IMPORTANT FEATURES IN TEXT PRESENTATION FOR CHILDREN WITH DYSLEXIA

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ABSTRACT

Information and communication technology (ICT) plays an important role in providing solutions, support and hope for children with dyslexia. Teachers and parents acknowledge the capability of ICT to assist children in acquiring the lessons taught using educational courseware. Teaching dyslexic students requires more than just basic multimedia applications. Customized applications with an emphasis on special techniques are important to engage students with normal educational subjects. Research and studies in this area actively utilize the human-computer interaction (HCI) to increase the usability and success rate when developing a dyslexic's educational courseware. We conducted a few experiments to investigate the usage of text as one of a number of interesting features by which to increase usability. The interaction behaviors of children with dyslexia in the focus groups were then observed and analyzed. This paper reports the research findings that elaborate on how different formats of text can influence successful interaction in designing educational courseware for children with dyslexia.

Keywords: *Dyslexia, Usability, Interaction Design, Education For Children*

1. INTRODUCTION

For most of us, reading information on the web or using educational courseware is an easy job. We can quickly read and understand the information or instruction stated in the media without too many problems. However, for people who have learning difficulties (e.g. dyslexia), the situation might be different and can cause them anxiety and frustration. For a dyslexic, searching for and reading simple instructions (on the web or educational courseware) can be tough and time-consuming. The challenge to understanding the information is not due to an intelligence quotient (IQ) but rather the underlying circumstances faced by dyslexics to be able to read it like normal people.

Dyslexia is the most common learning difficulty in children and it was estimated around 10 to 17 percent of children will experience this condition[1] . Dyslexia is a condition that can affect reading, writing, mathematics orientation and coordination [2][3][4]. Children with dyslexia do not like to read, or read as little as possible, and find reading to be a painful activity. In addition to that, those with dyslexia have problems related to the inability to use short-term memory which is sometimes referred to as a neurological deficit [5][6] . They have a different level of cognitive skills, learning style preferences, competence and experience [7] . However, past and current studies have been explored to find ways to help dyslexics overcome their problems. Several studies have looked at the experiences of children with dyslexia using computer software and tools in supporting the acquisition of reading competence [8][6][9][10]. Through specialized education, and by using special tools and techniques, dyslexics can realize their potential, despite having difficulties in coping with their problems to acquire knowledge [11]. Implementing various techniques, for example, multisensory approaches, visual images and learning through games could increase their motivation and self-esteem [3][12].

2. DYSLEXIA IN MALAYSIA

In Malaysia, it was reported that dyslexia affects 5 to 10 percent of school children [13]. The Ministry of Education Malaysia has accordingly developed a Special Education unit in selected schools throughout Malaysia [14]. The objective is to make sure that children with learning difficulties such as Autism, Dyslexia, and Downs Syndrome

will have the same chances and opportunities in acquiring knowledge as mainstream students. To cater for the needs of these children, a small and special classroom has been designed that is conducive for teaching and learning to take place. This is to make sure that these children can give full attention to every lesson and activity designed by the teachers. Each classroom is limited to 8-10 children with one or two teachers involved in every lesson. Once the child has been identified as having dyslexia, he is taken out from his normal class to join this special class mentioned earlier. Focus will be given to three core subjects, namely: Bahasa Melayu, English and Mathematics, as dyslexia is characterized by severe reading, spelling and writing difficulties that are persistent to the usual teaching methods [15].

In the case of Bahasa Melayu and the English language, it was found that teachers will play videos that contain learning of words and letters through songs. The dyslexics were asked to sing along so that they would be able to recognize and remember the words and letters that have been introduced in the video. In addition, multimedia courseware was also being used as a supplementary tool in teaching the subjects mentioned earlier. However it was found that, most of the time, the teacher was the one who used the courseware while the dyslexics were asked to look and listen.

3. USING COMPUTER AND MULTIMEDIA TECHNOLOGIES FOR DYSLEXIA

Teaching children with learning difficulties requires a high degree of commitment and patience. Teachers and parents need to be creative in order to create an enjoyable and engaging learning atmosphere with these children. Dyslexic children can easily become distracted by their surroundings. They may easily get distracted and become mentally tired sooner than their friends [3] . Proper teaching tools and techniques that suit a dyslexic's personality need to be identified in order to motivate and encourage these children to be engaged with the teaching-learning activities[1][16].

Nowadays, information and communication technology (ICT) helps not only dyslexics but other people with cognitive disabilities in their daily activities [17][18][19]. E-learning, word processing or multimedia courseware are among the tools that have been used for quite some time. The developer of these tools

should know that their systems are not only accessible by normal users, but also those with learning difficulties like dyslexia [2]. Hence, developers need to adhere to certain design guidelines if the system is intended for dyslexics. Design considerations include aesthetics, accessibility, simplicity and usability aimed at enhancing readability for people with dyslexia [20]. The British Dyslexia Association has come up with a Dyslexia Style Guide (DSG) which contains guidelines for dyslexic readers [21]. Most of the guidelines can be used for improving access for people with other disabilities as well [22]. In fact, non-disabled users benefited greatly from adherence to the accessibility guidelines aimed at dyslexic users. An interview has been conducted with ten dyslexic Web users and concluded that there are considerable barriers to web use for dyslexics [23]. The study has revealed several patterns of behavior among the interviewees, including frustrations with both Web site structures and textual presentations. Dyslexics have different style preferences and each dyslexic is treated individually. They should be given the freedom to create a visual environment that suits their preferences [6].

This study explored one aspect of design guidelines for dyslexics, that is; how text presentation influences the interaction behaviors of children with dyslexia. The aim of this study is to find answers to the following questions:

i.   Which format or presentation of text is preferred by children with dyslexia when educational courseware or online material is used in the learning process?

ii. Which features in text do dyslexic children find useful to helping them in the learning process?

The findings from this study can be used as a guideline for designers to design effective material for children with dyslexia.

4. METHOD

A preliminary study to develop an understanding of the difficulties faced by children with dyslexia using educational multimedia courseware and computers has already been conducted [24]. The dyslexics showed a positive attitude towards the use of computers and educational multimedia courseware. Although they took some time to familiarize themselves with the

tools, after a while they were seen to be engaged with the learning activities. The dyslexic children were able to explore the courseware with minimal assistance. However there are some issues pertaining to the interface design that needs to be considered by designers when designing for dyslexics. The study in this paper was designed based on the findings that we had gathered earlier; that is, to investigate the interaction between dyslexia and different formats of text used in educational courseware or online educational materials. It is hoped that findings from the study will reveal the features of text in interaction designs for dyslexics and help them to minimize the impact of their condition when it comes to self-learning.

4.1 Participants

The study in this paper focuses on children aged between 8 to 12 years. They were divided into two groups. The non-dyslexic children consisted of ten children, being five girls and five boys. Further, eight dyslexic children who participated in the study were selected by the teacher in charge of the Special Education Class from Sekolah Kebangsaan Jalan Enam Bandar Baru Bangi. The study was approved by the Ministry of Education and written consent from parents was obtained. All the participating children had normal vision.

4.2 Materials

This experiment focused on dyslexic children who already know how to read at least a very simple and short story. The study was not conducted to assess their reading skills, but to observe their preferences and any existing difficulties in reading and learning using certain types of formatted text. Nowadays children not only acquire knowledge from text books, but they also need to seek information from the Internet or learning using courseware and online materials. The way in which text is presented may have a significant impact on usability for those with learning disabilities like dyslexics.

33 slides using MS PowerPoint were created. For this experiment, we focused on seven design elements (Table 1). The first element was to find out the font (typefaces) that the children were comfortable with and found easy to read. In order to do that, we referred to previous studies that focused on interface design guidelines [25]. Six types of font that were the most mentioned and highlighted in past research had been selected. In addition, the British Dyslexia Association (BDA) also suggested using these fonts for dyslexic users.

The second element indicated the size of text used, so as to identify which size of text the dyslexics found to be the most visible. The third element was the use of small and capital letters in text, to ascertain if any discernible difference exists when small and capital letters are being used in the learning content. The next item to be analyzed was to see whether the dyslexics found the use of underline, italic and bold fonts (as a way of emphasizing important words or information) more usable and visible. Color usage for text and background was also tested, where several colors were chosen to see the effect on the dyslexic of using these colors. The next element we tested involved the use of flashing and moving text. Normally, in educational courseware, developers like to add this element to make the courseware look more attractive to users, especially for young children. As a result, we wished to observe whether this element can also be used for dyslexic users. The last element was to observe the manner in which layout and spacing affect dyslexics' attention when reading information on the screen.

Table 1. Design Elements For Text.

No	Design Elements	Example
1	Typeface/font	1. Comic Sans
		2. Arial
		3. Verdana
		4. Tahoma
		5. Trebuchet Ms
		6. Georgia
2	Font Size	14, 20, 24, 28
3	Capital and Small letters	
4	Highlighting text	1. Underline
		2. Bold
		3. Italic
5	Color	Green, red, pink, black, white, blue
6	Animation of text	Flashing and moving
7	Layout and spacing	Screen with less and crowded text

4.3 Procedure

The experiment was carried out in a computer lab, with two children being tested and observed concurrently. They were presented with a set of slides containing a short paragraph of a story. There were 33 slides with different types of font, font sizes, colors and combinations of those elements. They were told that they needed to read aloud the paragraph on the slides to the researcher. They were then asked a few questions throughout the experiment. Basically, questions asked were to determine their preferences. They needed to choose which they preferred. This process was repeated and questions were presented in the same order for

all children. All comments and feedback were noted by the researcher.

We also used webcam in order to record their reaction and behavior while interacting with the slides. Time given was approximately 35-45 minutes for each child.

4.4 Findings

Based on the experiment, we observed a few notable findings. First, a font type that is visible and without curly edges should be used when information or instruction that needs to be read and understood is presented. Dyslexic children expressed a preference for Comic Sans MS. This preference is in accordance with design guidelines that suggested the use of sans serif fonts in presenting text for dyslexics [26]. Second, small fonts should not be used as they are difficult, not only for dyslexics, but for other users to read quickly and easily. An option for altering text sizes can be added to allow dyslexic users to choose whichever size he feels comfortable with. Third, it was decided to try not to use capital letters as it takes more effort for dyslexics to transform capital letters into meaningful words. Fourth, the use of 'Bold' was determined to be useful for focusing attention and for identifying important information.

Fifth, it was decided to avoid using light text with a dark background, or using black for the text with white as the background color, in line with the suggestion mentioned by [23]. In line with the recommendations, it was suggested to use dark blue or black on a pale blue or yellow color for background and text [21]. Sixth, it was recommended to not have the text moving or flashing, as it can lead to visual stress and discomfort when reading the text [27]. Lastly, the information presented should be divided into smaller parts with fewer words on each screen. Dyslexics dislike screens with many texts, as they may become confused, hence leading to frustration and feelings of demotivation.

Feedback from the children on design elements and what they found to be useful about each element are detailed below. Table 2 shows the findings of seven design elements between dyslexic and non-dyslexic children.

Table 2. Summary Of Findings.

No	Design Element	Dyslexic Children
1	Font	Most of them prefer Comic Sans MS.
2	Font Size	All of them prefer a larger font size, that is, 28. They have difficulties with slides that use text with a smaller size than 28.
3	Capital and small letters	Six out of eight dyslexics stated that they prefer reading text using small letters
4	Highlighting text	All eight dyslexics chose 'Bold' as the indication for important words. Italic font is difficult for them to see.
5	Color	Most of them prefer text using black color or dark blue and they chose light blue as a background color.
6	Animation of Text	All of them disliked flashing and moving text as it is difficult for them to understand the text
7	Layout and spacing	Most of them prefer less text on one screen.

No	Design Element	Non-dyslexic Children
1	Font	Half of the children opt for Comic Sans MS and others prefer Arial and Verdana.
2	Font Size	Most of them have no problem reading text with size 20, but overall, they prefer a larger font size as it is easier for them to read.
3	Capital and small letters	Most of them have no problem reading the text using either small or capital letters.
4	Highlighting text	Five of them choose Bold and italic fonts to indicate important information.
5	Color	The majority chose a black color for text and white or light blue as the background color.
6	Animation of Text	Four out of ten children stated that flashing and moving text can attract their attention to read the text. Similarly, others have no problem reading text that is moving or flashing.
7	Layout and spacing	Overall, they also prefer less text in a screen because it is easier for them to read and understand the information

4.4.1 Font

All dyslexics chose Comic Sans MS. They said that it made the reading seem more approachable. Five of them seemed to become confused and took a longer time to read with slides that use other types of fonts. They informed us that they did not understand, and were not familiar with, certain letters. We subsequently discovered the following, namely: they were unable to interpret the letter "a" using Arial; the letter "g" looks awkward using Trebuchet MS and the letter "c" looks like letter "a" when using Georgia. One of the dyslexics said: (*"Teacher, there is something wrong here..why there is number 8 here. I do not understand..")* . He pointed to a word with the letter "g" using Trebuchet MS. However, there were no issues reported with text using Comic Sans MS.

For non-dyslexic children, no usability issue such as unfamiliar letters was reported. They seemed to have no problems reading the text while using different types of fonts. Table 3 illustrates the

difference in format of letters "a", "g" and "c" using different font types.

Table 3. The Difference In Format Of Letters Using Different Types Of Fonts.

Arial	the little girl wore a red riding **cloak** a
Trebuchet MS	the little **girl** wore a red riding cloak g
Georgia	the little girl wore a red riding **cloak** c
Comic Sans MS	the little **girl** wore a red riding **cloak** a g c

4.4.2 Size

All the dyslexic children preferred a larger font size, as it is easier for them to read the text without the need to get closer to the monitor screen. We observed that they felt intimidated with smaller font sizes, as they needed to move their heads closer towards the monitor screen. Moreover, we noticed that most of them automatically rubbed their eyes and blinked quite often when it came to slides using smaller font sizes. One of the dyslexics commented *("...just now I cannot see the words..but I think this one is much better and I can read it.")*. He was referring to a slide using size 28.

As for non-dyslexic children, although all of them can read even when using smaller text such as size 14, they have been shown to be more comfortable with text that uses a larger size, such as 20. One of them commented that it is easier for him to read, as the text is clearer. *("This one is easier for me to read and I can easily find my spot on the next word")*. He pointed to a slide using size 24.

4.4.3 Capital and Small letter

Six out of eight dyslexics prefer text using small letters. We were informed by one of the teachers that capital letters take a longer time for those with learning difficulties like dyslexia to interpret the letter into meaningful words. We also understand that they were being taught and introduced with small letters quite often as compared with capital letters.

As for non-dyslexic children, no issues were reported, as they showed no problems reading either capital or small letters.

4.4.4 Bold

Overall, most students liked the bold font in general and found it to be useful. All eight dyslexics mentioned that they preferred the bold font compared with underline and italic. One of them mentioned that when he read the story, he saw that certain words were darker than other words. This was an important point that the teacher wanted to make him aware of. Bold font contributes to a better reading experience for them, as it helps focus their attention and increase their confidence while reading. On the other hand, three of them reported that text in italic font and underlined text or words was distracting. We also observed that one of them took a longer time to read sentences having italics in one of the words or text.

In the case of non-dyslexic children, all of them said that bold, underline and italic fonts helped them read less and they can thereby identify important information. Five of them informed the researchers that the bold and italic fonts were useful because it helped them to remember what is important. From the findings, it clearly shows bold font to be helpful in accentuating important information. However, it is important to avoid using too much bold font in sentences, as it may lead to confusion. Normally bold is used to highlight key sentences, titles and headings and to help users identify what is most important from the text.

4.4.5 Color

The use of colors in designing web and educational courseware plays an important role in attracting users' attention. For children, the learning activity will not last long without a proper use of colors for text, background and images. The children might become easily bored. For the dyslexics, there are certain colors that make their eyes feel uncomfortable. We have tested, and we agree, that in designing materials for dyslexics, colors do affect their motivation in learning. Pink, red and green were among colors that designers need to avoid, as past research has stated that dyslexics experienced problems if text or screen/page backgrounds used these colors [20][21]. In this experiment, we found that five dyslexics preferred black color for text, while the rest chose dark blue. For the background, all of them preferred light blue. One of them told us that

he would appreciate being given flexibility to choose and change whatever colors he liked. He asked *("...teacher, can I change this one to blue and that one to purple?")*

For non-dyslexic children, we can see that they enjoyed screens having colorful text. But most of them preferred black to be used for text and white as the background color. When considering creating materials for dyslexics, flexibility allowing a user freedom to select and choose their preferred color from the options available could help to accommodate their preferences.

4.4.6 Flashing and moving text

Screens with flashing or moving text can lead to visual stress and discomfort when reading [27]. We noticed that five dyslexics tried not to look at screens containing those elements. One of them mentioned that it hurt his eyes. *(" I don't like this one teacher..my eyes hurt..why is it moving here and there?").* He was referring to a slide that had moving text on one paragraph. Flashing and moving text is used to attract a reader's attention, but that is not the case for those with dyslexia. Non-dyslexic children appeared to have no problems with flashing and moving text, indeed most of them enjoyed it as some of them claimed that it triggered their attention.

Generally, flashing and moving text is used to highlight words to make them stand out from others. But if the users have learning difficulties like dyslexia, other strategies need to be identified. From our study, we found that the use of bold font, where the color of certain texts is darker than others, triggered a better response from the dyslexics. The use of bold font is not only to indicate important points in reading, but at the same time to help dyslexics to focus their attention in the learning activity.

4.4.7 Layout and spacing

All children found the layout and spacing to be useful in some way. One of the dyslexics said that fewer texts in one screen made the activity of reading the story easier because his eyes do not have to look at so many texts and at the same time try to understand what it is all about. In addition, another two dyslexics and five out of ten non-dyslexic children said that the spacing made them more able to keep their place while reading. One of the dyslexics commented that he can see letters jumping up and down when referring to slides that contained more texts and were crowded with letters. *("..why do all alphabets keep on jumping up and down...and it doesn't stop...please teacher make them stop..").*

To make the texts less intimidating to dyslexics, we suggested breaking or chunking the texts into smaller paragraphs. In this way, the dyslexics do not feel there are so many texts on every screen that may lead them to skip reading the paragraphs. On the other hand, considerable use of plenty of white space on one screen may also help their eyes to move from one word to another much better. It is also advisable to increase the space between lines of text to at least 1.5 lines. This will enable them to feel more comfortable and, at the same time, their eyes will not simply skip lines of text without noticing them.

5. CONCLUSION

We examined the effects of different formats of text, and how they are presented in an interaction design while observing the resulting impact for children with dyslexia. The results suggested that features in a text might affect the cognitive behavior for children who had dyslexia compared to non-dyslexic children. Findings from the study have raised a number of important issues related to text and how it is supposed to be presented in learning modules. These findings, coupled with other design elements, can be used to resolve learning difficulties encountered by children with dyslexia. It is also suggested that a larger population of dyslexics' focus groups could provide a better insight into the research objectives, while also confirming key features. Another interesting study that can be researched is to gauge the results on multiscreen devices (i.e. tablet, smart phones, smart TV and PCs) using the same text features. Further research in this area aims to establish a model combining the best working elements in designing a highly usable dyslexic educational courseware.

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