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Participatory Design with Dyslectics: Design and Evaluation of an Enhancing Reading Skills Tool

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ABSTRACT.

Participatory Design (PD) was used successfully in many projects but the question is how participatory design works with people with a cognitive disorder like dyslexia. In this study, we analyzed observations on PD sessions with dyslectic participants for developing designs of a reading software application by applying two participatory design methods: the IDEAS and CI methods. Furthermore, we conducted online surveys to gather information on dyslectics participants' and their special-education teachers' opinion regarding the participatory design process, methods and final designs. The results indicate that participatory design works effectively with dyslectic people provided the participation of Proxy Users to represent dyslectics, when it is necessary, the participation of an experienced on dyslexia facilitator who has the knowledge to address incidents caused due to dyslexia, and a proper allocation of the groups in proportion to the required tasks to prevent biases.

Keywords: Design Techniques; Cooperative design; Participatory Design; Participatory Design (PD) methods; Dyslexia; Interactive Design; Cooperative Inquiry method; IDEAS method; Grounded Theory;

1 INTRODUCTION

To begin with the PD (or alternatively cooperative-design, or brugerinddragende design), it has its origins in Scandinavia [1]. PD is an approach that requires the involvement of products' potential users as participants to the design process. It has been characterized as an innovative co-design methodology, since participants are focused on finding a solution through investigating a problem. The participants finally evaluate the solution in order to validate that the final solution meets their expectations [2]. PD methodology is being applied, to a large extent, in pedagogical experiments of Human-Computer Interaction (HCI) research [2]. Based on participatory design theory, this approach is an iterative process of 'making' things tangible by using verbal and visual tools, 'saying' (discussing) about existing related techniques-tools-practices, and 'acting' or alternatively 'developing through practicing' [3].

The usefulness of participatory design is that it increases the chance of the final design to meet the expectations of the product's users [4]. Moreover, by using participatory design method developers can avoid a common mistake of designing an application for themselves instead of designing it for the product's users [5]. Throughout participatory design, participants express their thoughts and perspectives on a design problem, and by cooperating with each other, they have the chance to build a design, which will finally correspond to their expectations and aims [6]. Dyslexia, as a learning disability, prevents dyslectics to read or write fluently. This situation can deeply affect dyslectics' life by making often their adoption to the community difficult; the result is for dyslectic to isolate themselves and lose the interest of living a normal life [7]. Studies

have proved that assistive technology has helped dyslectics improve their reading skills [8], [9]. However, the majority of studies and experiments have been focused on children, even though cognitive impairments, like dyslexia, last for a lifetime and a high number of adults struggle with reading or writing due to dyslexia [10]. The above factors and the academic contribution of a research on participatory design with dyslectic participants were the mainspring of this empirical study. After a systematic research, we realized that studies on participatory design with dyslectic participants are very limited, even though dyslexia is a cognitive impairment, which strongly affects dyslectics' daily routine. With this study, we aim at contributing future studies on participatory design with dyslectic participants.

2 RELATED WORK

For the purpose of this study, we have searched for methods that have been applied for participatory design involving people with other cognitive impairments than dyslexia, because of the fact that we were not able to find any method of participatory design with dyslectics. We selected two methods, namely IDEAS and CI methods, already used on participatory design for people with a certain cognitive impairment of Autism Spectrum Disorders (ASD). Both selected methods consist of specific features appropriate for people with cognitive impairments, such as ASD. At this point, it is important to make clear that there are many similarities between Dyslexia and Autism, since Dyslexia and Autism are relative cognitive impairments. That means that people suffered by autism often are diagnosed with dyslexia [11], [12]. To begin with, the two selected participatory design methods consist of the four steps of an Introduction, Discussion, Brainstorming and Design. The main difference between each other is that the IDEAS method makes use of High-tech materials, while the CI method is more traditional than the former and it focuses strictly on Low-tech materials. The presence of a facilitator is required in both methods. Below there is a thorough analysis of both participatory design methods, applied to autistic participants.

In the IDEAS (Interface Design Experience for the Autistic Spectrum) method [13], initially the facilitator makes an Introduction of the participatory design study to the participants by using High-tech materials, e.g. videos, to inform them about the concept of the study, its goals and the process. On the Discussion step based on the content of the Introduction, the participants have to discuss and criticize the existing technologies for users with ASD that they watched on the video and talk about the presented technologies' designs. Afterwards, in the Brainstorming step, the participants generate, write as many design ideas as possible for a new technology for them, which they grade then. The final step, based on the previous brainstorming step, is the Development of the top design idea, which has been rated by the participants as the most efficient design idea for the autistic participants. In this step, the participants can use High-tech materials, e.g. computers, internet, videos, smartphones etc. in order for them to be inspired to generate as much efficient paper designs as they can. For developing paper designs, facilitators provide the participants supportive Low-tech materials e.g. post-it notes, color pens, markers, and pre-printed plastic icons.

Regarding the CI (Cooperative Inquiry) participatory design method [14], the whole process is taking place without any use of High-tech materials. To be more precise, at the Introduction step the facilitator presents verbally one or two existing software applications for users with ASD. The Discussion step is this, where the participants discuss about the presented, by the facilitator, existing software applications for users with ASD. Then, at the Brainstorming step, they write their thoughts about the previously presented pieces of software for autistic users, and they notice likes, dislikes or possible improvements. The goal of this step is for the participants to generate a variety of design ideas through combining their likes, dislikes and proposals for improvements. After

ending this step, participants write grade their ideas. On the final step of the Development of the design top rated design ideas, they create design paper prototypes for a new technology addressing to them. In this method, they are not allowed to use any High-tech material to get inspired. For developing paper designs, facilitators provide the participants supportive Low-tech materials e.g. post-it notes, color pens, markers, and pre-printed plastic icons. As we can see on the below table, the differences between the two participatory designs methods focus not only on the steps that they consist of, but also on the required Low- and High-tech materials on a case-by-case basis.

3 EMPIRICAL STUDY

3.1 Participants, Setting and Materials

Participants.

Three AOF dyslexia organizations agreed to participate in the empirical study by allowing us to observe how the two selected participatory design methods work with dyslectic participants. On observations three groups participated, which consisted of dyslectic adults aged from 20 to 57 years old. It is important to point out that the participants of Group_1 have been diagnosed with a high-level of dyslexia, which prevents them to read and/or write in comparison to the participants of other two groups. Groups' special education teachers –Maria Hyttel and Rita Cassøe- played a crucial role, as people with knowledge of dyslexia impairment. They contributed the study by translating parts of the process both in Danish and in English, or even representing dyslectic participants, when it was necessary.

Setting.

All the sessions took place at participants' schools of AOF-Vendsyssel of Hjallerup (Group1), AOF-Brønderslev (Group2), and AOF-Hjørring (Group3). AOF Danmark is a Danish educational organization, which provides free teaching to dyslectic adults to help them reduce their reading and/or writing difficulties, and improve their skills on reading-understanding, using and writing texts [15].

Materials.

The materials used in participatory design process were of two kinds: (1) Low-tech materials, e.g. Post-it Notes, Plastic Icons, Highlighters, Colored Pens and Pre-Printed Graphical Design Elements, and (2) High-tech materials, e.g. a webcam software 'CyberLink YouCam 5' in order to record the development-sessions, laptops and mobile phones. The whole process took place by respecting the rules of the signed agreement between us and AOF organization regarding ethical considerations, in order for any participant not to be stigmatized by the process.

3.2 Procedure

The sessions were conducted twice per week for a period of four weeks with Group_1 and Group_3, and for a period of three weeks with Group_2. All the sessions focused on applying the selected participatory design methods and observing participants in order for us to find out, how participatory design works with the dyslectic participants through the selected PD methods. The whole process took place with the dyslectic participants to create a range of designs for a reading software application, with the goal for the generated designs that will finally correspond to the dyslectic participants' ex-

pectations. The sessions were divided into two categories of the IDEAS-method sessions and CI-method sessions, and each category was separated into two parts of the Development part and Evaluation part.

IDEAS-Method Sessions.

The Development Part:

As it was mentioned earlier, the IDEAS participatory design method consists of the four steps of Introduction, Discussion, Brainstorming and Design. We applied the IDEAS participatory design method based on the method's guidelines [18]. In this participatory design method, all the three groups took part.

First step: At the Introduction step, the facilitator introduced the research to the participants by explaining them, in parallel, the process that they had to follow and the purpose of the research. A visual timetable presented the parts, rules and duration of each step. Regarding the video, we selected a video in Danish language, which video presented seven software applications for dyslectic users, as the most popular software applications tailor-made to dyslectic users' needs [19]. Regarding the video selection, we based on two main criteria of the language, which was the first and most serious criterion; the audience of the video consisted only of Danish people, who might face difficulties on understanding a foreign language. The second criterion was the descriptiveness of the video regarding the seven software applications.

Second step: At the Discussion step, the participants discussed with each other about what they liked or disliked on the software programs that they previously watched on the video. This discussion step was a preparation for the third step, since the discussion among the participants gave them the chance to think design ideas inspired by the previously presented software programs that they watched.

Third step: At the Brainstorming step, the participants received a pre-printed form (a Low-tech material), where they had to write a design 'Topic' for a reading software application. Then they should generate and write a number of eight design ideas related to the topic. This task was based on the previous 'Introduction' and 'Discussion' steps. Afterwards, the participants should rate their design ideas in order for them to find the special one that they should use on the Design step. All the 'Ideas Generation' pre-printed forms included rating boxes, where participants had to write a grade from 1 ('Terrible') to 10 ('Perfect'). The top rated design idea(s) should be built in the final Design step of the process. In case that someone of the participants faced difficulties in generating ideas, the facilitator was allowed to support them by giving them an extra pre-printed form (a Low-tech material) with a design topic and four, instead of eight, design ideas boxes. The pre-written design topic and the less number of design-ideas boxes, could facilitate and encourage dyslectic participants to generate design ideas. Below you can see a sample of the pre-printed form as an extra support. If the situation became more difficult and some of the participants were not able to think any idea, the facilitator was allowed to provide them a stronger support by giving more detailed pre-printed form (a Low-tech material). On this form, there were four pre-written design ideas of a specific design topic of a reading software application for dyslectic users. In this case, the participants had only to rate the design ideas, in order for them to draw it on the last step. Below you can see a sample of the extra supportive pre-printed form.

Fourth step: At the Design step, the participants received Low-tech materials, like Post-it Notes, Plastic Icons, Highlighters, Colored Pens and Pre-Printed Graphical Design Elements and a pre-printed Interface Design Template (See). With these Low-tech materials, they should build the best design idea(s) that came first among the total number of the design ideas after the rating process. At this step, it was allowed for the participants to use High-tech materials, e.g. internet, videos, mobile phones, etc. in order for them to be inspired to generate as much efficient design paper prototypes as they could.

CI-Method Sessions.

The Development process:

Based on the literature, the CI (Cooperative Inquiry) participatory design method consists of the four parts of Introduction, Discussion, Brainstorming and Design. As this is a more traditional participatory design method, there was neither visual support to the participants, nor any type of help provided by the facilitator or any High-tech source [13], [14]. We applied the CI participatory design method based on the method's guideline [18]. In the development-part of the CI-method participated only Group_1 and Group_3.

First step: At the Introduction step, the facilitator presented verbally two software programs for dyslectic users: The 'IntoWords' [20] and 'CD-ORD' programs [21]. We chose these two programs based on two criteria from our perspective. The experience was the first criterion, since the participants were experienced with one of the programs, the CD-ORD, since it is systematically being used by the AOF organization. The fact, that the participants already knew and were familiar with the design of the CD-ORD program, would facilitate them on the process of criticizing and finding its pros and cons. Regarding the 'IntoWords' software program is similar to the first one, but it was available only to iPhones. It is a fancy program but with less functions in comparison to the 'CD-ORD'. In our perspective, this selection could make the comparison between the two selected programs and, in parallel, the inspiration of design ideas easier for our dyslectic participants.

Second step: At the Discussion step and before participants start discussing design ideas with each other, they received colored Post-it notes and a pre-printed form, namely 'Sticky-notes' (Low-tech materials). On the pre-printed forms and by using the Sticky-notes, the participants should individually write likes, dislikes and/or any possible improvements regarding the presented by the facilitator software programs/applications for dyslectic users. Below you can see one participant's Stick-notes form with his/her likes, dislikes and improvement ideas.

We decided to give an individual character to this task to 'protect' the participants from any influence by their fellow-participants. Once they had finished this first part of the Discussion step, we came back to the cooperative character of the process, and the discussion among participants started. Participants discussed about the two presented programs and they expressed their opinions on them. Below we can see the dyslectic participants of a group to have started discussing on the presented software applications. The purpose of this step was to prepare dyslectic participants for the next step of Brainstorming. When ending the Discussion step, the participants would have already in their mind a general picture about what they like, dislike or suggested improvements on the already presented software programs.

Third step: In the Brainstorming step, the participants received a pre-printed form (a Low-tech material) and colored pens. The purpose of this step was to make participants think and write design ideas about a design for a new software application based on data from the former step of the Discussion. Below we can see participants while thinking and writing design ideas on the given pre-printed form. Once participants completed the Brainstorming step, they rated their design ideas in order for them to find, which one or what kind of combinations among their design ideas could lead them to a final design of a reading software application for dyslectic users.

Fourth step: At the Development step, the participants received Low-tech materials, like Post-it Notes, Plastic Icons, Highlighters, Colored Pens and Pre-Printed Graphical Design materials and a pre-printed Interface Design Template, where and with which they should make a design paper-prototype based on the design idea that came first after the grading process. In both participatory design methods, once the participants completed their design-prototypes put their prototypes on a mobile paper-prototype in order for them to present their work to their fellow-participants and us. In this way, we

would be informed about how their designs work, and what kind of help could a specific design offer to dyslectic users.

The Evaluation Part of IDEAS & CI methods:

Based on literature, once both IDEAS and CI participatory design processes were completed by all the groups, the final designs should be evaluated by the participating groups [13], [14], [18]. Specifically, each group should evaluate another group's generated designs. All the three groups took part in the evaluation process. Below you can see an evaluation map for each group and a sample of the evaluation process. The average grade of each final design was on a scale from 1 to 10. These numbers reflect the level of the efficiency of the final designs for the participants. Based on results we cannot talk about one ideal final design, because the differences among the grades are barely noticeable, especially among the designs that got a high grade (from 7 'Very Good' to 10 'Perfect').

Based on the designs' grades and participants comments, the final designs being full of words and providing many choices got a low grade (from 5 'OK' to 6 'Good Idea'), since dyslectics evaluated them as impractical or hard to use. Additionally, any foreign language feature was a strong reason for a final design to be graded low, since for instance an English logo might make difficult for dyslectics to find a useful app.

Final designs' simplicity proved crucial for the dyslectic participants considering those final designs' grades with less functions, which got a grade from '8' ('Great Idea') to '9'('Excellent Idea'). Final designs that explained distinctly their functions got a grade of '9' ('Excellent Idea'). This made us clear that descriptiveness of designs' functions was an important feature for the participants, since in other case the application may be distracting for them, as they said.

Final Designs' Evaluation by Greek participants:

Based on a previous literature research [22] the difficulty-level of a language depends also on the language-type. The difference between opaque and transparent types of languages affects the dyslectic peoples' reading performance [23], [24]. Therefore, we translated the Danish participants' final designs from the opaque Danish language into a transparent one (the Greek language in our case) and asked a number of nine dyslectic participants from Greece to evaluate them. Based on the evaluation we would be able to see, if there is any difference on the designs grading by participants taking a transparent language. The evaluation took place through online surveys. We cannot talk about one top-ideal final design, since the differences between the grades are barely noticeable, especially among the majority of the high graded final designs (from 7 'Very Good' to 10 'Perfect').

Designs with variable functions and colors got a higher grade in Greek language than in Danish one. The only design characterized as 'Complete' by the Greek dyslectic participants and taken the highest grade of '8.5' (higher than 'Great Idea' and lower than 'Excellent Idea') provided users variable functions and choices. On the other hand, Greek dyslectic participants did not show any preference on designs that were simple or with a small number of functions and colors. Conversely, a large number of them pointed out that such designs needed to become more attractive and they commented that 6 out of 8 designs need improvement. Similarly, to the Danish evaluation of the final designs, the designs explaining distinctly their functions got a better grade of '8' ('Great Idea'). This made us clear that descriptiveness of designs' functions was very crucial for the Greek participants –as it was for the Danish- since in other case the application may be distracting for them, as they claimed.

3.3 DATA COLLECTION

Throughout the empirical study, we collected data from sessions with the three groups of AOF regarding the collaboration of the dyslectic participants, problems that participants faced during the process, strengths of the empirical study during the process, and biases that may affect the evaluation of the final designs. We collected the participatory design data over a period of approximately one month. The data sources that we used were both qualitative (observations, video recordings, notes) and quantitative (online surveys). As we have already mentioned, the participatory sessions were divided into two main categories of (i) Development and (ii) Evaluation. All the groups took part in both categories of sessions except of the Group_2, which did not take part on the development session of the CI method due to the participants' dyslexia level. When possible, we collected data of the discussions and informal conversations among participants, facilitator and special education teachers though both video-records (in total 5h 47min) and notes (18 hand-written pages). We also gathered data through notes of participants' conversations on the final sessions for the design-evaluation and took photos of the final designs' rating. The table below is an overview of the total hours of the development process video records transcribed by evaluation session by group. Furthermore, we used two online surveys to gather information from both the participants and their special-education teachers. The online surveys were open-ended and they helped us gather information related to our areas of attention. Below is an overview of the three online surveys' focus: Online Survey 1: with a focus on the participants' opinion on the participatory design methods used and process. Online Survey 2: with a focus on the teachers' opinion on the participatory design, methods used and process.

4 DATA ANALYSIS

Video recordings' analysis was conducted in three phases inspired by the study of Nørgaard et al [25]. Initially, we transcribed the video recordings and partially translated them from Danish to English. Then, we segmented the recordings based on four areas of attention: Collaboration, Problems, Strengths, and Biases. Finally, we analyzed the transcriptions by trying to find among them parts related to our areas of attention. We also kept notes and conducted surveys during the sessions, which we observed. The whole process of data analysis was based on the Grounded Theory and Chi's proposals on analyses of verbal data [26] [27]. On the Findings section, we describe data aspects, which are important for the future studies to know when working on participatory design with dyslectic participants.

5 FINDINGS

As we mentioned on the previous section, we observed statements for the participants based on the four areas of attention: Collaboration, Problems, Strengths, and Biases. The areas of attention are described below with a focus on aspects that have been mentioned as important for the future studies on participatory design with dyslectic participants. Abbreviations have been used instead of the whole words in the following terms: Participant (P), Facilitator (F), and Teacher (T).

5.1 Collaboration

After observing the dyslectic participants' statements with a focus on the Collaboration area of attention, we found out that all the participants preferred to work as pairs or teams:

GROUP_1 – IDEAS:

P3: "Can we work together?" (P3 means as pairs)
F: "Of course you can. Why do you prefer to work together?"
P2: "Because it is easier for us when we work together."
GROUP_2 – IDEAS:
F: "Would it be possible for you to work as pairs?"
P10: "I'm not sure…"
T: "It is difficult for them to write anything."
F: "Then…we could do that as workshop. All together."
T: "Let's do it all together!"

To investigate the dyslectic participants' preference on collaboration we conducted the Online Survey 1, where all the participants answered that if they could choose how to work –with their fellow-participants or individually- they answered "with their fellow-participants". Furthermore, at the Online Survey 2 the special-education teachers corroborated the positive impact of collaboration for dyslectics. "They have been challenged to think creatively in terms of design. And they learned to collaborate and to accept a new way of collaboration." The results indicate that participatory design with dyslectics works more effectively, when participants collaborating between each other than working individually.

5.2 Problems

Throughout sessions, dyslectics seemed to enjoy the process to a large extent. However, after observing their statements, we found out that in some cases participatory design can become stressful for dyslectic participants or even make them have light tantrums. P3, P1 and P6 expressed the above statements under stress and even P6 had a light tantrum trying to 'translate' his/her design ideas into paper design prototype. These feelings may have been due to the difficulties facing dyslectics often on the writing conceptual area [22]. On the other hand, they may have been because of the lack of High-tech materials, which enhanced their creativity on the IDEAS developing process.

GROUP_1 - CI:
P3: "We have all the ideas in our mind but we cannot get it down on the paper!!! "
P1: "What we have to do is to draw the first page of an app, and write how it works and design it? How could we also use this to get help from dyslectics? I can't draw it!"
GROUP_3 – CI:
P6: "I think that it is more important to come up with ideas that could become real. I cannot draw them, but is more important for me to give you my ideas."

These results indicate that participatory design together with dyslectic people requires a facilitator experienced on dyslectics' emotional tantrums in order to conduct the process smoothly. In other case, dyslectics may feel frustrated and or even stop taking part to the process.

5.3 Strengths

On Strengths topic, which concerns the benefits of the participatory design for the participants, our findings focused on: Teachers as Proxy Users, and Facilitator experienced on dyslexia.

From the beginning of the sessions the special-education teachers had a vital role on the participatory design process as Proxy Users. Especially for the group where the participants had a high level of dyslexia the presence of their teacher as a Proxy User was necessary in order to represent them, when they were not able to express their thoughts.

GROUP_2 - IDEAS

T: “First Idea: "One application with one function, text to speech and reader and a scanner that modify the text to speech”, “Fourth Idea: "A translation function would be a nice idea”, “Fifth Idea: Suggestions of words' dictation and grammatical marks like comma, full stop etc.”

It was an advantage for the efficiency of the process the fact that teachers voluntarily took this role without even asking for this. The findings indicate that when dyslectic participants are diagnosed with a high-levelled dyslexia then participation of special-education teachers (or person from their close environment) as Proxy Users presence is deemed necessary, as they can contribute significantly the participatory design process. Similarly, it was advantageous for the smooth progress of the process the presence of an experienced facilitator, who was able to keep calm dyslectic people when being under stress, e.g. in a previous case, when participants got stressed or even they had light tantrums because they felt unable to carry through with design development.

An experienced facilitator has the knowledge to maintain a friendly and cozy atmosphere during the participatory design processes, and enhanced dyslectics’ productivity by making them feel always an important and crucial part of the process:

GROUP_1 - CI

F: “I don’t want to make you feel stressed or what else. It is ok for us to have your ideas. We can draw them for you! We are here to enjoy the process!”

GROUP_3 - IDEAS

F: “Don’t worry, it’s a game! Believe me! "Don't worry, it's a game! Believe me! You don’t need to feel stressed. Just relax and enjoy the process. You just need to sketch and play with papers and pencils”

Finding indicates that there is a requirement of a highly experienced person to address potential incidents in a way that will boost the process by encouraging dyslectics.

5.4 Biases

On Biases area of attention, our findings focused on:

- Dyslectics’ repetitive behaviors
- Same participants on bot design and evaluation parts

After observing the dyslectic participants’ statements with a focus on the biases area of attention, we found that some participants’ thoughts were affected by their fellow-participants’ repetitive behavior:

GROUP_3 - IDEAS

P6: “I think that this has to be very very simple…”, “I have written here simple. Because that is like the essence that it has to be simple.”, “This is a very very simple and actually it would help to be simple…”(P6’s words during all the four steps of PD)

Repetitive behavior is a typical symptom that appears on dyslectics sometimes. Finding indicates that in such cases facilitators have to be prepared to address such repetitive behaviors in order to avoid biases. It is important to make dyslectic participants clear, when a participatory design step starts and ends, what includes each step and that in case that a step does not include a discussion then the discussion is not allowed in order for avoiding distractive factors. A strong bias caused by a ‘bad’ allocation of the tasks that each group should take. This ‘bad’ allocation biased the final designs’ evaluation process, since some of the participants, who took part in the evaluation process, had already taken part on development process. Under such a circumstance, it was difficult for them to be fair and impartial. Findings indicate that regardless the limited number of dyslectic participants, there should be a clear allocation of the tasks that each group of participants takes, in order for the process to be unbiased.

6 DISCUSSION

In this section, we compare the results to related work, in regards to how participatory design works with autistics and dyslectic. Furthermore, we discuss a dyslectics' preference on the IDEAS method. We also discuss the different expectations of dyslectics based on their language's type. Finally, we discuss the implication that might have the involvement of dyslectic participants in designing technologies for dyslectic users.

6.1 Comparison of findings with related work.

Participatory design proved as promising as it was with children with ASD [18]. However, in the case of participatory design with dyslectic people, the process showed a more smooth progress than in the case of participatory design with autistics, since in our case there was not any need for an extra support on the collaboration among dyslectic participants. Additionally, even though dyslectics struggled sometimes on generating design ideas, they did not make use of any extra pre-printed supportive form. Conversely, children with ASD received a support on both collaboration and generation of IDEAS method steps of participatory design [18].

6.2 Comparison between IDEAS and CI methods.

Regarding the selected participatory design methods (IDEAS and CI), the IDEAS method seemed to be preferable to the dyslectic participants, since it worked better with them. Even though both participatory design methods gave the participants the chance to cooperate with each other, IDEAS method was proved that it enhanced dyslectics productiveness and creativity by providing them High-tech materials, in contrast to the CI method which made them struggle with generating ideas and developing of designs processes.

6.3 Participatory Design in Opaque and Transparent Languages.

After comparing the final designs' evaluations' from Danish and Greek dyslectic participants, we realized that the Greek language, as a transparent and simpler than the Danish language, gives dyslectics the opportunity to use designs that are more complex. Conversely, opaque languages, like the Danish one, increase the level of the simplicity on designs, in order for them to be efficient and useful to Danish dyslectic users.

7 IMPLICATIONS

The current research indicates that involvement of dyslectic people in designing software applications results in a tailor-made design of software applications guided by dyslectics' expectations. Of course, participation of dyslectic users in participatory design may have some implications for it. Any potential problems on collaboration, emotional tantrums, difficulties on expressing thoughts, limited imagination, and maybe a distracting focus on unnecessary details, may have implications on participatory design.

8 CONCLUSION

In this paper, we have described an empirical study on participatory design with dyslectic participants. The main goal of this study was to examine how participatory design works with dyslectic participants. Overall and considering the findings, participatory design was beneficial for the dyslectic participants and worked effectively with

them. Through participatory design, dyslectics had the chance to express their design ideas on a software application focused on dyslexia, and work on designing an application based on their expectations.

Based on findings participatory design can work efficiently with dyslectics only under certain conditions:

(i) collaboration among dyslectic participants is very important, since, in this way, dyslectics are more creative and productive,

(ii) a Proxy User participation is also important, since a Proxy User can represent participants with a high level of dyslexia, when it is necessary,

(iii) an experienced on dyslexia facilitator is necessary to take part to the process for avoiding incidences caused by dyslexia, and

(iv) a proper allocation of the groups by tasks is required for preventing biases.

Furthermore, based on dyslectics' special education teachers, through participatory design dyslectics managed to increase their attention on a task though cooperation and participating to this empirical study was a great motivation for collaboration among them.

In this study, one limitation that we faced was, in some cases, the language, which prevented us to communicate our thoughts efficiently and immediately to the participants. Language, in some cases, was a problem, since the majority of the Danish participants did not speak English and we were not native speakers of the Danish language. This limitation had as result the delay of the process sometimes. A second limitation was our skills on participatory design, since it was the first time that we worked on such a study. This limitation may have skewed to some extent some of the results

Regarding the future work, our dyslectic participants showed an interest in a future participation on a real software application's development based on the current study, and the special-education teachers corroborated this suggestion as beneficial for their students. Based on this, future studies might focus on Participatory Development of the product with Dyslectics. Furthermore, it might be beneficial for a future research on participatory design with dyslectics to take into account factors like dyslectic participants' age groups, the participants' level of dyslexia, and the other four conceptual areas. In this way the results might generalized, something that is missed from this study.

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10 REFERENCES

1. F. N. Stein, "Den Store Danske," 10. april 2017. [Online]. Available: http://denstoredanske.dk/index.php?sideId=255134.
2. C. Spinuzzi, "The Methodology of Participatory Design," Technical Communication, pp. 163-174, 2005.
3. E. B. a. T. B. Elizabeth B.-N. Sanders, "A Framework for Organizing the Tools and Techniques," 2010.
4. T. R. A. M. R. S. &. C. P. Val Mitchell, "Empirical investigation of the impact of using co-design methods when generating proposals for sustainable travel solutions," in International Journal of CoCreation in Design and the Arts, UK, 2015.
5. I. Anić, "UX Passion," Sunday November 2015. [Online]. Available: http://www.uxpassion.com/blog/participatory-design-what-makes-it-great/. [Accessed Thursday April 2017].

6. F. Labs, "Usability First," Foraker Labs, 2002-2015. [Online]. Available: http://www.usabilityfirst.com/usability-methods/participatory-design/. [Accessed Thursday April 2017].
7. Asha, "National Joint Committee on Learning Disabilities," Learning disabilities: Issues on definition, vol. 33, no. Suppl. 5, 1991.
8. L. Outhred, "Word Processing: Its Impact on Children's Writing," Journal of Learning Disabilities, vol. 22, pp. 262-264, 1989.
9. B. W. W. R. K. Olson, "Reading on the Computer with Orthographic and Speech Feedback: an Overview of the Colorado Remediation Project," Reading and Writing: An Interdisciplinary Journal, vol. 4, pp. 107-144, 1992.
10. J. Lerner, Learning Disabilities: Theories, Diagnosis, and Teaching Strategies(7th ed.), Boston: Boston: Houghton Mifflin Company, 1997.
11. Σ. N. D. K. ΨΥΧΟΛΟΓΟΣ, "ΤΟ ΦΑΣΜΑ ΤΟΥ ΑΥΤΙΣΜΟΥ: ΔΙΑΧΥΤΕΣ ΑΝΑΠΤΥΞΙΑΚΕΣ ΔΙΑΤΑΡΑΧΕΣ ΕΝΑΣ ΟΔΗΓΟΣ ΓΙΑ ΤΗΝ ΟΙΚΟΓΕΝΕΙΑ," ΣΥΛΛΟΓΟΣ ΓΟΝΕΩΝ ΚΗΔΕΜΟΝΩΝ ΚΑΙ ΦΙΛΩΝ ΑΥΤΙΣΤΙΚΩΝ ΑΤΟΜΩΝ, ΛΑΡΙΣΑ , 2006.
12. J. M. O. J. S. Stella Tsermentseli, "Comparison of Form and Motion Coherence Processing in Autistic Spectrum Disorders and Dyslexia," J Autism Dev Disord , vol. 38, p. 1201–1210, 2008.
13. L. Benton, "Participatory Design and Autism:Supporting the participation, contribution and collaboration of children with ASD during the technology design process," University of Bath, Bath, 2013.
14. A. Druin, "Cooperative Inquiry:Developing New Technologies for Children with Children," 1999.
15. "AOF," AOF Danmark , [Online]. Available: https://aftenskole.aof.dk/temaer/ordblindeundervisning/ .
16. M. J. Muller, "PICTIVE-An Exploration in Participatory Design," pp. 225-231, 1991.
17. "CyberLink," 2017. [Online]. Available: https://www.cyberlink.com/index_en_EU.html?r=1.
18. H. J. E. A. M. B. a. B. G. Laura Benton, "Developing IDEAS: Supporting children with autism within a participatory design team," in CHI'12, Texas, 2012.
19. K. Svendsen, "Youtube - Top 7 apps til ordblinde," 2012. [Online]. Available: https://www.youtube.com/watch?v=9fqf4MpyFj8.
20. "MV-NORDIC," MV-NORDIC, [Online]. Available: https://www.mv-nordic.com/dk/produkter/intowords.
21. "MV-NORDIC," [Online]. Available: https://www.mv-nordic.com/dk/produkter/cd-ord/vejledninger.
22. P. Vangeli, "Literature Research on Interaction Design of Systems for Dyslectic Users," Aalborg University, Aalborg, 2017.
23. Giovanna, "Italo Bimbi," Italo Bimbi, 22 November 2011. [Online]. Available: http://www.italobimbi.it/en/blog/57-lingue-opache-e-lingue-trasparenti.html. [Accessed 02 May 2017].
24. J. S. C. M. L. F. P. Madeira, "Assistive Mobile Applications for Dyslexia," Procedia Computer Science, pp. 417-424, 2015.
25. K. H. Mie Nørgaard, "What Do Usability Evaluators Do in Practice? An Explorative Study of Think-Aloud Testing," in Proceedings of the 6th conference on Designing Interactive systems , University Park, PA, USA, 2006 .
26. S. Pace, "A Grounded Theory of the Flow Experiences of Web Users," International Journal of HumanComputer Studies, vol. 60, pp. 347-363, 2004.
27. C. M.T.H., "Quantifying Qualitative Analyses of," The Journal of the Learning Sciences, vol. 6, no. 3, pp. 271-315, 1997.
28. J. R. Judith Good, "CARSS: A Framework for Learner-Centred Design with Children," 2006.
29. J. Nielsen, "TEACHING EXPERIENCED DEVELOPERS TO DESIGN GRAPHICAL USER INTERFACES," CHI '92, pp. 557-564, 1992.
30. V. N. J. B. a. L. B. A. Large, "Bonded Design: A novel approach to intergenerational information technology design," Library & Information Science Research, vol. 28, pp. 64-82, 2006.
31. K. H. Mie Nørgaard, "What Do Usability Evaluators Do in Practice? An Explorative Study of Think-Aloud Testing," vol. DIS , p. 9, 26-28 June 2006.