something on your wall?
2. Let something to be read out loud (for example a wallpost).
3. Update your status (again with a popup to see their reaction).
4. Whose birthday is it today?
5. When is event X?



Figure 2: Mockup on the iPad for iteration II

6. Can you read out loud what person Y said to person Z?
7. Start a new Facebook chat.
8. Can you check who your friends are?
9. Of which groups are you a member?

After doing the scenarios, the test users would be asked the same questions as in the previous iteration. The result of this evaluation was really positive. Most scenarios were completed successfully. For scenario 2, like said before, the user was not explained how to do this. The intuitive way was not the way that we planned to implement it. The idea was to first press the big speaker icon and then select the words to be read out loud, but the test user first tried to select the words and then press the speaker icon. The problem with this is that it would not be possible to read the icons out loud. Now if an icon is not that clear, the user can press the big icon and then press the menu icon to let it read out loud (for example "Home"). For this reason we explained then how it was actually planned to be used and the user since then used it that way every time. The only problem the user had was with scenario 4 but not in a way you would expect it. The user did not find it though he



noticed the pictures were the answer was and when asked why he did not see it, the answer was that it was not correct since those persons already had their birthday, which was indeed correct. This shows again that it is sometimes difficult to test certain things with persons with a mental disability (like with the paper prototype) because they have trouble with imagining something unreal.

Since it was only possible to test the mockup with one person we contacted an expert to give his opinion on the application and check whether this can be used by most of the persons with a mental disability. When we showed the application the immediate reaction was really positive. For the dilemma for the selection and then reading out loud or the other way around he responded that it might be better to choose for first selecting and then reading it out loud because this way it is consistent with the reading applications which some of them already use. For the buttons problem it might be a solution when they are tapped to just read it out loud anyway and also navigate to the page. Facebook does not really have a deep hierarchy of pages therefore going back to the previous page is not that difficult in this application. Some other suggestions were to use sclera pictograms for the statuses with a sub hierarchy, like I feel... and when they select this you go to happy, sad, etc. Another nice thing would be the possibility to change font and font size. The best readable font for people with a mental disability is really different for every person.

## V. FUTURE WORK

For the first part, the Facebook application, we are now working on iteration 3, which is the implementation of the application. When this is finished, the end result will be evaluated with at least five persons with a mental disability.

After the goals are achieved part two begins, a visualization application. It is a tool for teachers and will use the data gathered from the text-to-speech in the Facebook application and like in the original idea show the words were that user has problems with. That way the teacher can give extra exercises on that or the other way around if that user is someone who gets easily frustrated when something is not going, avoid exercises with that word. This is so for many people with a mental disability. The application can also cluster similar students hence they can be grouped for certain tasks. This will again happen in iterations with a paper prototype, a mockup and the actual implementation of the application.

When both of the applications are combined, the result is a support learning application without the users even knowing it. The persons with a mental disability are doing something fun, browsing a social network site, but with the data collected from that, their abilities can be improved. Other future work is to extend this application to be used by other potential targets such as elderly people who might have problems with sight (need text-to-speech and larger fonts), people with reduced motor skills and others who want to use Facebook for example in their car making it less unsafe.

## VI. CONCLUSION

There is already considerable research done around making applications for people with a disability but there is still a big social gap between people with and without a mental disability. For this reason, we provide an application that is secure and usable for people with a mental disability, but using an existing social network hence they can have contact with people without a disability. The functionality of gathering the data of the text-to-speech allows guardians to see on which problems there should be worked. This way you get a support learning application with the learner possibly not even knowing it.

Making applications for people with a mental disability does introduce some problems. You have to keep in mind that it is harder for them to imagine something unreal. For this reason a paper prototype is not useful to test with and it is better to directly use a mockup. It is also important to keep in mind that every mental disability is different therefore the application should be adjustable.

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