NEW TECHNOLOGY APPROACH (D-MIC) FOR STUDENTS WITH DYSLEXIA

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Dyslexic children have their own learning preference, such as simple task, short time performance, motivation oriented, and multi-sensory preference. Intervention for dyslexia is possible and some researches have been done to help dyslexic children to learn better. Here, the researchers have done a preliminary research by combining instructional technology and mobile technology, then produced a mobile comic application. The application, named D-Mic was developed and observation was conducted to foresee possibilities of dyslexia children learning style. D-Mic was designed using instructional process. The evaluation covers five processes: entry level, impression, interface communication, navigation, and motivation. Hallway and Think Aloud Protocol usability testing methods were employed among three dyslexia students to test the prototype. As a result, D-Mic reveals motivation of learning, as well as good response in interactive learning. The study also reported that there was evidence that the mobile application interface design communicates effectively to the dyslexic children. It concludes the perception to the fact that dyslexia children have no problem in using mobile as their learning tool. Following this study, the researchers will look into more possibilities on the learning style. The researchers are working on employing richer content and integrating with special instruction.

Keywords: Dyslexia learning style, mobile application, mobile technology, mobile comic

What is dyslexia? According to Carol and George (1996) dyslexia is a specific type of learning disability involving a severe impairment in reading ability which affects and disrupts a person's language development and functioning. The individual with dyslexia can become confused when several instructions are given at the same time, and will usually have a poor-short-term memory, difficulty with directional orientation, such as telling right from left and map reading (Gavin, 2005). Dyslexia individuals may also have a word finding difficulty and in discussions and conversation may use inappropriate words that sound or look similar such as 'they' and 'their'. Gain also stated that dyslexia individuals may

also confuse syllables in words, or put these in the wrong order when writing or talking. However, dyslexia individual characteristics can amount to a different way of processing information-they usually have visual, right-brained global processing style and it is important to acknowledge the strengths in this style, as well as considering the difficulties.

Dyslexia in Malaysia

The Special Education Department of MOE (Ministry of Education, Malaysia) has been practicing the principle of "Education for All" and "Democratization of Education" in planning education for children with special needs. In Malaysia, Dyslexia is categorized as Specific Learning Disabled (SLD). There were about 314,000 school-going children in Malaysia who have dyslexia in 2005 and the number is still increasing. Learning difficulties experienced by these children will contribute to later educational, social, psychological, health and employment disadvantages. For these children, the long term consequences of having experienced failure at school are very alarming. Knowing the important fact of basic skill of literacy (known as the 3M, which refers to *Membaca, Menulis dan Mengira* (in Malay), dyslexia children may experience serious problems on their survival skill, such as counting money, recognizing bus number and house address. One of the contribution factors that children do not have the 3M is cognitive problem such as dyslexia. Komala (2004) reported that there were five percent (5%) dyslexia case identified at any community or at one out of every twenty (20) students in Malaysia. On the other hand, the President of Malaysia Social Harmony Association, Nordin Ahmad (2005) added that his organization has conducted a research and found that about ten to fifteen percent (10%-15%) primary school students, the majority of whom were Malays, have dyslexia.

A study on identifying dyslexia symptom among forty preschoolers from selected kindergartens in Negeri Sembilan was revealed. According to Rohayati and Shafie (2005), the finding of this study indicated that 27.5% of the preschoolers have dyslexic symptoms; 15% were identified as having high risk of dyslexic symptoms. More boys have dyslexic symptoms (10%) compared to girls (5%). There were three subtests that showed low scores; letter naming, rhyme detection, and phonological discrimination. As a result, this study reported urgent need to train parents to interact with dyslexic children at home. The study also suggested that teacher training addresses strategies to overcome difficulties facing dyslexic children.

Dyslexia Intervention

Mohd. Sharani Ahmad (2004) recommended some intervention approaches and techniques that can be employed to help SLD students, including educational intervention (strategies, activities & environment) technical intervention (learning packages & voice printing programs) and medical intervention (drug therapy and

diets). According to Nigel (n.d.) multimedia can be used to enhance the accessibility of the learning environment. Multimedia has the potential to reduce or even remove such problems. For example, learning materials containing text can be supplemented with and/or represented in graphical and auditory forms. He also added that dyslexic students are able to comprehend meaning from what is being spoken about a picture. Having learning materials delivered in this way can reduce the difficulties dyslexic students have recognizing or confusing between letters or familiar words. Furthermore, hearing new spoken words can help dyslexic students with mispronunciations. It can help them to form links between what a new word sounds like and what it looks like.

The use of interactive comic for learning is believed to be something new. The approach of reading content through comic by utilizing multimedia technology will hopefully be a new successful way in improving dyslexia learning style. Nor Hasbiah (2007) in her research reported that multimedia courseware has the capability to motivate dyslexic children. She also added that multimedia technology possesses the ability to touch various sensory modalities of dyslexic children. Watson (n.d.) confirmed that multimedia negates the need for a dyslexic student to rely on the text alone and provides a multimodal means of relaying that information to the brain, placing control back in the hands of the student.

Learning Style

According to Mortimore (2008), learning style is this cognitive style (cognitive style is characteristics and relatively consistent way of processing incoming information of all types from the environment) applied to a learning task. She stated that both research and experience suggests that students with dyslexia succeed when teaching is multi-sensory and uses all channels to reinforce learning.

Through her research, she reported that it is possible that students with dyslexia may tend towards:

a) A wholistic or imaging style either because memory difficulties or weakness in processing verbal information force them to rely on the visuo-spatial channels or through innate strengths in these areas.
b) A less flexible unitary style, which leaves them with difficulties responding to verbal detail. It may be because of the problems with concentration, attention span, working memory or automaticity. It may be due to fear of failure and increased anxiety in academic situations. Whatever the reasons, without explicit help, this will make it more difficult for them to develop coping strategies when teaching presentation does not match their preferred styles.

The above suggested styles seem to require a multi-sensory learning. Multi-sensory learning has been used for many years. It is believed to be an effective way to learn.

In 1977, Thomas advocated a multi-sensory approach with children using remedial problems: the use of audio-visual and mechanical aids-overhead projectors, typewriters, epidiascope-spelling aloud, sounding out, look-and-say. In 1976, Hooton adopted a multi-sensory approach. She said that there were few children who cannot be helped by looking at the symbol, saying the sound and feeling the shape simultaneously. She sees the multi-sensory way as succeeding with any child no matter what is dominant channel for learning. In 1970 (as stated in Tandley & Panckhurst, 1981, pp. 236-238), Cotterell states: 'When writing a word I encourage vocalization, with clear articulation, so that kinaesthetic, visual and auditory pathway to brain are all engaged to strengthen the memory pattern to recall'. In 1969 (as stated in Paula Tandley & John Panckhurst, 1981, pp. 236-238), Shedd affirms one-to-one instruction, a multi-sensory approach and highly structured material as the critical ingredients of success. The alphabetic-Phonetic-Structural-Linguistic (APSL) program was employing methods similar to those of the UK dyslexia centres.

The use of multi-sensory learning was also confirmed by Spafford and Grosser (1996, p.17). They stated that for the student with dyslexia, repeated readings, retellings and so on would be needed to reinforce presented materials. They recommended that structured lesson activities be used that incorporate a multi sensory interactive approach for the full benefit of enrichment for the student of dyslexia.

Another learning style is believed to be simple task and short time performance. Tansley and Panckhurst (1981) suggested that learning style of dyslexic children can be done in a way that they are given a simple task which is possible to complete in a short time. Having said (as cited in Paula Tanslley & Jogn Packhurst, 1981, pp. 115-116) Newton et al. (1979) that they have poor performance at skills such as sequencing, blending sounds, associating sounds and arbitrary symbol, the dyslexia children need a learning style. Van Meel et al. (cited in Tansley & Panckhurst, 1981, p. 116) also propose that children with reading difficulties may have a particular 'style' of cognitive functioning which can be summarized as a 'foreshortening of temporal perspective' i.e. preference for or pressure towards those cognitive options that, given a certain task, would do the job in the shortest time possible.

In addition, Reid (2005) has put some key points in relation to dyslexia learning styles:

- Every effort should be made to organise the classroom environment in a manner which can be adapted to suit a range of styles.
- The classroom should be global (considering all types of dyslexics), for example, consideration of lighting, design and other learning atmosphere.
- Teacher awareness on different styles of every child.
- Teachers should keep observe the students and encourage discussion.
- Considering how the children learn in different stages of the information processing cycle.

- Dyslexia children may find experience of learning is more important than the finished product.
- It is important that dyslexia children themselves become aware of their own learning style.

John Bradford (n.d.) outlined some usable principles in designing screen-based content. Many dyslexic readers are particularly sensitive to the brightness of text on a pure white background. This can cause the words to appear to move around and to blur together. Therefore, darker/colored background (not patterns) with bright color text is recommended. Type face of sans serif such as 'Arial' is clearer and is preferable. It would be better if the text is provided with visual support to stimulate memory. Text with long sentences needs to be broken up into shorter ones. Therefore, the best way is to plan and put strategy before providing the learning material.

The above readings have suggested evidence that indicate that most dyslexia people learn best when the style of presentation harmonises with their preferred learning style. Therefore, it is encouraged that teaching strategy be varied.

If dyslexia students can be made aware of their learning styles, they will then be more able to recognise their strengths and become more sensitive to their weaknesses. To a certain extent, they can also take responsibility in ensuring their preferred style. Thus, teaching strategies are needed to match the learning styles.

Teaching Strategy

Reid (2005) suggested some teaching principles for dyslexia students, which are

1) Multi-sensory (Incorporation of visual, auditory, kinaesthetic and tactile elements)
2) Overlearning (The use of a range of teaching approaches to ensure that the same word or skills are being taught in different situations)
3) Automaticity (Consolidation of skills that learners normally achieve through practice)
4) Structure (Structured learning experiences that meet the need of dyslexia children within the classroom situation).
5) Practice (Activities to engage the students)

Dean (1996) suggested that children with learning difficulties need a number of different teaching approaches. They need:

- work which is broken down into small steps;
- activities which enable them to practice the learning they acquire to the point when it is over-learned;
- work which involves the stimulus of first-hand experience;
- some collaborative work.

These kinds of strategies are possible using information technology. For example, The Dyslexia Institute uses a system called 'Units of Sound' (Room 1997) which is derived from a cassette based audiovisual program. This was transferred to CD Rom whereupon a number of advantages were noted. It was found that using an audiovisual program like this allowed more dyslexia pupils to pace their own learning more effectively and motivated them to work better.

Another evidence of multi-sensory approach is shown in the 'Talking books'; a new phenomenon of new technology that motivates dyslexia children to take a more positive attitude to books and reading. The book is presented on CD ROM and incorporated a feature whereby words can be pointed and repeated. This can help with both identification and practice of unfamiliar words.

Interactive Story Software

The same approach was used by Keates in 2000. She believed that ICT (Information and Communications Technology) can support and facilitate learning in dyslexic students. She reported that dyslexic students use ICT because it is an area where they generally have not previously failed. It is helpful, supportive, facilitating and motivating. In her research, Keates has proven that dyslexic children have skills in keyboarding, handling the mouse, and interacting with the screen. It was also proven that an interactive story software like one of the Living Book series: Broderbund (TAG) has presented a multi-sensory environment, listening to the words, watching them and then being able to interact with the page on the screen. Keates also claimed that dyslexic pupils can create moving adverts, cartoon stories, talking stories and other multimedia presentations. She confirmed that by understanding the dyslexic students and their particular strengths and difficulties, one can select software that helps and facilitates them.

Shelly et al. (1998) asserts that students are able to retain 20% of what they see, 30% of what they hear, 50% of what they see and hear and 80% of what they see, hear and interact. This statement was also confirmed by Flecther (1991) saying that computer based instruction is more cost-effective as it allows for a 10% to 20% improvement in performance than traditional training methods, allowing for one-third less time usage.

With the capabilities of dyslexia children in interacting with multimedia tools such as cartoon stories, talking stories and other multimedia presentation, the researchers are confident of implementing an interactive comic application.

Interactive Comic

Cohn (2005) stated that interactive comics play an important role as a social interactivity for a further visual language. He believed that interactive comic has a "modality holistic" method, where real-time narratives combined all three "modalities" in which language can manifest: spoken, gestured, and drawn.

Spoken language is used for various communicative purposes, gestured language provides a wealth of information in addition to speech and drawn language, while the visuals support the two languages.

Pesonen (2001) reported that interactive comic is a technology-based learning environment that provides an opportunity for personal differentiation in the learning material. It supports different learners and different learning styles. The personal feedback offered to the learners in the interactive comics motivates and guides their learning processes.

Through his research, Pesonen added that interactive comics as a form of the learning material were evaluated to be an excellent way to inform learners about energy saving. This was the opinion of 60% of the learners who took part in the learning experiment; 40% of the learners thought that the comics were adequate for explaining energy issues.

Vassilikopoulou et al. (2007.) supports this belief and declared that digital hypermedia comics have strengths as educational tools. Through their research Vassilikopoulou et al. reported that the feelings about the use of digital hypermedia comics as learning tools were positive; most of the student-teachers thought that using comics helped them to think differently about the learning situations and to begin the process of restructuring their understanding, and they were also easy to use.

Interactive comic is also delivered in a mobile phone. In 2006, GoComics has released its comic books that can be downloaded to mobile phone. GoComics (2006) revealed that the mobile comics are presented in a panel-by-panel format for quick viewing and a simple interface that offers a great user experience.

D-Mic

D-Mic (Dyslexia Mobile Interactive Comic) was designed as a mobile application. Unlike GoComics, where users have to use software to open the comic, D-Mic runs on a common managed platform, namely Flash Lite.

According to the Mobile Marketing Association (2008), from a technical point of view, mobile applications are separated into three categories:

1. Native platforms and operating systems, such as Symbian, Windows Mobile and Linux.
2. Mobile Web/browser runtimes, such as Webkit, Mozilla/Firefox, Opera Mini and RIM
3. Other managed platforms and virtual machines such as Java/J2ME, BREW, Flash Lite and Silverlight.

Learning through mobile application is considered as a new way to provide and convey the education content. Due to the popularity of mobile devices, many communication service providers take benefit and mostly provide information, advertisement and entertainment content in order to make a profit. Nowadays, the use of mobile devices as one of the approaches for teaching and learning is

widely tested. According to Fisher and Baird (2006), the mobile environment is a platform in which interaction, collaboration, and knowledge can occur. The use of mobile technology defines the ability for students to reconcile their authentic use of technology in a learning context and can motivate and persuade users to actively engage in the course content.

A user acceptance study was carried out by reseachers from Universiti Teknologi Petronas (UTP) to measure the feasibility of m-learning (mobile learning) management application development. Amin, Mahmud, Abidin, and Rahman (2006) have developed m-learning management application and indicate a tendency towards the m-learning acceptance in the campus wide environment. They found that the application has provided users with a new look on learning style, where they can access information they want using a mobile device, anywhere and anytime.

D-Mic was developed using Macromedia Flash CS3 software and produced a Flash Lite platform file (in .swf (shockwave file) format). This file was viewed using a pre-installed program called Flash Lite. However, the same file format could also be viewed using Internet browser on PDAs or smart phones. Moreover, users could view this file offline (without Internet connection) provided the files (html and flash files) were pre-installed. The idea was to have more accessibility by different type of users.

D-Mic content was carefully designed. It covers four phases of Learner Needs, Strategy, Design, and Evaluation.

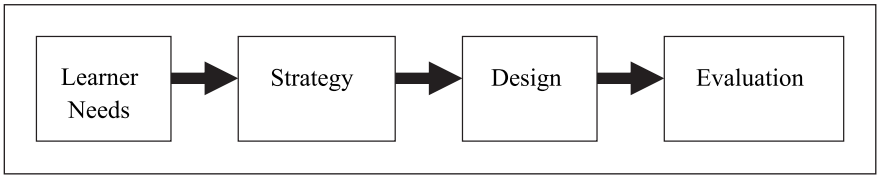

Figure 1. D-Mic development phase

Learner Needs

During this phase, it is understood that dyslexia children needs to have experience learning, work on small working memory for better concentration, have motivation in learning, and depend on visuals more than text. The text can be set in san-serif style using bright color over the dark background.

Strategy

Based on the previous research mentioned, it is suggested that the strategies includes the use ICT to encourage experience learning, broken into small steps of content; this will help dyslexia students to utilize their short term memory more than their long term memory, implementing multi-sensory approach. Hughes

et al. (1996) established that multimedia programs through their rich integration of text, graphics, animation, sound and full-motion video can be utilized as a focal point to yield attention and participation of students. Figure 2 is the sample of screen capture that explains some of the implemented strategies.

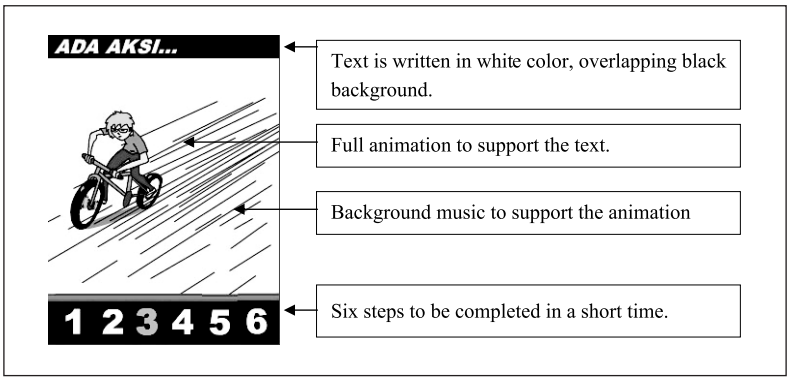

Figure 2. Screen shot of D-Mic

Design

The content is structured into two stories a) Amir di Kampung (Amir at the village) and b) Amir di Bandar (Amir in the city). Each story consists of six steps (see Figure 2), containing simple words to convey a message. Each step is indicated by the button- (which is the number itself) which turns into green color (please see Figure 2). This will help the students to decide on their next step. The screen has been designed with visual dominancy, where the style of film strip indicated the visual as the focal point.

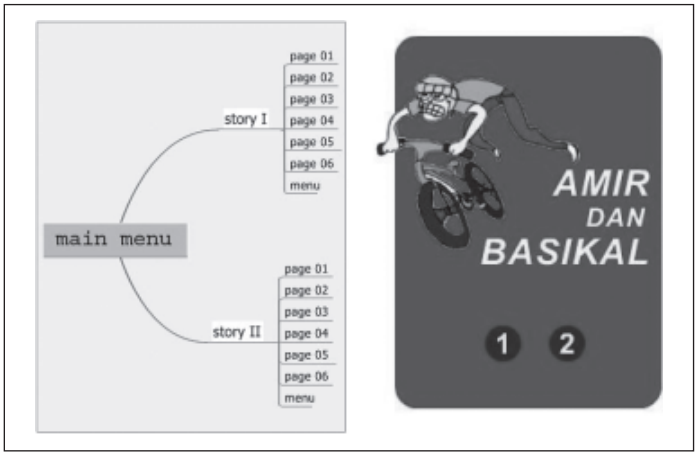

Figure 3. The information structure and its interface design

Similar to GoComic visual (Figure 4), D-Mic provides visual dominance. However, D-Mic was developed for dyslexia learning purposes. The use buttons, text and colors were chosen to meet the dyslexia children needs.

Figure 4. Screenshot of GoComic screen design

D-Mic is prepared with the combination of information structure, interactive experience, and multimedia presentation. Through his theory***; a unified field theory of design, Nathan Shedroff combined Information design, Interaction design and Sensorial design to produce content.*** Information Design is an approach to designing clear, understandable communications by giving care to structure, context, and presentation of data and information. Interaction Design is an approach to designing interactive experiences (in any medium) which is concerned with the participant's experience flow through time. Sensorial Design is a term used to include the presentation of an experience in all senses (visual, hearing, touch, smell, and taste). It is simply the employment of all techniques with which we communicate to others through our senses.

The information structure was predicted to be performed by students in a short time (about 3-5 minutes). There are only two contents and each one consists of six pages only. The two contents are telling stories in a different situation; the message remains the same.

The layout was very simple. It was split into three sections: text section, visual section, and navigation section (Figure 5). At a glance, it looked like a film strip, where attention is paid to the visual section. The button was designed using numbers, to identify number recognition and sequencing. It was placed consistently at the bottom of every page.

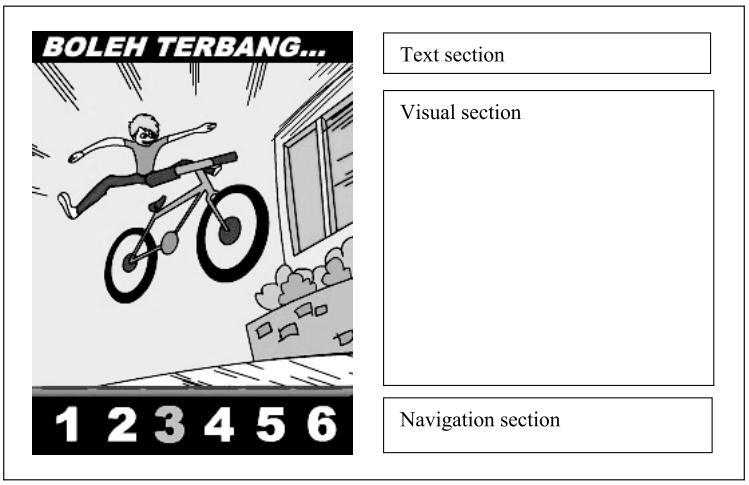

Figure 5. Layout design

Evaluation

The test was conducted at Sekolah Kebangsaan Bukit Cerakah Shah Alam. Three students of standard five were selected; they were male and aged 11 years. The students were gathered and given explanations about the application and how to use it. Dyslexia children populations are very limited and known as the protected group. Therefore, it was not easy to get a big sample for this research.

Think aloud protocol and Hallway usability testings were adopted to identify the usability issue on this new application. The methods used here require only 5-6 users to test the application (Nielsen, 2000). However, with the limitation of the dyslexia population itself, the researchers proceeded with the three students. The theory, as adopted from Jacob Nielsen research, is that 95% usability problems can be discovered using Hallway usability testing technique. Think aloud protocol involved the students thinking aloud as they were performing a set of specified tasks. The students were asked to say whatever they were looking at, thinking, doing, and feeling, as they went about their task. This enabled the researchers to see first-hand the process of task completion (rather than only its final output). Test sessions were video- taped so that the researchers can go back and refer to what participants did, and how they reacted.

The researchers also found that such field testing was useful and successfully implemented since 2005. Kaikkonen et al. (2005) had done a survey on usability testing on mobile application (comparison between laboratory and field testing). The usability of a consumer application was tested in two environments: in a laboratory and in the field with a total of 40 test users. Results indicate that it is possible that field testing is worthwhile when combining usability tests with a field pilot or contextual study where user behavior is investigated in a natural context.

There are four stages in the evaluation process (Figure 6). At the entry level stage, the students were asked about their demography and experience in using computer/mobile phone. At the impression stage, students were observed on their acceptance. At the interface stage, students were observed and asked about words, numbers and symbols they understand. At the navigation stage, students were observed and asked about direction and sequencing, and at motivation stage, students were observed and asked about their understanding on the content, and willingness to learn more. On top of that, the duration time of performance was also recorded.

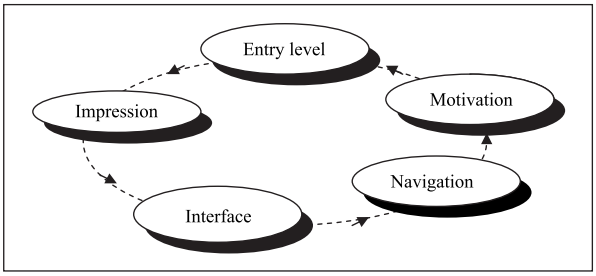

Figure 6. The evaluation process

RESULTS AND DISCUSSION

D-Mic has been tested and evaluated. Observation was done through video tape. Out of a total of 3 students, all of them were able to perform the task using D-Mic. When they performed the task, issues such as acceptance, usability, and preferences were asked. D-Mic has provided dyslexia students with a new look on learning style where they can enjoy the learning process along with their preferences.

When asked about using mobile phones, 100% of the respondents were using mobile phone outside the school (using mobile phone in school is prohibited in Malaysia). They know how to use phone call and mobile games. They also use computers at their homes.

Their first impression while introduced to D-Mic was good. All of the respondents were excited to know and use the application. The main menu was found simple and easy to use. They can understand the icons, navigate easily and browse the content. It was noted that they know where to click the button for the next page and they can read the text in the main menu. Even though looking unconfident, they were seen always smiling and enjoy while performing the task. Moreover, they were geared up to move to another page in a very short time.

It was noticed easily that with white text over the plain-green-colour background for the main menu interface communicates effectively. All the

respondents were able to indicate the 'next page' button. When they were inside the story, 100% of the respondents were able to read the white text on black background. They were also able to recognize the question mark symbol (?) and number 1 to 6. The use of cartoon animation with suitable background music has encouraged them to understand the content better. It was noticed that they laughed while seeing visual before reading the text; 33% of the respondents were found having difficulties in reading black text on white background.

It was also surprising that 100% of the respondent were also found capable in moving direction (left and right), independently able move in sequence (from beginning to the end) and recognize all the buttons.

When they were asked about the message of the story, 100% of the respondents have shown good understanding; 33% of the respondents has read the text at the last page wrongly, but managed to understand the message. It was proven that the animation, sound, and story helped them to understand the message better.

At the end of the story, 100% of the respondents claimed that they wanted to have such application for their learning on curriculum subjects such as Bahasa Malaysia. They admitted that they understand the story message, enjoyed the learning process, and were very enthusiastic in using D-Mic.

CONCLUSION

This study found that three students with dyslexia, who are in Year Five of primary school managed to use D-Mic and performed the task assigned to them. They did not feel uncomfortable, although it was their first time using a PDA. They were found to be very enthusiastic in learning mobile interactive comic application. Furthermore, they interacted with the application smoothly and managed to perform the task without much supervision. The understanding of content was good, as the content was broken down into small and short steps. It was also revealed that the students had no problem in reading white text on black background, recognising numbers, symbols and sequencing. It is suggested that teachers need to have a variety of strategies in teaching students with dyslexia as they need to be encouraged to learn content that they find enjoyable. Breaking down content into small steps, allowing them to perform the task in a short time, and utilizing ICT, had a positive impact on these children.

As these children with dyslexia had no problems in using mobile application, future investigation should include the possibilities in implementing mobile learning as an innovative approach. Mobile has its benefit for being flexible resulting in a learning process for children with dyslexia that is not limited to time and place. It is also wise to investigate mobile applications that employ richer content with special instruction.

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