Interactive Multimedia Learning Object (IMLO) for Dyslexic Children

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Designing Learning Object (LO) can be very challenging when the students are those who come from the special needs background. Research has been conducted and has identified the need for designing a specific LO for dyslexic children in learning multiplication topic. The objective of this research is to describe the development and evaluation process of the proposed Interactive Multimedia Learning Object (IMLO) in three phases of (1) Analysis, (2) Development, and (3) Evaluation. Analysis phase identifies the user needs through user analysis and content analysis. The development phase describes the proposed teaching strategy implemented in IMLO. The evaluation phase elaborates the dyslexic children evaluation. RLO Student Evaluation form was used to ask and observe the students on the use of IMLO. The result reveals positive feedback in terms of acceptance, attention, usability, narrative content, interactivity, activity and comprehension.

Keywords: Dyslexia, Learning Object, Multimedia components, Usability.

1. Introduction

1.1. Background of Study

Dyslexia is defined as a specific type of learning disability involving a severe impairment in reading ability which affects and disrupts a person’s language development and functioning (Carol & George, 1996). The individual with dyslexia can actually 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 (Reid, 2005).
There were about 314,000 school-going children in Malaysia who have dyslexia in the year 2005 and the number may have actually increased. Learning difficulties experienced by these children will contribute to future 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 importance of basic skill of literacy (known as the 3M, which refers to Membaca (Reading), Menulis (Writing) dan Mengira (Counting)), dyslexic children may experience serious problem on their survival skills, such as counting money, recognizing bus number and house address. One of the contributing 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 within any community or at 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, have dyslexia.

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.) explored ways in which 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 in 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.

In terms of the strategy, Joan Dean (1996) suggested that children with learning difficulties need a number of different teaching approaches such as work which is broken down into small steps, activities which enables them to practice the learning they acquire to the point when it is over-learned, work which involves the stimulus of first-hand experience and some collaborative works. Therefore, the researcher believes that Learning Object (LO) is the perfect match. LO is a content that offers the opportunity to create instructional elements (content segments, process instructions, and affective exercises) in small parts that are reusable, scalable, and adaptable in multiple and varied learning contexts (Wiley, 2001). According to Hamel and Ryan-Jones (2002) A Learning Object narrowly defined, refers to a small, stand-alone unit of instruction that can be tagged with descriptors and stored in repositories for reuse in various instructional contexts.

### 1.2. Problem Statement

Early analysis was conducted to identify the use of LO at seven schools with dyslexia program in Klang Valley including Malaysia Dyslexia Pilot School as well as one NGO. Through site visit and telephone conversation, the researcher has found three research problems; (1) there is no LO available at the dyslexia schools, (2) No multimedia approach employed to teach the dyslexic children, (3) There is limited research done on dyslexia with numeracy problem in Malaysia. The same statement was agreed upon by Ishak (2008) as well as no related research was found in Malaysian Thesis Online (MYTO).

### 1.3. Research significance

This study describes the development and evaluation of Interactive Multimedia Learning Object (IMLO) for dyslexic students with numeracy problem. In specific, IMLO consists of specific topic on mathematics subject based on the need of the dyslexic children. It is hoped that the dyslexic children can benefit from IMLO, improve their learning activity, and to a certain extent, reduce the numeracy problem.

Realizing the importance of IMLO development, the content quality has become a concern. IMLO content would not just generally help the dyslexic children to learn, but it also becomes a useful tool in providing information, giving opportunity for the dyslexic children to interact and create a new atmosphere for knowledge retrieval. The interactive multimedia functions provide special instruction and feedbacks in interactive learning activities. The dyslexic children should be able to adapt themselves in the learning process according to individual preferences. According to Mortimore (2008), such situation is common amongst the dyslexics, it is called automaticity.
Thus, this research provides relevant information about dyslexia learning preferences, especially for learning mathematics. Teachers can benefit by using IMLO to plan towards more effective teaching strategies. In fact, more importantly, this research provides advice in setting standard guideline for producing such IMLO. Since IMLO content is carefully designed for easy-learning purpose, it can be reused for various types of learning disability. It is hoped that this research will contribute to the method of IMLO development and its application on the dyslexic children.

2. Literature Review

Applying multimedia in LO can help the dyslexia learning process. Keates (2000) supported the use of software as a learning tool. The same agreement came from Mortimore (2008) who confirmed that dyslexic students learn better when they are taught using multisensory approach. The use of multimedia type of LO has been proven. Rosnah (2007) has developed LO Science and revealed that the LO provides educational value and value added to form-four Malaysian students. Another benefit of LO is proven by Kay & Knaack (2005), where they have developed five LOs for secondary school students and found that two thirds of the students reported that the LOs were beneficial, citing a motivating theme, interactivity, and found visual qualities as the most important features.

The researcher found similar approach done by Ismail et al (2010), where a courseware (called E-Z-Disleksia) has been developed to accommodate the needs of dyslexic children with difficulty in reading and learning to read Malay language. It was made by some concerns such as (1) content structure (where six modules were organized based on levels), (2) navigational structure, to permit flexibility amongst dyslexic children to explore the content, and (3) main menu, that act as the index page, (4) sub module, the content to learn, and (5) activity, where the dyslexic children needs to follow the animated hand written letter.

However, e-z-disleksia multimedia elements do not show solid justification in terms of the dyslexic children preferences. It is important to understand the dyslexic children learning style (Fadilahwati & Fattawi, 2009) and the multimedia components have their own role in providing instructions. To fully exploit interactive multimedia components to full advantage of the instruction, designer needs to be aware of how learners actually learn as well as the different types of learning that exist. McEwan & Cairncross (2004) believed that meaningful evaluation of Multimedia Learning Object requires consideration of integration of learning application into curriculum. They also added that attention must be given on how best to incorporate multimedia components to enhance learning. Previous research done by Fadilahwati et al (2011) revealed that dyslexic children needed to be motivated and engaged by using multimedia components such as animation, audio, graphic and text.
On the other hand, Ronaldi and Fadilahwati (2009) have identified the benefits of dyslexia learning content on mobile interactive comic. D-Mic (Dyslexia Mobile Interactive Comic) delivered learning content about understanding Malay verbs. D-Mic was designed as a mobile application. To use it, dyslexic children need to open the application under the ‘program’ menu. D-Mic content was made interactive. Dyslexic children can learn a specific topic ‘verbs’ on Malay language subject.

![D-Mic screenshot](image)

D-Mic developmental process was made using strategy. Referring to Hughes et al (1996) who stated that multimedia (integration of text, graphics, animation, sound and full motion video) can be utilized as a focal point to yield attention and participation of students, D-Mic implemented animation and sound to support the text meaning. The researcher thought that such strategy was suitable because dyslexic children is known for having poor attention. Everatt et al (1999) and Goldish (1997) confirmed that dyslexics have problems in paying attention. The use of two words text per screen was also found to be good. Even though Pepper & Lovergrove (1999) suggested to present one word text at a time for easy reading, D-Mic research proved that dyslexic children was able to read the two words easily with the help of multimedia elements. In terms of presenting materials for the dyslexic children D-Mic approach was also found aligned with Reid & Green (2007), who suggested using large font size with relevant pictures to aid the text comprehension. D-Mic was tested on children with dyslexia in Malaysian schools. Observation and interviews were conducted to assess questions on usability and D-Mic was found motivating. The children had no difficulty reading the text, following the sequence and performing the given task. One contributing success factor is the D-Mic was split into small units and this ease understanding amongst the dyslexic. On another research, Fadilahwati et al (2010) also confirmed that using Multimedia-based Learning Object, where content is broken down into small steps, dyslexic children can perform the task in a short time, and lead to better learning process.

3. Methodology

This research suggests the development of Interactive Multimedia Learning Object (IMLO). According to Richey & Klein (2007), developmental research is the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis of the creation of instructional and non-instructional products and tools and new or enhanced models that govern their development.
Multiplication-of-two topic has been selected as the content to be strategized using IMLO. The process from topic selection until evaluation is described based on three phases (see Figure) of (1) Analysis, (2) Prototype Development, and (3) Evaluation.

<table>
<thead>
<tr>
<th>Phase 1: Analysis</th>
<th>Content Analysis</th>
<th>is made based on syllabus, module, teaching strategy, text book, report book, quiz, test, and interview with Subject Matter Expert.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Student Analysis</td>
<td>is made based on learning style survey, class observation, and interview with teacher.</td>
</tr>
<tr>
<td></td>
<td>The need is identified</td>
<td></td>
</tr>
<tr>
<td>Phase 2: Development</td>
<td>Storyboard</td>
<td>is made to come up with teaching strategy. The outcome is validated by experts.</td>
</tr>
<tr>
<td></td>
<td>Prototype (version 1 and 2)</td>
<td>are developed, validated by experts and tested on dyslexic students</td>
</tr>
<tr>
<td>Phase 3: Evaluation</td>
<td>Dyslexic children evaluation</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3. IMLO developmental process

This research describes the assessment of IMLO by the dyslexic children. IMLO is evaluated using RLO Student Evaluation form as adapted from the Centre of Excellence in Teaching and Learning for Reusable Learning Objects [http://www.rlo-cetl.ac.uk](http://www.rlo-cetl.ac.uk). Such evaluation has been widely deployed (Bath-Hextall et al., 2011). The dyslexic children were observed while using the prototype. To obtain more accurate data, they were also asked questions after they used the prototype. The whole situations were videotaped and replayed for further observation to confirm the answer. The results were presented in percentage.

The study sample is the population of dyslexic students at all dyslexia schools that teaches mathematics in Klang Valley, Malaysia. The whole population consisted of thirteen students in the mathematic inclusion class. To address the ethical issue, the researcher has obtained permission from The Ministry of Education, The State Education Department, the school headmasters, as well as the teachers to conduct the test in classrooms.

4. Development

The first phase describes the analysis of content and user. Document analysis was performed where quiz, test, and report book have identified the pattern of majority difficulties faced by the dyslexic children on a particular topic: multiplication-of-two. As a continuation of the analysis process, teacher was interviewed and class observation was also made to confirm the situation. This identifies the need of designing IMLO on multiplication-of-two topic.
Figure 4: An evidence pertaining to the difficulty faced in answering multiplication-of-two questions. Students who face difficulty with multiplication of two are expected to find difficulty with other multiples as well. They might need to comprehend the concept in the beginning.

It is understood that dyslexic children also have learning styles. Result of survey conducted identified that majority of dyslexic children were visual learners. However, the researcher suggested considering all learning styles for the strategy. This agrees with Reid (2005) who said that every effort should be made to organize the learning environment in a manner which can be adapted to suit a range of styles.

The second phase describes the process of creating a storyboard with special instruction based on theories and expert opinions. It was suggested that the content be delivered using a story which relates to their environment/common activities. This approach will hopefully improve their understanding. The content is broken down into small steps containing specific topics. It is believed that dyslexic children can perform better when the content is small and specific.

Preliminary studies were also conducted where Ronaldi et al (2011) identified the significance of using animation for the proposed special instruction. Animation using cartoon characters was used to describe certain complex information and concept such as simulation explaining two repeated addition concept, skip counting, numbers recalling (Figure 5). The animation created multisensory engagement through the use of graphic symbols motion pictures, sound and voice over. Reid (2005) stated that multisensory teaching approach incorporating visual, auditory, kinesthetic and tactile. Each of the visuals used were also carefully selected to help the dyslexic children retain the information through their imagination.

Figure 5: Screen on the left shows animation of two candies to be put into three party packs representing repeated addition concept of 2 x 3. Screen in the middle shows animation of arrows, cartoon character (named Amir) reading the numbers and voice over for skip counting technique. Screen on the right shows animated cartoon characters recalling the skip counting concept.
The use of appropriate visuals was also considered. It was believed that relevant images referring to the dyslexic children environment help them to comprehend better. This statement was in agreement with Reid and Green (2007) who said adding pictures to the text aid comprehension. Furthermore, the cartoon character was also made to keep the attention and interest. The main character of Amir (Figure 5) was designed to appear at random throughout the learning process. His sudden appearances help to keep the attention and interest. Similar to Everatt (1999) opinion, the researcher believed that the dyslexic children need attention process while reading.

The third phase describes the evaluation process. This phase focuses on evaluation of the IMLO based on feedback obtained from the dyslexic children by using the RLO Student Evaluation. Twenty one questions were selected to address certain aspects of the IMLO situations. These questions reflect the IMLO development strategy as described in the second phase.(Figure 6)

<table>
<thead>
<tr>
<th>RLO Student Evaluation</th>
<th>Agree</th>
<th>Neither</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acceptance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The content was appropriate and fitted my learning needs</td>
<td>92.3%</td>
<td>7.7%</td>
<td>0%</td>
</tr>
<tr>
<td>The RLO was pitched at the right level for me</td>
<td>92.3%</td>
<td>0%</td>
<td>7.7%</td>
</tr>
<tr>
<td><strong>Attention</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The RLO encouraged me to reflect on the material</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>I liked the look and feel of the RLO</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>The RLO was interesting and engaging</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>The images and animations were valuable components of the RLO</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Usability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The RLO was easy to use</td>
<td>92.3%</td>
<td>0%</td>
<td>7.7%</td>
</tr>
<tr>
<td>The on screen text was useful and helped me assess the amount of information each section contained</td>
<td>76.9%</td>
<td>0%</td>
<td>23.1%</td>
</tr>
<tr>
<td><strong>Narrative content</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The narration made the RLO more engaging. I preferred this to text alone</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>The RLO was well structured and easy to follow</td>
<td>84.6%</td>
<td>0%</td>
<td>15.4%</td>
</tr>
<tr>
<td>The RLO integrated well with the module and other teaching sessions</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Interactivity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoyed being able to work at my own pace</td>
<td>92.3%</td>
<td>0%</td>
<td>7.7%</td>
</tr>
<tr>
<td>The RLO was easy to navigate. I felt in control</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The self-assessment helped me gauge how well I understood the material</td>
<td>92.3%</td>
<td>0%</td>
<td>7.7%</td>
</tr>
<tr>
<td>The activity was appropriate and aided my understanding</td>
<td>92.3%</td>
<td>0%</td>
<td>7.7%</td>
</tr>
<tr>
<td><strong>Comprehension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am confident that I will be able to use the knowledge gained from this RLO in future practice</td>
<td>92.3%</td>
<td>7.7%</td>
<td>0%</td>
</tr>
<tr>
<td>I like the idea that I can access this RLO whenever I need to</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>I will use this RLO again</td>
<td>92.3%</td>
<td>7.7%</td>
<td>0%</td>
</tr>
<tr>
<td>The RLO will help me retain the information</td>
<td>92.3%</td>
<td>0%</td>
<td>7.7%</td>
</tr>
<tr>
<td>The RLO has aided my understanding and I feel I have achieved the learning objective</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Figure 6: Shows the percentage obtained based on the students agreement

5. Results and Discussion

IMLO was evaluated. All dyslexic children participated well and completed the user testing task. The answers were obtained using triangulation approach where feedbacks obtained from the questions were confirmed through observations. Overall, the results showed positive feedback.
IMLO content was conceptualized through the story of a birthday party, where the narrative content was broken down into small steps. Majority of dyslexic children (92.3%) found such content appropriate and fitted their learning needs. Even though majority of them were visual learners, IMLO was designed for all learning styles. All of the dyslexic children agreed that the narration made IMLO more engaging and integrated well with the module.

Amir cartoon character has been designed to engage the attention of the dyslexic children and due to his character, the children found the IMLO interesting and engaging. All of the dyslexic children liked the look and feel of the IMLO. They found that images and animation were valuable components of the IMLO.

In terms of usability, 92.3% of the dyslexic children found IMLO easy to use. 76.9% of them also found that the on screen text was useful and helped them to assess the amount of information each section contained. The dyslexic children can easily explore the IMLO content as it was well structured and easy to follow (as agreed by 84.6% of them). They (92.3%) also enjoyed being able to work at their own pace.

While using IMLO, the dyslexic children were engaged with activities. 92.3% of them found the activity was appropriate and aided their understanding. This helped them achieve the learning objective. IMLO was designed with specific visualization. The use of relevant images referring to the dyslexic children environment helped them to retain the information. The animation simulation explained the concept of repeated addition and boost their confidence in using the knowledge gained from IMLO in the future practice (92.3%). When they were asked whether they will use IMLO again, 92.3% agreed. IMLO hoped to be used as reusable Learning Object.

6. Conclusion and Recommendation

Understanding the dyslexic children and the need of learning a specific topic is important in developing IMLO. IMLO has been designed with specific strategies to suit the dyslexic children’s needs. They need to relate the learning content to their environment and therefore narrative content was found useful. The choice of story helps to identify the visuals, graphics and icons that suit to their preferences. Using cartoon character design was also found helpful in engaging the dyslexic children’s attention. The researcher believes that digital/interactive comic can be employed to teach a certain topic. Through specific cartoon character design and narrative content, dyslexic children might have better reasons to focus and complete a task. The researcher is looking into that area.

IMLO was successful in supporting the students understanding of multiplication-of-two. The IMLO was evaluated positively by the dyslexic children, and they reported the continued usage of the IMLO after the evaluation. IMLO managed to help students to understand difficult concept such as repeated addition and skip counting. The animation plays an important role to illustrate the concept and skills. Students are interested to plug gaps in their knowledge and keep their mind focused with the animation, graphics, and cartoon character displayed. The feedback showed that the IMLO supported learning as well as provided self control. The dyslexic children were able to perform the given task with minimum supervision.
Acknowledgements

We are grateful to the International Islamic University Malaysia and Ministry of Higher Education Malaysia for making this research possible through the SLAI scholarship scheme. Furthermore we would like to extend our gratitude to the reviewer who made valuable comments contributing to the improvement of this article.

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