A Persuasive Mathematic Courseware Design Model for Special Needs Children

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Abstract This paper describes an ongoing study related to the courseware design model which specific to Mathematics learning content application for Special Needs Children. Reviews from literatures indicate that content application such as courseware which is specifically designed to cater the needs of Special Needs Children learners in learning is highly scarce. It was found that most of the existing content applications including courseware focus to the needs of normal student, in which most of this courseware mean too little to the Special Needs Children learners which have their own problem of difficulty in learning. Thus, this study aims at studying the core element needed in education courseware for Special Needs Children learners. This paper proposes a Courseware Design Model for Special Needs Children by utilizing persuasive approach. Future works is to validate the proposed model through expert review and prototyping method.

Keywords: Courseware Design Model, Special Needs Children learning, Mathematic Courseware.

1. INTRODUCTION

Special need is disability person who need special attention and specific necessities that other children do not in result of interaction between both health conditions and personal factor (World Health Organization, 2014). People with autism, Down syndrome, dyslexia, blindness, or cystic fibrosis, for example, may be considered to have special needs.

Thirteen special need learning courseware have been reviewed during the previous studies towards courseware development for special need children. However, most of the reviewed courseware is design to accommodate for reading learning (Rahmah et al., 2010; Ramlı et al., 2011). Only two of them are developed for mathematics learning of special need children which are SynMax (Shafie et al., 2013) and MathLexic (Ahmad et al., 2013). However, both of these mathematic courseware does not follow the standard curriculum for mathematics learning of special need children that has been provided by Education Ministry. Besides, SynMax (Shafie et al., 2013) is a courseware that developed for Down syndrome learner while MathLexic (Ahmad et al., 2013) is developed for Dyslexia learner, hence their chosen components is based on learning problem faced by targeted group of learner. The problem is that, difference groups of learner have a difference learning problem (Khan, 2010). As the result, SynMax (Shafie et al., 2013) courseware cannot really help children with Dyslexia in their learning process, so do the MathLexic (Ahmad et al., 2013) courseware towards Down syndrome children.

In the persuasive mathematic courseware design model for special needs children, an analysis on design model of courseware is significant important as it could identify those common components (illustrated) in the conceptual design model (Aziz et al., 2014). All the components that favored the needs of all group of special need learner are accessed in this study and were proposed into the development of conceptual design model.

Therefore, this study moves forward by implementing a comparative analysis involving two conceptual design models of courseware with the main objective is to propose a conceptual courseware design model designated for special needs learners in Mathematics subject, call “MyMath”. An analysis of existing common component suggested by previous study has been done in order to fine the compatible component to be included in mathematic design model (Hossain et al., 2006; Aziz et al, 2014a). The specific objectives for this article are designing a conceptual design model of “MyMath”.

2. ANALYSIS ON EXISTING MODELS
An analysis on existing models found that two studies on common component of courseware by Hossain et al., (2006) and Aziz et al., (2014a). Hossain et al., (2006) suggest basic component for multimedia courseware as broad without specified the scope of learning subject. Five basic elements in multimedia courseware have been highlighted by Hossain et al., (2006), which are course content, pedagogical methods, course objective, multimedia elements and architecture. Meanwhile, the common component suggested by Aziz et al, (2014a) is mean for low vision learner. They are structural component, content composition, design guideline, learning theory, learning approach, development process, Instructional Design (ID) model and technology.

In this study, we will adopted Aziz et al, (2014a) common component design model as the target learner of Aziz et al, (2014a) model are low vision learner which is also included under special need groups, while component suggested by Hossain et al., (2006) are designed for normal learner.

3. RESEARCH METHODOLOGY

In achieving the stated objectives, this study employs two phases of activities which are (i) literature review, and (ii) comparative analysis as illustrated in Figure 1.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Actions</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Literature Review (Respected Database)</td>
<td>Two common conceptual models. Two mathematic courseware for special needs.</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Comparative Analysis</td>
<td>Common component of conceptual design model of “MyMath”</td>
</tr>
</tbody>
</table>

**Figure 1: Research Framework**

The first phase is to gather the previous conceptual design models of common courseware. Two common component design model has been identified through comprehensive literature review. However, only one of them is design for special need courseware which common component design model suggested by Aziz et al (2014). Hence, his common component is chosen to be use in this study. Two Mathematical courseware for special need children also has been identified in this study. One courseware is for of Down syndrome group (Shafei et al., 2013) and another one is for dyslexia group (Ahmad et al., 2013). Moving on the next stage which is comparative analysis. During this stage, both chosen Mathematical courseware is compared with common component design model suggested by Aziz et al (2014). The comparative analysis is importance in order to gather information and filter component that should be adopted in this study. Based on comparison, common component is selected and justification of each component is stated. End of study, conceptual design model for special need children’s mathematic learning is produced.

4. FINDING AND DISCUSSION

4.1 Comparative analysis

After went through common component of courseware, Aziz et al., (2014b) common component is selected to be adopted in this study. However, only six common components from Aziz et al., (2014b) conceptual design model is selected which is structural component, content composition, design guidelines, learning theory, learning approach and technology. Instructional Design (ID) model and development process will be not included in “MyMath” conceptual design model.

All six components from Aziz et al., (2014b) are selected because combination of selected components will be able to encounter the learning problem of special need children and reduce complexity of conceptual design model by eliminating unneeded component. The scope of “MyMath” also is very broad which included all special need group. Hence, it is already involve complicated process since not all type of special need has same learning problem (Khan, 2010). Aziz et al., (2014b) stated that development process is not critical component that need to be inserted in research and only an optional component in design model. While ID model is eliminate from this study since this study will not use any instructional design process and principles.

Next is the comparative analysis of mathematic courseware with common component from Aziz et al., (2014a). Since this research is regarding mathematic courseware for special need, two courseware that are developed for mathematic was chosen which are SynMax (Shafei et al., 2013) and MathLexic (Ahmad et al., 2013). This comparison is importance since both courseware targeting difference group of learner under special need branch. Therefore, their component also will be differed with each other due to difference learning problem and learning style of each groups of learner. “MyMath” conceptual design model need to fulfil all type of learning problem and limitation of each group of special need. Hence, through comparing existing mathematic courseware, researcher will be able to identify strength and weakness of existing mathematic courseware and extract importance element under each component to be implant in conceptual design model.
Table 1: Component of current existing courseware for Mathematic learning

<table>
<thead>
<tr>
<th>Common Component</th>
<th>SynMax (Shafie et al., 2013)</th>
<th>MathLexic (Ahmad et al., 2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Content Composition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Guidelines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Theories</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Learning Approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development Process</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Instructional Design (ID) Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Based on comparison made in Table 1, most of the common component that applied in both mathematic courseware are structural component, content composition, learning theory, and technology. Meanwhile, the development process component is only available in SynMax (Shafie et al., 2013) courseware. Although this study also would not implement Instructional design (ID) model, the existing courseware still showing lack in design guideline and not mention about learning approach in their paper.

4.2 Justification of Selection Component and Elements

Although Aziz et al., (2014a) suggesting eight common components in total, not all of them are compulsory to be included in this study as it is depend on the suitability of each component with the target learner and learning subjects of courseware. The justification of selecting each of these components is because those components are compatible and suitable to be matched with learning guideline provided by the Malaysia Education Ministry for special need children.

The other two components are not selected to be included in this study; are the development process and the Instructional Design (ID) Model. One of the reasons for not adopting development process component in this research is that, Aziz et al., (2014b) stated that development process is not critical component that need to be inserted in research as it is only an optional component in the design model.

To be added, Aziz et al., (2014b) only adopted Instructional Design (ID) Model component if the study is related to instructional design material. In technical, Instructional Design (ID) Model provides organized approach of implementing instructional design process for specific education initiative (Morrison, Ross & Kemp, 2004). However, this research does not use any instructional design process and principles. “MyMath” also does not develop following any instructional design model.

(i) Courseware Component: Learning Approach

The analysis result from Table 1 shows both mathematical courseware not applying learning approach, therefore in this study, we added the component of learning approach in to the proposed courseware design model. Learning approach express the styles of learner interact with the learning tasks (Laureillard, 1979). A good learning approach is significant to be applied in the courseware in order to enable special needs children to learn better and extend their abilities. Ahmad et al. (2012) found that special needs children can interact with the teaching tools and apply extra creativity towards their learning contents through an effective learning approach. Thus, it is very important for learning approach to be included in the design model of this research.

There are various learning approaches available in education, such as Phonic Reading Technique (Ahmad et al., 2012), flash card (Rahmah et al., 2010; Ramli & Zaman, 2011) and a Picture Word Inductive Model (Calhoun, 1999). Due to the broad scope of special needs children in this study and according to previous studies, learning approach of Picture Word Inductive Model (PWIM) is chosen to be studied deeply for this research.

According to Calhoun, (1999), Picture Word Inductive Model (PWIM) is an instructional approach used to teach reading using familiar pictures of objects, actions and scenes by drawing out the familiar words from students’ listening and speaking vocabularies. Using PWIM photographs can helps improve mathematical concepts and aid connections to the real world. Teachers can request children to count the image one by one repeatedly until they are familiar with it. By doing this, it can directly increase their memorizing skills. Based on this proposing model, children will be able to recognize more objects in their daily life and improve their mathematic skills.

(ii) Courseware Component: Structural Component

Structural Component is defined as interrelated component of software (Gorton, 2006). According to Aziz et al., (2014b), a courseware should have a proper structure. In short, the whole presentation of the content must be organized in consistent and reliable for the
learners. Besides, Education Ministry of Malaysia also has provided a standard systematic structure that has to be followed by special needs children institution in learning mathematics; this computes of six modules.

A mathematic text book for an early childhood special education as, written by Zakaria et al., (2014) has listed down the suitable module that believes will be very helpful in learning of special needs children. It contains the important elements or components that need to be included in the mathematical learning process of special children.

(iii) Courseware Component: Technology

A number of researchers show that the involvement of technology into a learning process helps improve the behaviors of students with learning disabilities. (Howard et al., 2004; Manzoni et al., 2004). Table 1 also shows that both mathematical courseware designs for special needs children using technology in their courseware. Besides, both the courseware reviewed in previous study use mobile technology. This shows that technology is one of the crucial components that must be added into a design model for a better result. Although Aziz et al., (2014b) also suggest and applying this component into his design model, the technology that been use by him is VCD or DVD or downloaded by the interested users over the internet. The learning content uses such as graphics, animation and sound in order to illustrate the learning content easily and suitable to develop for mobile learning resources. Hence, following the current trend of technology, this study wills also using mobile technology as a platform to facilitate the needs of mathematic learning of special needs children.

(iv) Courseware Component: Design Guideline

The analysis in table 1 shows that none of both courseware used design guideline in their courseware. A lot of previous studies agree that the design of courseware is the vital component to be adopted in the courseware (Wagenif, 2004; Baele and Sharpless, 2002). Wagenif (2004) stated that the combination of pedagogy and software design can enable the computers to serve as interactive agents within educational exchange. There are many design guidelines available for a different courseware and different target learners. For example, instructional design (Aziz et al., 2014) and persuasive design (Mintz and Aagaard, 2012; Yusoff et al., 2011; Lucero et al., 2006; Bakri and Abusafia, 2014; Rosmani and Wahab, 2011; Shahiri and Husain, 2013).

However, persuasive design has been chosen as a design guideline to be applied in this study. As it shown a positive result towards the special education studies (Mintz and Aagaard, 2012). Literally, this persuasive design studies the human behaviour and persuades user to achieve target behaviour (Fogg, 2009a). It help and support special needs children’s problems such as poor short term memory, weak in distinguishing significant information, poor understanding in object concept, and poor concentration. It is important to be implementing in this study in order to observe the behaviour change of children with difficulty or learning by applying this model in mobile apps.

Persuasive System Design (PSD) and Fogg Design Model (FBM) are combined in this study as suggested by Ng et al., (2015). Ng et al., (2015) claim that each of the PSD’s persuasive design principles in this proposed courseware is able to improve one or more of the elements in FBM (Ng et al., 2015). For example, the ability can be increased by reducing complexity according to the user. Out of 28 PSD, only 10 are chosen to be implemented in this study due to its suitability with special need children’s learning. They are Reduction, Tunneling, Tailoring, Personalization, Self-monitoring, Praise, Rewards, Liking, Social comparison, and Competition.

(v) Courseware Component: Content Composition

Content composition is the learning content that will be displayed in the courseware (Aziz et al., 2014a). Based on analysis done in table 1, both mathematical courseware applied this component in their study. Aziz et al., (2014b) explain that the content composition is divided into two parts which are pedagogical approaches and human entities. The relationship of both is that the human entities are needed in order to express the pedagogical aspects in the courseware (Aziz et al., 2014b). Pedagogical approach is divided into five sub-categories which are multimedia elements, presentation styles, teaching and learning techniques, content delivery strategies and conduction styles (Aziz et al., 2014b)

As we can see, the compactness of element in this component will create the gap in the research if it does not apply in the design model of courseware. This is supported by Liou (2013), where he explains that content composition is very important in the design process as it needed to explain the learning material inside the courseware. Besides, the special needs children in Malaysia also have their own standard content delivery strategy that provided by the Education Ministry (Malaysia Education Ministry, 2011).

In this research, the courseware will be developed for Mathematic learning according to the real syllabus of the special need education system. The content that will be utilized in this research is “Asas 3M Matematik (Tahap 1)” learning book. This learning material does not directly targeting any specific group of special needs children as a specific user. It makes the module content compatible with any group of special needs children’s learning problem. 3M stand for “membaca”,“menulis” dan “mengira”. “Asas 3M Matematik” is a standard curriculum for special education with is standardized by the Malaysia Education Ministry (Malaysia Education Ministry, 2011). This learning material does fit well with special needs children since the phase of learning is structured and organized from easy to hard or as default step by step.
The other element that will be added in this study is the personalization. By definition, anything “personalized” implies variation across individuals (Twyman, 2014). Personalized learning requires attention to the unique needs students in term of abilities since that each of them have different learning styles including students with mild, moderate or severe disabilities (UNESCO, 2011). There is a few education courseware that has implemented personalized as one of their design model's elements. Block-Base Education Courseware is a courseware that is designed for autism children with difficulty of learning (Ismael et al., 2012). In this courseware, personalized is applied when the learner is allowed to fill in their profile detail, including name, age, gender, color preference and sensitivity settings. It also allows the teacher or parent to develop an application by selecting and integrating those blocks such as choice of answers, text as well as the audio file.

According to Gelman et al., (1978), young children have more understanding on number. However, special needs children always having problem in learning mathematic. For examples, Down syndrome children showed lower achievements in numbers compared to language skill (Abdelhameed & Porter, 2006). While dyslexic children often show difficulties in learning mathematics, in such as misinterpretation of mathematic operators, problem in understanding sequencing of numbers and confusion when solving mathematic operations. Thus, she recommends a set of Counting Principles that characterize an actual counting (Gelman & Gallistel, 1978).

Three of those principles are the cardinality, one-to-one and the stable-order (Gelman & Gallistel, 1978). The cardinality principle means that the total number of a set is represented by last number tag (Gelman & Gallistel, 1978). For instance, when special needs children were asked of how many of the item in a particular group, they need to give a final count word as the answers. While, the one-to-one principle defines each item to be counted must have a unique tag and item in the array has only one tag (Gelman & Gallistel, 1978). For example, DS children were asked to count a group of items where each item can only be represented by a specific number in a correct order. On the other hand, the stable-order principle need the number tags to have a permanent order across counts (Gelman & Gallistel, 1978). This means that they need to count in correct order and not skip any number in the order. Learner will be able to detect an error once they have fully control on counting principles.

Multimedia learning occurs when mental representations from words and pictures are built (Sorden, 2012). This theory of multimedia learning has been emphasized and defined by Mayer’s cognitive theory of multimedia learning. Generally, it tries to address the issue of how to structure multimedia instructional practices and employ more effective cognitive strategies to help people learn efficiently (Sorden, 2012). Besides, Principles of Multimedia also show a positive impact toward certain case study involving disable children. Due to the suitability of each principle in Principles of Multimedia with special need learning, only 4 principles are chosen which are Coherence principle, Redundancy principle, Modality principle and Multimedia Principle

(vi) Courseware Component: Learning Theory

According to the analysis in table 1, both courseware using learning theory component in their courseware. Learning Theory defined as a conceptual framework that describes how information is absorbed, processed, and retained during learning (Chaudhary, 2013). It can increase the effectiveness of the courseware towards the target learner. According to Jamaludin, (2005), learning theory offers basic strategies that could be used to strengthen the quality of learning by providing a suitable learning practice based on the needs of learners.

This is the reason of why the Education Ministry provides a special module that suits the needs of special need children learning. Reid (1987) suggests that students are taught using consistent techniques with their learning styles, so that it will result in more easily and efficiently learning process (Reid, 1987). Among of them are Neil Fleming’s Visual, Auditory and Kinesthetic (VARK) Model (Fleming & Baume, 2006) and Dual Coding theory (Clark & Paivo, 1991).

However, Dual-coding theory postulates that both visual and verbal information is used to represent information (Clark & Paivo, 1991). The ability to stimulate two different ways increases the chance of remembering an item. For instance, there will be both written and verbal instructions to assist the children in using the application. MyLexics (Abdullah et al., 2009) and SynMax (Shafie et al., 2013) was developed based the ‘Dual coding theory’ by Allan Paivo (Paivo and Begg, 1981) who suggested that a recall or recognition can be enhanced by presenting information in both visual and verbal forms.

Figure 2 shows the overall “MyMath” courseware design model that containing six common components adopted from Aziz et al., (2014b) study.
5. CONCLUSION

This paper proposes a mathematics courseware design model for Special Needs Children. Through an extensive review of literature, the model is developed to be used as a guide in courseware development and specifically design to meet the needs of special need learners. Six comment component of design model is finalized and selected elements that suitable for special needs children learning are identified through these studies. With the development of this model, hopefully it will encourage courseware designers to develop more multimedia applications for teaching and learning Mathematics by having the learning problem of special need children in mind. An upcoming study of this research is to verify the components of the proposed model through initial verification and selection of each element in order to produce a courseware name as “MyMath” that developed for special needs children.

6. CITATION AND REFERENCE


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