Reading Discrepency and the Promise of Computer Technology

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ABSTRACT

Computer technology is one of the promising tools for students with reading discrepancy. In the first section this paper discusses previous studies related to computer technology which is used to improve reading. Second section puts forward reviews on research that has been carried out on augmented reality technology and learning. Summarized data from 2001 to 2008 are also highlighted as evidence on how augmented technology improves reading. This paper finally put up the proposed Bahasa Melayu augmented reality books for students with reading disability.

Keywords
Computer technology, augmented reality, reading disabilities student.

1.0 INTRODUCTION

Computer technology can be utilized as a supercharger to improve reading ability amongst students, especially those with learning disabilities. Teaching and learning (TL) in information age demand educators to fully utilize the 'power' of this technology. Computer technology has enhanced the development of sophisticated devices that can assist more than two million students with various disabilities – from speech and hearing impairments to blindness and severe physical disabilities (Glaser, 2000). TL with technology allows educators to meet the needs of student with different abilities and disabilities, at the same time increasing the motivation.

One of the emerging computer technologies is called augmented reality (AR). AR works by overlaying seemingly-real object in real environment. It can be utilised to capture students' attention and engage them in learning. In reading, students with reading disability need to repeat the reading process until they become completely proficient with the words.

Despite the technology that is available in TL, there are still challenges in developing the courseware for the student with reading disabilities. Furthermore there is no courseware using AR technology available for the purpose of TL Bahasa Melayu.

This paper reviews previous studies carried out related to reading approaches, technologies used including AR and students with reading disabilities. We would like to find out how AR is used in the previous research, specifically for improving students' motivation and the reading process. The research question addressed here is: Can AR be used in teaching students with reading disability to read in Bahasa Melayu?

Previous studies indicate that AR is promising in improving students' reading level. However, to fully determine the effect on student reading performance with AR technology we need significant data and further analysis. Thus, the significance of this work is to serve as a review of literature that reports on the readiness of AR technology for implementing reading Bahasa Melayu prototype in order to serve and enrich educational practices.

2.0 BACKGROUND

2.1 Learning and Reading Disabilities

Learning disabilities is a general term that refer to heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities (Lerner, 2003). It gives the effect to the brain's ability in order to receive, process, analyze, or store information. Previous research state that at least 80% of student with learning disabilities have problems in reading (Lyon & Moat, 1997; Kirk & Elkins, 1975) or we can infer that about 3.5% of the school population (Shaywitz, 2003). Learning to read is not a simple and natural process for reading disabilities student in order to "read to learn".

Reading is one of the language systems. It relates to oral language (listening and speaking) and writing. Process to recognise the word is complex (Lerner, 2003) and readers must use various techniques, methods, approaches in order to master it. Moats (1998) identified five stages that children need to pass through in learning to read they are, logographic reading, early alphabetic reading, mature alphabetic reading, orthographic stages (recognizing syllables and morphemes) and gaining fluency.

Reading disabilities is a condition for those who suffer a neurological and developmental condition. In medical terms they are called dyslexia. In table 1, the term for reading disabilities are explained in details. Dyslexia also gives problems in writing, motor skills, spelling, decoding activities, memory, cognition and mathematics.

Table 1: *Terms: Reading disabilities.*

| Terms	Explaination
Dyslexia	Dyslexia refers to severe difficulty in language, especially reading and may also have difficulties with spelling, understanding language they hear or expressing themselves clearly in speaking or in writing (Lerner, 2003).
Word Blindness	In 1895 Dr. James Hinshelwood introduced the terms word blindness to refer to reading disabilities.
Phonological Processing Deficit (PPD)	Difficulties in changing the word into sounds, error in identify the word and wipe out the character in the word are the characteristics in PPD.
Strephosymbolia (twisted letter)	Dr Samuel T. Orton, America neurologist suggested the word "strephosymbolia," which means "twisted symbols," to replace "congenital word blindness" to imply to reading disablities.
Visual Stress / Meares-Irlen Syndrome	Visual stress happens when character and word run and getting blur which reader had a difficulty to maintain the reading. This involves 20%-30% world population (Irlen, 2005).
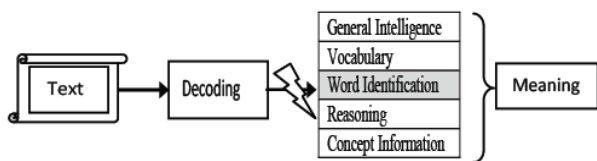
Figure 1: Going from Text to Meaning (Shaywitz, 2003)

A phonologic weakness blocks decoding, this turns interferences with word identification (Shaywitz, 2003). This condition prevents a reader to get a word's meaning. Figure 1 show the problem area occurred. As another example, Irlen (2005) address five factor that affects a person who has scotopic sensitivity syndrome or visual stress which are light sensitivity, inadequate background accommodation, poor print resolution, restrict span of recognition and lack of sustained attention. This factor should be considered when designing the reading prototype using AR for student with disabilities.

2.2 Computer Technology is a Tools for Reading Disabilities Student

Students by nature are using traditional textbook in learning to read and reading to learn. Traditional textbooks have certain limitations in supporting learners to develop understanding and their development skills (Chen, 2006) which rely on text and static 2D illustrations. In contrast, AR offers an interactive reading, which and educator agreed that *"What you get is what you experience (WYGIWYX)"*. Experience is the best teacher (Loftin et al., 1993). This helps reading disabilities students to get the picture with visualization from AR. In the same way gives understanding and relation to their experience.

In order to help students to read and understand the contents a lot of research and development have been done with computer technology. Activities and software program can help student with disabilities to overcome their reading difficulties (Lewis, 1998). Examples are Speech synthesis (www.rfbd.org), Kurzweil 3000 (www.kurzweiledu.com/kurzweil 3000.html, educational reading software (www.talkingfingers.com, Rocky Mountain Learning Systems (www.rmlearning.com), Windows Eyes (www.gwmicro.com), and Phonic Software Program (www.spencerlearning.com). Table 2 summarized the previous research and the technologies in helping these poor children and table 3 summarize the courseware using 2D animation in learning Bahasa Melayu.

Table 2: *Previous research for reading disabilities student.*

Researcher	Research
Keyser-Marcus, Briel, Sherron-Targett, Yasuda, Johnson & Wehman, 2002.	*Provide highly visual advance organizers*
Coyne, Kame'enui & Simmons, 2004	*Continuum of instructional programs*
Bryant, et al., 2003	*Computer-Assisted Instruction (CAI).*
Fischman, 2001	Provide technology programs such as Fast ForWord, Earobics and Waterford Early Reading Program.
Harrison, 2003	Direct instruction in cognitive and metacognitive skills.

Table 3: *Learning Bahasa Melayu through 2D animation*

Title	Contents	Approach
MEL (UKM)	Story	Whole language
KACEMM (KPM) (Kaedah Cepat Membaca dan Menulis)	Small letters, vocal, consonant, combined vocal, vocal and consonant reading, exercise	Phonetic

Program MUTIARA (KPM)	Reading, writing, sound recording	Phonetic
Menguasai Abjad PraSekolah (KPM)	Games, singing and exercise	Phonetic

*KPM = Kementerian Pelajaran Malaysia *MEL=Multimedia dalam pendidikan untuk memotivasi literasi.

Technology offers a lot of choices from static word, power point, 2D animation, 3D animation, virtual reality and augmented reality to help the reading disabilities students. Previous research shows multiple results for the researcher to compare and analyze which is the best suite for the reading disabilities student.

2.3 Augmented Reality and Reading

AR refers to a system in which the real physical environment of a person is augmented with virtual computer-generated information, creating an enhanced perception of the surroundings (Azuma, 1997) and involving the learner. AR is a variation of *Virtual Environments* (VE). AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world and interactive in real time. Therefore, AR supplements reality, rather than completely replacing it.

Augmented Reality enhances a user's perception of and interaction with the real world. This enables user to experience the real world augmented with computer generated content (Dunser, 2007a). AR can be found to be applied in the teaching geometry, spatial relationships between planets and molecule structures (Inagawa & Fujinami, 2008; Mark, 2001) AR can potentially apply to all senses, including hearing, touch and smell (Azuma et al., 2001).

Augmented books have caught the attention not only of researcher but also educators as a means to enhance books with interactive visualization and simulation, animation, 3D graphics and sound (Shelton, 2002). In order to make students engage with the AR elements, storytelling approach is another factor in AR. The story should be engaging and include a clear structure and climax (Dunser & Hornecker 2007c). Table 4 shows the previous research that related to AR and reading.

Table 4: *Previous Research: AR and Reading.*

Research	Explanations
Eye Magic Book	Explores how a children's book can be transformed into a new type of reading experience through the use of Augmented Reality technology. Allow user to see 3D animation and sounds. (McKenzie & Dernell, 2004).
AR Comic Book	To enhance the reading experience of children.
Augmented Book Cover and Bookmark	To provides a reader with value added experience (Nobuhiro & Kaori, 2008).
MagicBook	Sees 3D character related to the page through a head mounted display (Billinghurst, Kato & Poupyrev, 2001). Similar to pop-up books.
AR-Based Storybook	To study how interactive AR affects low ability learners (Dunser, 2008).
AR Volcano	Allow user to interact with the virtual content (Woods et al., 2004)
AR-Jam	Early literacy (Dunsern & Hornecker, 2007a).
Augmented Chemistry	Reports on some of the advantages tangible interaction can bring to chemistry education (Morten & Benedikt, 2002)
Augmented Biochemistry	Examine how AR helps student in learning and understand how student learned in AR environments.
AR Interactive Tutorial	Tangible interactive application for language learning with 3D tangible cubes and animated agent.
Theory of Colours	Learning Using Augmented Reality Technology: Multiple Means of Interaction for Teaching Children the Theory of Colours. (Ucelli et al. 2005)
Science and Augmented Reality	"Making it real": Exploring the potential of augmented reality for teaching primary school science(Kerawalla 2006).
AR Book Cover and Bookmark	A proposed virtual illustration system with two types of add-on devices for the flipping detection: book cover and bookmark. (Inagawa & Fujinami, 2008)

AR books also can support students who have problems with traditional text books (Dunser, 2008) which offer better visual quality of reading. The ideal entertainment and learning experience in such mixed reality play environments and games then comes from the combination of physical experience, virtual content, storytelling and the imagination of the user (Stapleton et. al., 2002). Benefits of learning with technologies are engagement, motivation (Dunser, 2008), construct understanding of dynamic 3D processes (Winn et al., 2002), and understanding of complex contents (Dunser et al., 2006) and interacts in real time.

3.0 PROPOSED AUGMENTED BOOKS

Books can be improved and upgrades with available technologies. Interactive animation (2D and 3D), graphics (2D and 3D), visualization and simulation are among the applications. In integrating books with technologies, the suitable contents are one of the design phases to consider. Furthermore contents are the heart of the books. The crucial parts of the book which gives understanding are the first priority in merging and visualize with the technology. The content of the books will be analyzed in order to determine the potential in extending them in AR. Proposed content in AR books are 2D static content, 2D dynamic contents, 3D content, animation and sound.

In this research, the reading modules for disabilities children will consist of 3 parts:

    i.   Word (with level of syllable + AR)

    ii.   Short sentences (with thematic) + AR and

    iii.   Word games + AR.

The most suitable and low cost technology is desktop AR system with a web camera and AR book with black square ARToolkit marker. Children can choose to turn on or off the help voice. Besides that the standard button such as next, back, listen, close and exit will be displayed. Webcam will detect the marker (black and white print pattern), and display animated sequences for a selected words in the modules, which leads to interactive learning systems.

According to Schaller (2006), six key aspects of successful learning systems are identified specifically for successful design considerations. First, the system should motivate challenges and at the same time support feedback. Secondly, it will take account the sensory curiosity and cognitive curiosity. Thirdly, it is able to control the learning experience. Forth, it provides fantasy that gives emotional needs to learners and relevant metaphor and analogy. Next, it has an iteration support learning process by encouraging experimentation, hypothesis testing and synthesis and finally the system will gives reflections.

User interface design strives to enable the user to focus on the actual task and to reduce cognitive overhead needed to interact with the application (Dunser, 2007b). Designing guidelines for tangible user interface (TUI) should also be included in the AR book design phase (Terrenghi, 2007).

4.0 CONCLUSION

In reading process, the combination of text, 3D, sound, animation is not the only element to be focused. Previous research shows that bahasa Melayu has no difficulties in merging with technologies. AR is a technology to helps, improves, engages and gives excitement to student in learning to read bahasa Melayu. Reader need to adapt a new way of reading in order to be a better reader and understand what is read.

5.0 FUTURE WORKS

A preliminary analysis will take into specific account of the student interest, behaviour, learning pattern, level of reading, basic knowledge, emotional response to reading problems and physical information as well. Secondly, is about environment (home, school, social and cultural) and lastly curriculum. We plan to use questionnaire, interview, observation and diagnostic test as a research tools. This data will pivotal in

helping us understand the reading disabilities student. These students are obviously different; the process of knowing and understanding user has to be detailed. The researchers of AR systems will need to come up with specific individual problems solutions. Other elements such as theories of reading, methods, strategies, approaches are all the things that should be studied in the designing process.

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