

Online Learning for Individuals with Dyslexia: A Literature Review

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Abstract—Although there are relative researches on dyslexia, little is known about the difficulties of those with dyslexia faced when exploring internet for learning. This paper conducted a review of papers to investigate the existing researches and work done related to online learning for individuals with dyslexia. It is aimed to identify the currently available knowledge about dyslexia and online learning. The results of the searches clearly show that there are limited researches on the needs of people with dyslexia and problems encountered in online learning. Most of researches context revolved in higher education where the samples are adolescent and adults. From the aspect of the media used in online learning, synchronous and asynchronous text based chatting were more focused in research. Based on the review of the nine articles, three main research themes including design guidelines, engagement with different media types and online learning systems for individual with dyslexia were identified. It is reviewed that although online learning has a large acknowledgement for its benefits in distance learning or personalized learning, the guidelines for current online learning design may not beneficial all the users such as people with dyslexia. Based on the review, the authors of this paper have identified a need for the application of specific design principles in the development of online learning accessibility to provide equal accessibility and inclusive education for all levels.

Index Terms—dyslexia, online learning, design guidelines

I. INTRODUCTION

The word *dyslexia* is made up of two parts with *dys* meaning ‘not’ or ‘difficult’ and *lexia* meaning ‘words’, ‘reading’ or ‘language’. In general, dyslexia means having difficulty with words [1]. Based on definition given by British Dyslexia Association [2], “*Dyslexia is a specific learning difficulty that mainly affects the development of literacy and language related skills. It is likely to be present at birth and to be life-long in its effects. It is characterized by difficulties with phonological processing, rapid naming, working memory, processing speed, and the automatic development of skills that may not match up to an individual's other cognitive abilities*”.

Dyslexia is not a disease so it cannot be cure and may continue to occur in the stage of adolescence and adulthood. Besides reading and writing, individuals with dyslexia may display a range of characteristics such as short term memory, difficulties with automatizing skills (e.g.

listening to teacher and taking notes at the same time) and problems with visual processing (e.g. when dealing with large amount of text, text may appear unstable). However, with appropriate interventions and instructions, the severity of the symptoms of dyslexia can be reduced. Dyslexia does not only occur in alphabetical language but also in other language such as Mandarin [3].

Despite traditional learning environment, online learning is currently widely used among learners of different levels of literacy. However, the online learning experience may be different among those with learning disabilities, dyslexia to be specific. Online learning is an improved version of distance learning. The term e-learning and online learning is often interchangeable. Online learning in this paper refers to online environment with the use of technology for learning [4]. The main aim of this paper is to explore literature about issues related to the use of online learning among individuals with dyslexia. Such a review provides insight into the status of work done to understand and enhance the online learning experience of this group of learners.

II. METHODOLOGY

This paper focuses mainly on related peer-reviewed developmental and empirical research studies. This review involved the extraction of English written related literature from EBSCO electronic database. The key words used initially for searching were online learning” and “e-learning”. Subsequently, the search results were further narrowed down to “dyslexia”. Finally, related articles are filtered manually. Although the search was set from the year 2000 till current, the search result only revealed articles that are dated from the year 2005 till 2014.

This paper is an add-on to the existing literature review of McCarthy & Swierenga [5]. Although there are similar literature review done in areas related to accessibility and online learning of dyslexia [6], [7], [5], the review of [5] appears to be more comprehensive. The researches reviewed by McCarthy & Swierenga [5] are excluded from this review to prevent repetition.

This study reviewed in this paper was narrowed down to six empirical studies and three non-empirical studies. The results of the distribution of empirical studies and non-empirical studies are displayed in Table I and Table II, respectively.

TABLE I. DISTRIBUTION OF EMPIRICAL STUDIES REVIEWED IN THIS ARTICLE

Journal Title	Number of Articles	Empirical Study
Behaviour & Information Technology	1	Fajardo, Cañas, Salmerón, & Abascal (2006)
Computer and Education	1	Woodfine, Nunes, & Wright (2008)
Journal of Computer Assisted Learning	1	Habib et al. (2012)
Library Hi Tech	1	Dermody & Majekodunmi (2011)
Literacy	1	Barden (2012)
Research in Learning Technology	1	Barden (2014)

III. FINDINGS AND DISCUSSION

The nine articles were reviewed and the findings are presented in this section. First, the researchers provided a general picture of the six empirical studies by providing a matrix. Second, the researchers identified the research themes explored by the current literature. Based on the

review of the nine articles, three main research themes including design guidelines, engagement with different media types and online learning systems for individual with dyslexia were identified.

A. Matrix of Current Research

Researchers examined the empirical studies from the aspect of theoretical frameworks, research goals, contexts and participants, tasks, and research methods and instruments. The detail findings are presented in Table III.

TABLE II. DISTRIBUTION OF NON-EMPIRICAL STUDY

Journal Title	Number of Articles	Study
Medical Education Online	1	MacDougall (2009)
Procedia Social and Behavioral Sciences	1	Andruseac, Rotariu, Rotariu, & Costin (2013)
Universal Access in the Information Society	1	Gregor & Dickinson (2006)

TABLE III. MATRIX OF 6 EMPIRICAL STUDIES

Study	Theoretical / conceptual frameworks	Research goals	Contexts and Participants	Tasks	Research methods & Instruments
Barden (2012); Barden (2014)	Digital mediated social network	Educational affordance of Facebook	Five A-level students with dyslexia	A project involving teacher-researcher and student-participants co-constructed a Facebook group page about dyslexia.	Combination of case study and action research using participant-observation, semi-structured pre- and post-project interviews, video, dynamic screen capture and protocol analysis
Dermody & Majekodunmi (2011)	Online database accessibility	University students with print disability's experience in searching and their use of screen reading software to navigate databases.	Ten undergraduate and graduate students with print disability and had experience using screen reading software	One task to access and read the first page of two full text academic articles by performing a search for three databases respectively	Qualitative study using pre and post-survey and observation through video and audio documentation
Fajardo, Cañas, Salmerón, & Abascal (2006)	Web accessibility	The effect of substituting textual links for graphical on deaf signers' performance in hypertext information retrieval	21 deaf signer users and 24 hearing users	A task to find sections of a newspaper implemented in hypertext with different format	Quasi-experiment design with independent variables of interface format, type of users and path length. The dependent variable was web accessibility
Habib et al. (2012)	Online learning	Students with dyslexia's learning experience in the use of virtual learning environment	Twelve adults with dyslexia and non-dyslexia (students of higher education or graduated)	Twelve different tasks in a fictive room in the virtual learning environment Fronter	Mixed method using interviews, questionnaires and laboratory experiments
Woodfine, Nunes, & Wright (2008)	Online learning	To investigate the problem faced by students with dyslexia in synchronous online learning environment	Four groups of three and four groups of five university students with each group involving student with dyslexia	One authentic problem to solve within a limited time frame in group.	Qualitative study involving experiments using pre and post-questionnaire, interview and conversation logs

Most of the research focused on higher education [8]-[11] where the samples used are adolescence and adults. The experimental research involving participants with

dyslexia involved a relatively small number of samples [8], [12], [9]. There is a need to highlight that even though participants in research conducted includes both

individuals with dyslexia and non-dyslexia individuals, only data from the perspective of dyslexia is presented in the result and discussion [9], [11].

Two set of experiments with the involvement of students with dyslexia and normal students were conducted to investigate on the problems students with dyslexia faced while engaging in text based synchronous online learning environment [11]. The first set consisted of three students in a group while the second involved five students. Students are required to solve an authentic problem within the time frame given. Post questionnaire were given to participants immediately after the experiment to access their feelings as a reference for the interview which is the following week after the study was conducted. However the delayed of interview might affect the accuracy of the answers given by the participants as their memories of their experience from the aspect of feelings, difficulties and impression of participation by others might fade as time pass [11]. Further study can be exploring the effect of the group size on the experience of individuals with dyslexia in synchronous learning and compare the use of different type of media besides text based such as video or audio in synchronous online learning.

B. Design Guidelines

Reference [12] reported three ongoing studies focusing on the two main categories of people with cognitive difficulties that are dyslexia and elderly people. Instead of adding on the design currently available, reference [12] argued that design of interaction should emphasize on the needs of the users. Information system that is compatible with assistive technology allows the alteration on the way the content is presented. However, it caused difficulties users with cognitive impairments at the same time as the interface may not have direct access to the functionality. Furthermore, the study of the use of screen reader while conducting search in online database for print disabilities students highlighted the need of online learning environment to be compatible with assistive technologies for those with learning disabilities [13]. With new approaches tackling the problems users faced, the accessibility of people with cognitive difficulties can be improved by having better interaction design utilizing the current technology. For instance with the use of See World, personal word processing environment with direct interface, reduced cognitive load and personalized setting which support individuals with dyslexia in reading and writing [12]. In order to comply with the need of person with dyslexia, the design of online learning environment should not only focusing on adding in features that is suitable for person with dyslexia based on the current design, but to implement a new design guidelines.

On the other hand, [14] listed out a design guideline of online learning resources to support undergraduate medical students with dyslexia and dyscalculia in statistics based on previous literature. The guideline includes the interface design which allows better navigation of information needed and the text presentation such as the use of Sans Serif font and bullet points to facilitate the reading of students. As the guideline has a specific target group, there are recommendation on the design for the

materials of statistic involving the graph and statistical results. Therefore, the design guidelines for person with dyslexia should also be categorized based on the disciplines or subjects of online learning.

Although assistive technologies are suggested, but the author strongly advise the consultation of the professionals before implementing it on online learning materials [14]. Word processor received positive feedback from individuals with dyslexia as it helps in highlighting the mistakes made with spellchecker and grammar checker in which they might not realize the present of mistakes without rereading it for several times [9]. Assistive technologies play a crucial role in overcoming the problems faced by individuals with dyslexia.

The design interface of online learning environment such as the function of buttons shown and searching for location of folders which the named do not reflect their contents required a lot of effort for students with dyslexia in using online learning environment. Online learning environment should allow the user to personalize their learning environment to avoid overload of information that are unrelated to the users such as calendar [9]. Although online learning environment can be used both for social and academic purpose, students with dyslexia had to use extra time to filter information as both types of information displayed at the same platform [9]. The findings of [9] also reveal that there is a need considering the issues of pedagogical and didactical design of courses in designing the interface of online learning environment. The consistent and homogeneity in terms of online learning environment use across the same program allows the dyslexia users to be familiar with the usage which reduced the cognitive load while using online learning environment.

Individuals with dyslexia face difficulties in focusing on the text that is crowded with pictures (or moving and blinking elements) and links and where navigation requires the use of scrollbar when reading on screen [9]. The information that is presented in different media such as video and visuals besides text allows students to understand the content based on their own pace. Rich sources in Facebook create awareness of students meta-cognitive in their learning approach [8]. Students with dyslexia can personalize their reading and writing method by choosing the media they prefer [8]. There is a need to provide the element of personalization in the design guidelines of online learning where individuals with dyslexia can change the settings based on their own preference and learning styles.

C. Engagement with Different Media Types

Text based synchronous online learning activities show evidence that it can isolate, demotivate and disappoint students with dyslexia as they have difficulties in reading, spelling, word order and argumentation [11]. Students with dyslexia fell behind other normal students in the text based synchronous online chat as they need longer time to read and comprehend the text-based chat. The spelling and word order used by student with dyslexia confused other members in the group and make it hard for students with dyslexia to participate actively in the

chat. These findings are similar to research conducted by [9] where dyslexia individuals cannot keep up with the speed of communication from the aspect of reading and writing in chat-based tools. The use of acronyms, abbreviations and other types of Internet jargon by non-dyslexia users cause confusion to dyslexia users.

Besides that, students with dyslexia that are lack of confident may affect their participation in synchronous learning environment [11]. This shows that engagement of students with dyslexia in online learning environment may depend on their self-esteems and emotions despite the type of computer mediated communication used. Individuals with dyslexia tend to hesitate to post on social network where their posts are exposed to large amount of readers. They are worried of others are aware of their writing mistakes. This will further affect their willingness to participate in group work with others in collaborative writing [9]. However, the collaboratively researching on the topic "dyslexia" among the students with dyslexia helps to develop their identities as individuals with dyslexia [15].

On the other hand, [8] showed that synchronous communication through Facebook allows students with dyslexia to get instant response and keep track of the conversations. Asynchronous interaction through wall posts in Facebook function as a reminder which allows the students to refer when they forget. Furthermore, the interactivity among the online group formed by students with dyslexia creates the feel of being "experts" and "helpers". Students showed commitment in the group where their involvement is crucial to others. This shows that the effect of having students with dyslexia in a group and mixture of students with dyslexia and normal students in online learning environment. Students with dyslexia feel the support from their companion when they face the same issues in using online learning environment.

D. Online Learning Environment for Individual with Dyslexia

A developmental research developed an online learning platform in Romania language for personalized therapy and online monitoring of dyslexia patients [16]. The target group of this platform is for patients with speech and cognitive disorders age from 7 to 12. The platform is divided into two parts: a) application for patient's management and b) recovery module for rehabilitation process of patients with dyslexia. Besides dyslexia patients, speech therapists and administrator are part of the management system. Interaction can be made through synchronous and asynchronous for the all the users. Recovery module has four distinct components which helps patients with dyslexia to practice their pronunciations, cognitive, reading and understanding both verbally and written. Besides allowing responses in multiple possible, all the exercises of recovery module comes with level of difficulty and personalized feedback.

IV. CONCLUSION

In this review of literature, the researchers examined

the past studies in peer reviewed journals on online learning of dyslexia from 2005 to 2014. The findings indicate that online learning researches were widely conducted in tertiary education. Three research themes were identified and discussion on each theme was synthesized. Future research on online learning for dyslexia should also covered secondary and primary educations besides the tertiary education and adults. The literature provided general design guideline for online learning. In depth research can be conducted to explore on design guidelines for each disciplines or subjects in online learning materials. Besides difficulties with reading and writing, engagement of individuals with dyslexia in different types of media is also influenced by self-esteem of learner. However, the engagement of learners in group on asynchronous online learning is left unclear. Most of the studies only include individuals with dyslexia where the results only proven beneficial to individuals with dyslexia while the effect on non-dyslexia individuals are neglected. Based on the review, the authors of this paper have identified a need for the application of specific design principles in the development of online learning accessibility to provide equal accessibility and inclusive education for all levels.

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