Multimedia Elements as Instructions for Dyslexic Children

Fadilahwati Abdul Rahman, Fattawi Mokhtar, Nor Aziah Alias, and Ronaldi Saleh

Abstract—This paper focuses on the implementation of multimedia elements used for instructions on IMLO. IMLO (Interactive Multimedia Learning Object) is a multimedia software prototype about 'multiplication of two' topic which is developed for dyslexic children in Malaysia. The aim of this research is to describe the functions of multimedia elements in IMLO's learning and exercise activities. The approach for this research is qualitative, where the multimedia elements are interpreted using ARCS model and the outcomes are validated by experts. This finding is very important to develop IMLO prototype as well as other researchers who want to get useful guidelines for similar multimedia instruction development for dyslexic children.

Keywords— Dyslexia, Multimedia Instruction, Multimedia Elements, Learning Object, ARCS, Dyslexic children

I. INTRODUCTION

Multimedia is widely used in education, even for special needs. Research in Romania has proven the advantages of multimedia resources such as movies, audio and animation for keeping the student's interest awake on its music educational system (Nedelcut and Pop, 2011). Deaf students were found using video with text synchronization system to learn in Brazil (Oliveira *et al*, 2011). Onintra (2007) also revealed that a multimedia system enhanced Thailand deaf students in their learning. In Malaysia, computer assisted instruction in teaching Malay children folk tale found to have advantage as it has audio and visual effect, interactive functions, shot story, exercises and games.

In Malaysia too, dyslexic children were found motivated with the use of multimedia courseware (Nor Hasbiah, 2007). In Malaysia, Dyslexia is categorized as Specific Learning Disabled (SLD). There were about 314,000 school-going children in Malaysia who have dyslexia reported in the year 2005. With such amount of population, intervention program is in serious need. This argument is also supported by Gomez (2004) who reported that help for children with dyslexia has been scarce and isolated.

Fadilahwati Abdul Rahman is with the Kulliyyah of Information and Technology, International Islamic University Malaysia (email: fila_research@yahoo.com)

Fattawi Mokhtar is with the Faculty of Education, Universiti Teknologi Mara, Malaysia. (email:).

Nor Aziah Alias is with the Faculty of Education, Universiti Teknologi Mara, Malaysia. (email: noraz112@salam.uitm.edu.my)

Ronaldi Saleh is with the Faculty of Design and Architecture, Universiti Putra Malaysia (email: ronresearch@gmail.com)

The definition of dyslexia has been defined differently into specific terms. According to Critchley (1970), dyslexia is a disorder manifested by difficulty in learning to read despite conventional instruction, adequate intelligence, and socio-cultural opportunity. Such difficulties also extend to certain math disabilities. One important fact discovered is that dyslexia also has difficulties in some aspects of mathematics, most particularly in numeracy (Chinn, 2006).

The suggested intervention was educational and technological (Mohd. Sharani Ahmad, 2004). This research suggested multimedia elements to be used on strategies, activities and environment. A multimedia based Learning Object, namely IMLO (Interactive Multimedia Learning Object) was developed to teach 'multiplication of two' topic.

II. BACKGROUND OF STUDY

The overall research is the development of educational intervention multimedia software called Interactive Multimedia Learning Object (IMLO). IMLO is a Learning Object (LO) developed with Interactive Multimedia functions. Research on IMLO development was made at Dyslexia Schools in Malaysia within mathematic inclusion classes. IMLO contains multiplication topic; a topic that was found as the most difficult topic to learn on mathematic subject. The idea is to deliver this topic in a form of interactive story-based content using multimedia elements.

Based on the final examination report on October 2010, it was found that majority year-two dyslexic students were graded averagely as below. Further investigation took place when the researcher observed the monthly test. Dyslexic students were found having difficulties in answering multiplication-of-two exercises. Figure 4 shows some examples of the evidence. The first test example (on the left side) indicates wrong answer for all answer. The researcher believed that when the students failed for foundation level (multiplication-of-two), they have difficulties to proceed to the next level. The second test example (Figure 1) shows wrong understanding in repeated addition concept.

Further problems were identified in understanding skip counting as well as answering Solve the *Word Problem*. Kay and Yeo (2003) described that many dyslexic pupils find written *Word Problems* (of mathematical questions) very difficult to solve. But the researcher believes that such difficulties can be overcome using the help of multimedia. If the students were given motivational factors using multimedia elements such as sound, animation and graphic to conceptualize the process, they might be able to recognize and

to solve *Word Problem*. Perhaps, interactive functions might contribute to repeat previous topic learned. Some consistent images might also remind them about using similar calculation scenario. Bird (2007) stated that to help dyslexic children in multiplication, it is encouraged to explore the multiplication pattern using concrete materials as well as pictorial representations.
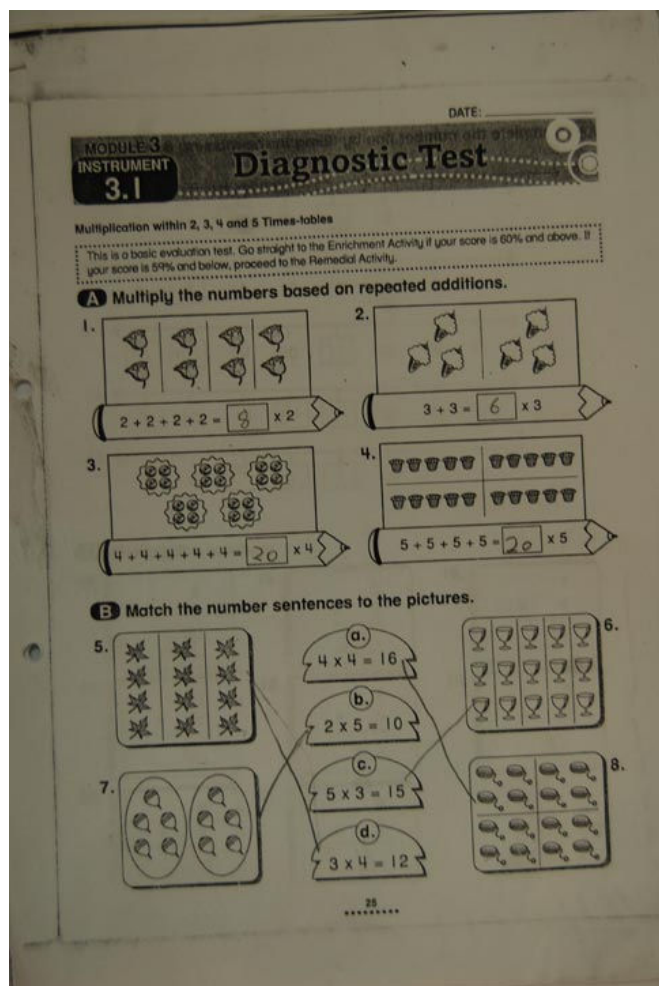

Fig.1: Problem in multiplication of two was spotted as the dyslexic children were found answer the question wrongly.

Through class observation too, dyslexic students were found having lack of focus. Majority students had the tendency to do other kind of activities (such as sharpening pencils, pencil-erasing, talking with friends, and sometimes walking around) in every short time. Chin (2009) confirmed this situation by stating that dyslexics have the barrier to learning math in terms of short term memory. Thus, class activities were delayed and a lot of times wasted. When the researcher asked for teacher's confirmation, they admitted the problem. The researcher believes that multimedia can help in creating attention and motivation to learn. Smythe (2010) stated that the computer offers the potential to teach literacy skills by providing the structured, sequential, multisensory teaching necessary for the dyslexic individual. He also added that there were some multimedia elements application that can contribute to

computer learning environment such as navigational, typographic, and layout design. The next issue would be the multimedia element strategy that should keep the students motivated until they finish the given task.

Using multimedia is believed to be able to assist dyslexic learners. Alty and Beacham (2006) suggested using words and pictures as well as auditory and narration without corresponding on-screen text. On the other hand, Nigel (n.d.) has explored ways in which multimedia can be used to enhance the accessibility of the learning environment. Multimedia elements were found having 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 were 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.

However, this research focus is not about curing dyslexia. It is about understanding the use of multimedia elements for IMLO in the field of dyslexia with regard to both learning and support. IMLO development process involves three phases including (1) analysis, (2) development, and (3) evaluation. Through its analysis phase, data from quiz results, report books, examination results, class observation and interview with teachers were obtained. These data then became guidelines in designing special instruction for IMLO content.
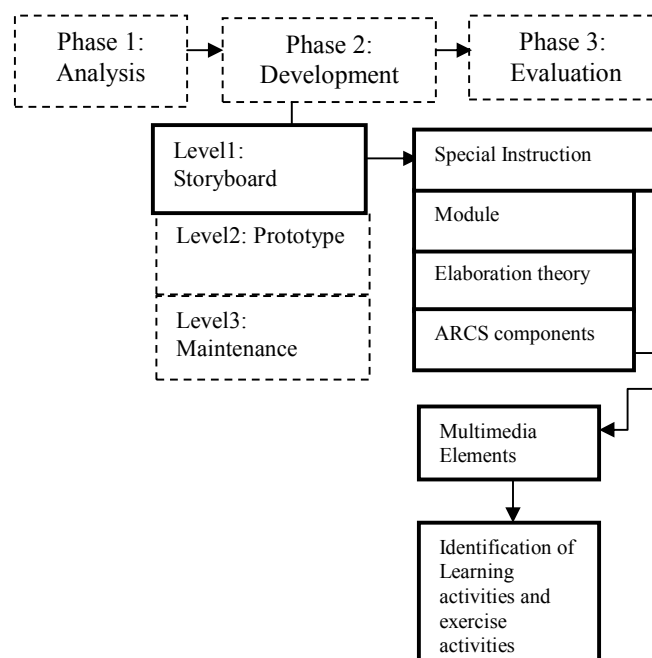

Fig.2: IMLO development process consists of three phases. The second phase comprises of three levels. This paper describes ARCS components on level one.

Designing the special instruction using interactive multimedia elements is not an easy task. Dellaporta (2007) stated that the designing task can be affected by both the look of graphical user interface (GUI) and the visual readability of the content. Spafford and Grosser (1996) 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 that incorporate a multi-sensory interactive approach to be used for the full benefit of enrichment for the students of dyslexia. Furthermore, Gavin Reid (2005) suggested some teaching principles for dyslexic students, which are

1) Multi-sensory (Incorporation of visual, auditory, kinesthetic 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)

With the suggestions from literature and IMLO development process, there is a need to identify the suitable use of multimedia elements for the dyslexic children

III. RESEARCH METHOD

The implementation of multimedia elements was made based on ARCS model (Keller, 1987), where each of the ARCS components was interpreted into multimedia elements instructions.

Bender (2001) suggested the use of ARCS for the development of multimedia lessons to stimulate and sustain the motivation for a student with learning disabilities. ARCS model is a proven approach for designing instruction. Shellnut, et al (1999) applied ARCS for designing interface as well as possible strategies for computer-based lessons. Reflecting to the ARCS components, Shellnut has also put emphasis on the use of pull-down menu buttons, tool buttons (like calculator and note) and their position in interface design.

List of multimedia elements result was reviewed by fifteen experts from different fields

1) Two dyslexia experts, who are associate professors of special education in Malaysian public universities.
2) Three instructional technology experts, who are one senior lecturer from Malaysian university, one professor from a university in the USA and one educational technology consultant from USA.
3) Two multimedia experts, who are associate professors of multimedia in Malaysian university.
4) Eight Subject Matter Experts, who are mathematic teachers who teach the dyslexic children.

Agreements were obtained from these experts and further discussion on the expert's opinions was discussed too.

IV. DESIGN PROCESS

This chapter describes the use of elaboration theory, and the use of ARCS model.

According to Reigeluth (1999), Elaboration theory has the following values:

- It values a sequence of instruction that is as holistic as possible, to foster meaning-making and motivation.
- It allows learners to make many scopes and sequence decisions on their own during the learning process.
- It is an approach that facilitates rapid prototyping in the instructional development process.
- It integrates viable approaches to scope and sequence into a coherent design theory.

Considering these values, this research suggests the use of interactive story-based content to sequence the multiplication-of-two learning stages as a holistic approach in IMLO. A story about birthday party that requires party pack preparation was set up. The party pack preparation has become the meaning-making of multiplication-of-two concept, while the interactive function allowed the students to decide the sequence at their own pace. These approaches were believed able to motivate students to learn multiplication-of-two module.

Multiplication-of-two module is a foundation topic for year two students to learn mathematic according to the Malaysian syllabus. The learning objectives of this module were to (1) understand multiplication as repeated addition, (2) recall the multiplication table of two, and (3) use multiplication in everyday life.

In this research, the researcher used the ARCS Model of Motivational Design developed by John M. Keller of Florida State University (Keller, 1983, 1987) to apply the instructional design. It consists of four strategy components; (1) attention, (2) relevance, (3) confidence and (4) satisfaction. Each of these components describes in form of multimedia elements and its significant role in the special instruction.

A. Attention

Attention is one of components in ARCS model to arouse and sustain of curiosity and sensation seeking. Creating attention is an important issue in developing a multimedia application. Mitropoulu and Triantafyllidis (2005) stated that researchers have shown that maintaining of students' interests is one of the factors that should be taken into consideration during the designing of educational software. According to Keller, J. M., & Suzuki, K. (1988), attention component has three sub components, which are

1) *Perceptual arousal* (gain and maintain attention by the use of novel, surprising, uncertain event in instruction)
2) *Inquiry* (stimulate information seeking behaviour by posing, or having the learner generate questions or problems to solve)
3) *Variability* (maintaining students' interests by varying the elements of instruction)

Fig.3 Screen shot sample of IMLO showing Amir and friends' cartoon characters and navigation buttons.

One of important multimedia elements that has attention factor is the main cartoon character of Amir; an eight year old local boy who explained the plot of the story (in a form of a journey ride). Amir played the role to show learning activities such as repeated addition, skip counting, and multiplication table. Amir was wearing school uniform and animatedly appeared, talked, and moved in every page, inviting user to participate with the activities. Amir has *Perceptual arousal* value because of its surprising appearance at every scene. Moreover, the use of interactive navigation buttons also provided uncertain event (Fig.3).

By having interactive navigation buttons too, students will be able to choose the 'next button' at every scene. The scene however, has been designed to create curiosity for the students to continue the story. The 'next button' provided possibilities to engage the students and proceed with more learning material. This explains the *Enquiry* sub component.

Despite of character, Amir also has voice over of a variety of instruction elements to maintain the students' interests (*Variability*).

Thus, the multimedia elements that contribute to the special instruction for the *Attention* component were Amir cartoon character and interactive navigation buttons.

B. Relevance

Relevance has its own sub components. These sub components describes the sequence process of ARCS after Attention. It is believed that *Relevance* happened when the students wonder how the given material relates to their interests and goals. When relevance happens, the students can be motivated. Sub components of Relevance are;

1) *Familiarity* (The use of concrete language and examples)
2) *Goal Orientation* (Provide statements or examples that present the objectives and unity of the instruction)
3) *Motivate watching* (The use of teaching strategies that matches the motive profiles of the students).

Having the fact that IMLO was designed for Malaysian students, there were also cartoon characters designed by different races of Malay, Indian, and Chinese. They were designed wearing school uniform and aged about eight years old (see figure 4). Similar approaches to create familiarity were from the images of candies, balloon, and cupcake. All these examples of images created *familiarity* among the students on their interests and goals of completing the story content.

To ensure the *Goal Orientation* sub component, Amir played a role of inviting the students to participate in each activity inside the story. This invitation can be seen from Amir's animation and voice over.

However, some dyslexic teaching strategies were also taken into consideration when delivering the whole story, especially on the use of dyslexia-friendly font and color setting (*motivate watching*). The font setting used was white-color-Arial Black with the size than is relatively big and readable. To support the readability issue, the background color was set as dark.

Thus, the multimedia elements that contribute to the special instruction for the *Relevance* component were images of birthday party situation, Amir's invitation (voice over and animation) to the party's activities, the color setting of the screen design, and font setting.

Fig.4: Screen shot sample of IMLO showing party's activity preparing two candies for one bag. The colors and fonts used were made for easy reading. The font was sans serif, bright color, on top of dark color background.

C. Confidence

Confidence is the third step of ARCS model, where students have to know that they will probably be successful before completing a given task. The strategy requires students to be challenged with an easy task. The sub components of confidence are;

(1) *Learning* Requirement (help students estimate the probability of success by presenting performance requirements and evaluation criteria).
(2) *Success Opportunities* (Provide challenge that allow meaningful success experience under both learning and performance condition).

(3) *Personal Control* (Provide feedback and opportunities for control that support internal attributions for success).

IMLO was designed with consideration of *Learning Requirement*. All counting activities involved more than one element to help the students to estimate the probability of success; images, numbers as well as voice (see figure 4). These multimedia elements helped the students' estimation when they read and calculate. The same voice over also challenged the students to read and count individually (*success opportunities*). They practically just need to repeat the same statement following the animation showed. In any case the students wanted to repeat the scene, they can click repeat button to repeat, or back button to start from the previous screen (*personal control*).

Thus, the multimedia elements that contribute to the special instruction for the *Confidence* component were images that symbolize amount and numbers, voice over and navigation buttons.

The images, numbers and voice over helped the students to recall the multiplication table (second learning objectives), and the button functions helped the students to answer the exercise questions (the third learning objectives) confidently.

scenario was the moment where the birthday has come to the climax scene. Amir needed to blow the candles, while the students needed to count the number of candles. Here, the students no longer use the previous scenario (party pack preparation for calculation concept. Thus, the multimedia elements used for Natural consequences sub component were new images (candle and balloon images).

To solve this problem, students need to answer from the given options. Positive feedbacks were provided for both correct and incorrect answers. Multimedia elements used for correct answer were Voice, sound effects, and texts, and for incorrect answer, the elements were replay-able animation (of calculation technique), text and voice. Chinn (2009) also suggested praising the work, not the learner, because dyslexic tends to blame themselves for any feedback given.

Lastly, to provide the equity sub component, students will be acknowledged for what they have achieved using text, voice, and song.

Thus, the multimedia elements that contribute to the special instruction for the *Satisfaction* elements were candle images (new images), interactive functions on positive and corrective feedbacks, animation, text, voice over song, sound effects, and video.

Fig.5: Screen shot sample of IMLO showing pair of cupcakes was represented two times.

Fig.6: Screen shot sample of IMLO showing animation of the birthday party celebration.

D. Satisfaction

Satisfaction is the last component of ARCS. When it established, students will remain motivated. There are three subcomponents of Satisfaction.

(1) *Natural Consequences* (Provide opportunities to use newly acquired skills in real or stimulated setting)

(2) *Positive Consequences* (Provide feedback and reinforcement that will sustain the desired behavior)

(3) *Equity* (Maintain consistent standards and consequences for task accomplishment).

Natural consequences in IMLO were set at the exercise scene, where students need to solve new problem using new scenario and by utilizing new multimedia elements. The

In overall, the multimedia elements have been designed are (1) Amir cartoon character, (2) Interactive navigation buttons, (3) Images of birthday party situation, (4) Amir's invitation (voice over and animation) to the party's activities, (5) the color setting of the screen design, (6) Font setting, (7) Images that symbolize amount, (8) Voice over, (9) Navigation buttons, (10) Candle images (as new images), (11) Interactive functions on positive and corrective feedbacks, (12) Animation, (13) Text, (14) Voice over song, and (15) Sound effects, and (16) Video.

V. RESULTS AND DISCUSSIONS

On *Attention* component, majority of the experts thought that Amir cartoon character was suitable as it is interesting, but

only about half of the experts thought that interactive navigation button was suitable. Some experts thought that the interactive navigation buttons were too complicated. They suggested simplifying the options for the dyslexic children to browse/explore (Figure 7).
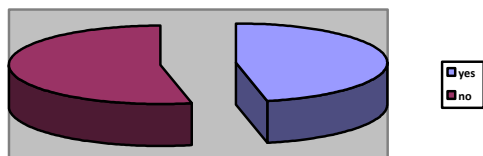

Fig.7: More than half (consists of all dyslexia experts, majority instructional technology experts, and some Subject Matter experts) thought that the interactive navigation buttons were not suitable.

On *Relevance* component, majority experts thought that images of birthday party situation were suitable for the target age group (Figure 8). Amir's invitation (voice over and animation) to the party's activities was also found suitable by majority experts. The font and color setting was found suitable too by majority experts. Little suggestion from one expert to change the letter "a" into "ɑ" to improve the readability. The letter "a" was believed to be confusing to letter "d".
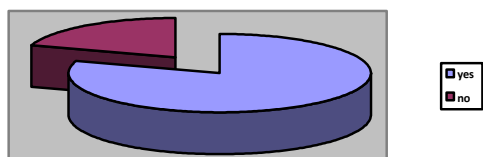

Fig. 8: Majority experts thought that images of birthday party were suitable. They also suggested other images on other stories such as visiting zoo, school holiday family tour, sports and playing in the park.

On *Confident* component, majority experts thought that images that symbolize amount were suitable and relevant. (Figure 9) Voice over was also found suitable by majority experts. Navigation buttons were also found suitable too by majority experts.
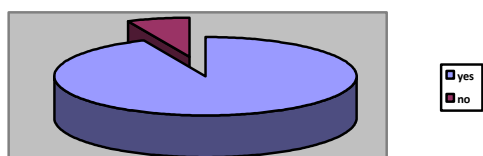

Fig. 9: Majority experts thought that images that symbolize the amount were suitable. These images were candies, party pack, cupcakes, friends, and candles.

On *Satisfaction* component, majority experts found candle images (as new images) (Figure 10), animation, text, voice over song, and sound effects, and video. They suggested including more songs and videos as they can improve the learning activities (Figure 12). However, the Interactive functions on positive and corrective feedbacks were found not suitable by majority experts (Figure 11). They suggested that more examples of answers need to be made so the dyslexic children will get more activity exposures. Reinforcement in terms of sounds for both positive and corrective feedback was also suggested.
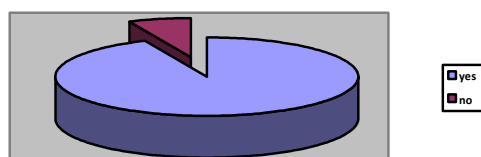

Fig.10: Majority experts thought that new introduced images were suitable. They suggested introducing more new images to encourage exposures on the learning.
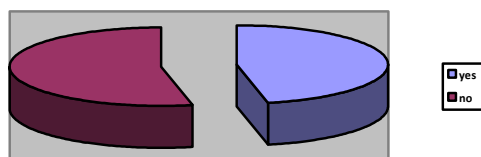

Fig.11: More than half (consists of all instructional technology experts and some other experts) thought that the interactive functions on positive and corrective feedbacks were not suitable. Instead, they suggested having more exercises with more explanations on the feedbacks
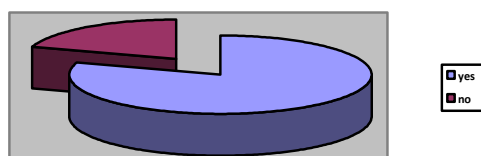

Fig.12: Majority experts thought that the use of video was suitable. In fact, they suggested to have more videos.

VI. CONCLUSION AND RECOMMENDATION

These multimedia elements were applied in ARCS motivational model, hence there could be more potentials for different types of cartoon characters, graphics, screen design, navigation button designs, voice over, sound effects, as well as animation.

However, the researcher believes that the attention component can be improved by putting humorous elements

such as humorous story content or humorous supporting cartoon character. Keller & Suzuki (1988) believed that humor can break up monotony and maintain interest by lightening the subject. Further study can be conducted in identifying specific cartoon character by preference. Better cartoon character may contribute to better attention and relevance factors. Moreover, specific images, graphics, and screen design can also be studied further. Story-based content might also be designed in a form of comic strips (if the students prefer comic), since it might include humorous elements and specific cartoon characters.

To improve the Relevance component, students can also experience new learning. IMLO has provided narrative content, with little exploratory interactive options. More interactive options can be employed to support the Goal Orientation in the learning process. These interactive options for example, may explore on how repeated addition concept could be applied in real life situation. There might be small quizzes, information links to websites, or showing videos. All these enrichment learning activities might help better Goal Orientation and keep the students motivated.

Confidence component were described with images that symbolize amount, numbers, voice over and navigation buttons. Even though these multimedia elements can provide imagination of successful probability in the given task, some interactive functions might also help. There could also be some constructive feedbacks given in every image clicked. These feedbacks might be presented in a form of special effect music, voice, and simple animation to explain further possible challenge. The same approach was also reported by Keates (2000), who stated that dyslexic students use ICT because it is an area where they generally have not previously failed.

Nevertheless, dyslexic students were also described as Automaticity (Consolidation of skills that learners normally achieve through practice) (Reid, 2005). This means, consistent approach of using similar cartoon character, images, buttons, color setting, and screen design might also contribute to Satisfaction component. Such consistency might also contribute to more IMLO-type products in the future.

The multimedia elements used for the special instruction can be used as a guideline for any similar learning material development for dyslexic students. Chin (2009) also believed that it is unlikely that there will be a definitive program for dyslexia with numeracy problem; nevertheless any future program will have to incorporate support for memory. Available guidelines in this literature for implementing multimedia elements were organized based on learning theory and model. Hence, these findings are appropriate and may be kept for discovering strategies used by relevant people in charge such as graphic designers, multimedia designers, Subject Matter Experts, as well as instructional designers to enhance the motivational aspects of Interactive Multimedia content development for dyslexic children.

REFERENCES

[1] Bender, W. N. (2001). *Learning Disabilities: Characteristics, Identification, and Teaching Strategies*. MA: Allyn and Bacon

[2] Bird, Ronit (2009) *The Dyscalculia Toolkit: Supporting Learning Difficulties in Maths*, London: Sage Publications.

[3] Chien Chou (1999) "Developing hypertext-based learning courseware for computer networks: the macro and micro stages," *Education, IEEE Transactions* [Electronic],, Vol.42, No.1, pp.39-44, Feb 1999, Available http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=746333&isnumber=16124 [1 May 2011]

[4] Chinn, S. (2009) *Course on Helping Learners Who Have Difficulties in Mathematics 2009*, Singapore: Dyslexia Association of Singapore.

[5] Critchley, M. (1970) *The Dyslexic Child*, London: Heinemann Medical Books.

[6] Dellaporta, Aspasia. (2007) *"Web Accessibility and the Needs of Users with Disabilities."* Advances in Universal Web Design and Evaluation: Research, Trends and Opportunities. (Ed). Sri Kurniawan and Panayiotis Zaphiris. Hershey, PA: Idea Group Publishing, 2007.

[7] Fadilahwati Abdul Rahman & Ronaldi Saleh (2009) "New Technology Approach (D-Mic) for Dyslexia Learning Style", *Proceedings: Regional Conference on Special Need Education,* University of Malaya, 20 -22 July 2009.

[8] Farideh Hamidi, Maryam Khoshbakht, Shobo Abdolmaleki, (2011) "Application of reigeluth instruction design model in virtual education", *Procediing Computer Science*, Volume 3, World Conference on Information Technology, 2011, Pages 796-800,

[9] Gavin Reid (2005) *Dyslexia and Inclusion: Classroom Approaches for Assessment, Teaching and Learning*, London: David Fulton Publishers.

[10] Gomez, C (2004) 'Dyslexia in Malaysia' in Ian Smythe, John Everatt and Robin Salter (ed.). *International Book of Dyslexia: A Guide to Practice and Resources,* John Wiley & Sons, Ltd.

[11] Hilda Carvalho de Oliveira, Celso Socorro Oliveira, and Edson Benedito dos Santos Jr. (2011). Generation of educational content for Open Digital TV and IPTV to assist the learning of Brazilian Sign Language (LIBRAS). *International Journal of Education and Information Technoogies,* Issue 4, Volume 5,

[12] Keates, A (2000) *Dyslexia and Information and Communication Technology: A Guide for teachers and Parents*, London: David Fulton Publishers.

[13] Kay, J and Yeo, D (2003) *Dyslexia And Math*, London: David Fulton Publishers.

[14] Keller, J. M. (1983) 'Motivational design of instruction' In C. M. Reigeluth (Ed.), *Instructional design theories and models: An overview of their current status.* Hillsdale, NJ: Erlbaum.

[15] Keller, J. M. (1987) *'The systematic process of motivational design'.* Volume 26, Issue 9-10, pages 1-8, November/December 1987

[16] Keller, J. M., & Suzuki, K. (1988) 'Use of the ARCS Motivation Model in Courseware Design'. In D. H. Jonassen (Ed.), *Instructional Designs for Microcomputer Courseware*. Hillsdale, NJ: Lawrence Erlbaum.

[17] Keller, J. M., & Burkman, E. (1993). 'Motivation principles', In M. Fleming & W. H. Levie (Ed.), *Instructional message design: Principles from the behavioral and cognitive sciences* (2nd ed.)(pp. 3-53). Englewood Cliffs: Educational Technology Publications.

[18] Lee, H., & Boling, E. (1999) 'Screen design guidelines for motivation in interactive multimedia instruction: a survey and framework for designers', *Educational Technology*, 39(3), pp.19-26

[19] Mitropoulou, V & Triantafyllidis, G (2005) 'Design of educational software: programmer and teacher approach,' *3rd International Symposium of Interactive Media Design.* 5-7 Januari 2005.

[20] Mohd. Sharani Ahmad (2004) *Special Children,* Serdang: Universiti Putra Malaysia.

[21] Nedelcut, N. (2011). 'Innovative Multimedia Resources Used in the Music Educational System: D.I.M.A. Experiment'. *International Journal of Education and Information Technoogies,* Issue 4, Volume 5,

[22] Nigel, Beacham (n.d.) *The potential of multimedia to enhance learning for students with dyslexia.Skills for Access*. Retrieved March 19, 2010, from http://skillsforaccess.org.uk/articles.php?id=150

[23] Nor Hasbiah (2007). Perisian Kursus Multimedia dalam literasi Matematik (D-Matematika) untuk pelajar disleksia. Unpublished doctoral dissertation, Universiti Kebangsaan Malaysia.

[24] Onintra Poobrasert. (2007). Educational Software & Development for People with Special Needs. *6th WSEAS International Conference on EDUCATION and EDUCATIONAL TECHNOLOGY, 259-263.* Retrieved on June 5th, 2012 from

https://www.google.com/url?q=http://www.wseas.us/e-library/conferences/2007venice/papers/570-295.pdf

[25] Peng, C.F.; Wah, T.Y.; Ishak, Z. (2009) *Computer-assisted instruction in teaching early childhood literature.* In: *8th WSEAS International Conference on Applied Computer and Applied Computational Science*, Retrieved on 5th June 2012 from http://www.wseas.us/e-library/conferences/2009/hangzhou/ACACOS/ACACOS52.pdf

[26] Reigeluth, C.M. (1999) 'The elaboration theory: Guidance for scope and sequence decisions'. In C.M. Reigeluth (Ed.) *Instructional-Design Theories and Models: A New Paradigm of Instructional Theory.* (Volume II). Hillsdale, NJ: Lawrence Erlbaum Assoc

[27] Shellnut B; Knowlton A; and Savage T (1999) 'Applying the ARCS model to the design and development of computer –based modules for manufacturing engineering courses', *Educational Technology Research and Development*, Vol. 47 Issue: 2 pp: 100-110

[28] Smythe, I (2010) *Dyslexia in the Digital Age: Making It work*, London: Continuum International Publishing Group.

[29] Spafford, C. S & Grosser,S. (1996) **Dyslexia** *Research and Resource Guide*, Massachusetts: Allyn & Bacon .

[30] Vaughan, T (2008) *Multimedia*: *making it work*, 7th edition, New York: McGraw-Hill