Critical Analysis in Proposing a Conceptual Design Model of Assistive Courseware for Low Vision (AC4LV) Learners

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ABSTRACT
This paper reports on an ongoing study, which intends to propose a conceptual design model of Assistive Courseware (AC) that is particularly designed for low vision learners (LV) learners. Altogether, 15 conceptual design models of courseware were compared and analyzed exhaustively with the main objectives (i) to determine the research gaps in proposing a conceptual design model of AC4LV and (ii) to identify their common components. Through a systematic and critical analysis, this study discovers that all of the previous models do not suggest any specific conceptual design model of courseware that caters the visually-impaired (VI) particularly low vision (LV) learners in detail. It is noted that this is the research gap that should be the focal point for further study. Also, the previous literatures suggest that Instructional Design (ID) model, learning theories, and learning approach must be the basic component in designing the conceptual design model of courseware.

General Terms
Human Computer Interaction (HCI), learning material for low vision learners.

Keywords
Assistive Technology (AT), comparative analysis, conceptual design model, Assistive Courseware (AC), low vision (LV) learners.

1. INTRODUCTION
Courseware has been utilized as one of the teaching aids that have grown tremendously for the past a few years. It is one of the e-learning platforms that could assist the learners to learn anytime and anywhere with or without guidance from the instructor. There are various types of courseware available in the market. Some of them can be access online besides in the form of CD-ROM. From a preliminary investigation [1][2][3] [4][5] this study found that most of the courseware are provided for normal learners. This means that the coursewares are designed with colorful animation, multiple font faces, and cheerful songs to tackle the learners to learn through the courseware [6]. Most of the professionals, multimedia organizations, and researchers are trying hard to produce courseware that could attract the normal learners to learn through it in making sure school-aged children have a brighter future life [7]. However, for the disabled learners' particularly low vision (LV), all this kind of courseware means too little to them and this indicate that they are neglected from this type of e-learning platform. In fact, they actually deserve to have similar quality of education with normal students. They also should not be neglected from contents disseminated through computers and computers application, especially content application such as courseware. Current state of disabled people in Malaysia is one of the factors that motivate this study to investigate this issue in-depth which is further described in the next paragraph.

The number of people with disabilities (PWDs) has been increasing rapidly around the world. The statistics from [8] reveal that 15% of the world's population have some form of disabilities; which is one third of them are children younger than 15 years old [9]. They are disabled differently including physical, learning, hearing, and visual. Among the various types of disabilities, visual impairment (VI) is considered the serious one. [8] reports that 285 million people in the world are visually-impaired (VI). Particularly 246 million of them have low vision (LV) and 39 million of them are blind. Approximately 90% of the VI people live in developing countries. Meanwhile, in Malaysia the Malaysian Social Welfare Department reports that the officially registered disabled people as at December 2011 are 359,203 people [10]. It is estimated that 900,000 children suffer from various disabilities [8]. Referring to the facts, it could be deduced that from the year 2004 until 2011, the registered VI people in Malaysia drastically increased to be double which is from 150,617 to 359,203.

Therefore, based on the preliminary investigation which has been published in [11] this study moves forward by implementing a critical analysis and comparative analysis involving 15 conceptual design models of courseware with the main objective to propose a conceptual design model of courseware that is specifically designed for LV learners which is called (AC4LV). In accordance, the specific objectives for this article are:

(i) To determine the research gaps in proposing a conceptual design model of AC4LV.

(ii) To identify the common components in designing a conceptual design model of AC4LV.

2. CRITICAL ANALYSIS ON EXISTING MODELS

In proposing a conceptual design model of AC4LV, an analysis on conceptual design model of courseware is important. It should identify their common components that should be adapted in the conceptual design model. Also, as discussed in the previous studies, the concepts of conceptual design model are divided into visual and interactive. In response to that, this study selects and analyzes 15 conceptual design models of typical courseware (TC) and AC for the past five years (i.e. 2009-2013) from various countries and respectable journals. They are discussed critically as follow:

Conceptual Design Model of Reality Learning Media (RLM): At first impression, this model requires complex works to be developed. Proposed by [12], the conceptual design model of RLM comprises of six main components which are structural components, content composition components, learning approaches, technology, process of developing, and learning theories. All of these components are organized structurally to form the RLM. The aim of this model is to produce RLM applications that contain entertaining and fun elements as the approach to deliver the knowledge to the learners in uninhibited situation. This model provides evidences that integrating fun and entertaining in the learning application does not mean that the students are unconcern with the learning process or not taking learning seriously, which could impede the learning activities as argued by [13]. Thus, other than considering multimedia elements, this study also emphasizes on entertaining and fun aspects as the approach to attract the LV learners to learn via courseware.

ID Model of Multimedia Courseware for Lines and Planes: ID model of multimedia courseware is suggested by [14] for developing a courseware in learning lines and planes in 3-Dimension topic. The model consists of four components which are source, learning theory, learning approach, and content. There are two learning theories underlying this model, which are cognitivism and constructivism. Both of these theories are applied in the provided lessons and exercises. ADDIE model is used as the methodology to produce this model. Additionally, the construction of this model considers the user background and their preference to ensure the learning outcome is achieved. In line with that, this model stresses on visualization aspect when their preliminary studies found that there were teenager students having visual problems in learning mathematics. For that reason, the learning approach applied in this model is learning through audio explanation together with text, image, animation, and video to support the visual explanation. The usage of multimedia elements in terms of colors, font size, navigation, and icon are also stated. This study believes that, this model is appropriate to be adapted in designing AC4LV. However, the target user is not clearly discussed even though the study claims that this model highlights on visualization aspects. Also, there is lack clarification in terms of each of the multimedia feature to point the LV learners as part of the users.

Conceptual Model for Small Screen Learning Application: Conceptual model of small screen is composed of three sets of design recommendations namely (i) design for presentation, (ii) design for small screen, and (iii) design for learning uses. The work is projected by [13] and built upon previous established work of [15]. These three sets of design recommendations may be used effectively by designers of multimedia resources and professionals who engage in instructional applications. Each set of the design recommendation is listed with specific guidelines to form a multimedia resource in learning application. Presentation as the first design recommendation refers to how the learning content should be displayed. With ten listed guidelines, it provides some general ideas for the designers to tailor with the construction of AC4LV design model. The guidelines are also integrated with a well-known learning theory that is Cognitive Theory of Multimedia Learning [15]. The second recommendation is design for small screen which is specific to designing learning applications for small screen handheld devices such as Personal Digital Assistants (PDAs) and mobile phones. It seems that the recommended guidelines are not fully considering the LV learners as part of the users, especially in Malaysian context. However, some of them can be utilized in AC4LV design model such as providing zooming facility, which might be useful to low vision students. Meanwhile, the third set of the recommendation specifically addresses the issue of designing learning applications to be used via handheld devices. It includes design for observation, design for analytical use, design for experimentation, design for thinking, and design for reuse. In a nutshell, the benefits of this conceptual model is seen in its flexibility, even though most of the time the study stresses that the conceptual model is addressed for learning via handheld devices and never states the LV learners as part of their users. The flexibility enables this study to consider all the recommended guidelines to be incorporated in the conceptual design model of AC4LV.

Framework of Virtual World Courseware: Framework of virtual world courseware is a design model that focuses on learning through immersive environment or virtual reality [16]. It was designed to cater students in medical education which always face problems in understanding the subject, especially those require practical tasks. The framework relatively looks simple with a single flow and only illustrates on content aspects, in which this only one component consists of objective, tutorial, enhancement, quiz, and test. This contrasts with the suggestion by [17] that a courseware should comprise of at least three components. Also, the framework of the courseware content seems similar to other ordinary courseware. On the other hand, each element that is said to be embedded in the immersive environment courseware is not clearly discussed. Furthermore, there is no learning theory or approach applied in the courseware content. In conclusion, although this framework is an effort of researchers in a respectable university in UK with suppressive title, it does not mean it is adaptable in modeling the AC4LV.

Courseware Development Model (CDM): CDM proposes by [18] encompasses three components which are content (C), learning theory entitle as meaningful learning (ML), and multimedia (M). C and M are configured according to the principles of meaningful learning theories to support the pedagogical features in the course. With that, to provide meaningful and easily understood knowledge, five principles are included in the ML components: (i) advanced organizers, (ii) bidirectional relationship between previously learned knowledge and newly learned knowledge, (iii) information and connections among the information units, (iv) consistency and coherency in new teaching information, and (v) transfer. In the interim, to produce structured contents, four principles were built-in in the C, which are (i) general and holistic view of content, (ii) divide content into small knowledge units, (iii) concrete each of the knowledge units with samples of problems, and (iv) setup connections between knowledge units. Also, there are several rules incorporated in ML

component on how to control the use of text, sound, animation, and video in courseware. This means that the CDM is designed to give an idea about the synthesis of C and M under the ML. It is a general conceptual design model, which is designed to be applied to any subject. However, in CDM the designers are able to utilize any learning method to catch the attention of the students such as simulations, problem-based, and scenario-based learning. So, any courseware that is developed using CDM would constitute a synthesis of this model. In short, a set of high-quality design principles have been proposed in this model. In fact, it has been tested and proven positive empirical evidence. However, the proposed design principles, especially the ML still describes for general use, which is not specific for LV learners or at least taking them into consideration.

Model of UZWEBMAT: [19] proposed the UZWEBMAT with an aim to design an adaptive and intelligent e-learning environment based on student learning style and expert system. So their model is designed more to architecture form. Focusing on individual learning styles (i.e. visual, auditory, and kinesthetic) this model prepares three different learning objects in three different ways to provide the most proper learning environment for the learners as well as adds force to conventional classroom education. In creating the content of UZWEBMAT, the constructivist learning approach acts as the basis of the model. Following are characteristics of UZWEBMAT that differentiate it from other e-learning applications:

a) Content is compliance with constructivist approach – the content of UZWEBMAT are prepared in accordance with constructivist approach. This means the intended information for the learner is not tangibly provided. In contrast, this application provides LO elements that enable the learners to construct their own knowledge.

b) Innovation adaption – UZWEBMAT functions dynamically based on learners' performance, which directs the learners in three different learning styles as mentioned above.

c) Intelligent solution supports – UZWEBMAT is provided with LOs that are rich with solutions supports and tips, which may adjust according to the learners performance.

d) Online and on-live visualization – All the leaner activities while using the UZWEBMAT are automatically monitored and recorded as well as reported to teachers.

An important part in the model of UZWEBMAT is the provision of LO in which it is designed separately for each of the learning style. As an example for those who learn visually, special attention should be given on creating figures, flow charts, pictures, and animations. Similarly, voice instructions, warnings, and feedbacks, should be designed exclusively to those who learn audibly. Correspondingly, special LO (i.e. interactive animations) should be designed for those who learn kinesthetically. Although an expert system underlies the UZWEBMAT jointly with three different LOs in three different learning styles, still the model is not intended for LV learners. The discussion is more on how the user could access the application, not on the content. This points out that the LV learners are not their target user.

Model of Constructivist Computational Platform: Model of constructivist computational platform by [20] is based on constructivist theory with an aim to develop a computational platform that supports the traditional education in learning mathematics among the elementary school students. It contains three main components which are input, process, and output. This web-based interactive platform allows the users to take part in the constructivist learning. This means the children with minor participation in class have a chance to involve in the learning activities. Going deeper in terms of the tools appear in this learning platform, it contains topic browser, toolbox, games or test explorer, workspace, communication interface, learning modules, and tutorial wizard. All this tools allow the teachers to configure based on students' intellectual ability. Although this model illustrates that they have characteristics of interactive platform as one of the sub-components, but this is poorly discussed in their study. Even though this is the current model and the content is developed special for elementary school children, the designers do not consider LV learners as part of the users. The discussion also states that the uses of mouse in one of their learning activities have created the children knowledge which totally contrasts with the needs of LV learners.

Auslan Children: *Auslan Children* by [21] is a multimedia application, built to assist hearing-impaired children in learning Australian sign language. According to the study, this prototype consists of three components which are learning theories, modules, and multimedia elements. The modules of *Auslan Children* were designed by absorbing Multiple Intelligence (MI) Theory and Constructivist Theory to cater the Australian hearing-impaired children with multiple skills similar to normal children. Therefore, the AC was built by inserting a signed song, a memory game, an interactive storybook, a series of questions, and the most importantly is vocabulary instruction. All of these modules were develop by integrating text, image, audio, and video to support the multimedia presentation. On the other hand, the developed prototype also includes character to be a magnet for children to facilitate them in learning activities. Although this prototype is point to disabled children and resulted that majority of that children enjoyed learning with *Auslan Children*, it does not enable the LV learners to join the learning activities because the visualization aspects do not match the needs LV learners.

LT125ThinkingMind: *LT125ThinkingMind* by [22] is an application developed to support the needs of children with severe learning disabilities particularly in learning pre-mathematical concepts such as position of objects, directionality, and object classification. The interface was designed differently for the use of educators and students. There is no discussion about the component, learning theory or learning approach in the model. However, the model deals with cognitive processes (i.e. recognize an object, sort objects, and classify objects by colors, sizes, or positions). This indicates that the study has adapted cognitive theory, which is important for the children with severe learning disabilities. Apart from that, it is very crucial to educate the teachers about the effectiveness of the model. Thus, the study considers the teachers' perspectives. Overall, a mathematical courseware could improve the children mental development. However, without considering the aspects of visual, audible, and interactive features it means nothing to LV learners.

eAccess2Learn: By considering the accessibility issues in web-based educational system, [23] come out with the *eAccess2Learn* framework which adopts the current Learning

Technology Specifications and Web Accessibility Standard. This framework is quite complicated to understand. The main aim of *eAccess2Learn* framework is to provide tools and services that support the design and development of accessible eTraining resources and courses to be used among different disabled user groups. Briefly, the tools and services in *eAccess2Learn* framework include (i) *eAccess2Learn* learning design toolkit for designing eTraining course templates and eTraining courses, (ii) *eAccess2Learn* guidelines and style sheets for developing accessible web-based training content, (iii) *eAccess2Learn* accessible learning objects metadata authoring toolkit, and (iv) *eAccess2Learn* web repository. Among these four, this study concerns on the guidelines of developing accessible web-based training content. More specifically, this service includes a set of W3C Web Content Guidelines 1.0 and a set of Cascading Style Sheets (CSS) for HTML-based content. In addition, these two sets of guidelines would transform the presentation of HTML elements such as text size, background and foreground color of the existing eTraining resources to be understandable and navigable by low vision, color blind, and motor disabled people. In summary, the analyzed framework has potential to further extend in providing eTraining resource and course that match with the learner accessibility preferences. However, the presented framework is more to web-based educational system which highly contrast with the needs of LV children in Malaysia. Furthermore, it is applicable for those (low vision, color blind and motor disabled) who need an access for training resources and courses.

Math Explorer: [24**]** introduced *Math Explorer* for early elementary students with learning disabilities after identifying the critical user interface design features of computer-assisted instruction (CAI) programs in mathematics. Cognitive development is important for students with learning disabilities. Therefore, by analyzing the previous research, this model adapts four steps of cognitive (i.e. *reading* (step 1), *finding* (step 2), *drawing* (step 3), and *computing* (step 4)) and three steps of meta-cognitive strategies (i.e. *do activity*, *ask activity*, and *check activity*) in *Math Explorer*. Besides cognitive development, the more important part in producing this model is the user interface design features which are embedded into *Math Explorer*. The identified user interface design features and guidelines are listed in Table 1:

Table 1. Interface design guidelines of Math Explorer

• Instruction-driven interface
○ Controlling the amount of mathematics instruction in *Math Explorer*
○ Using visual representations, animations, and graphics in *Math Explorer*
• Manifest structure interface
○ Having simplicity and consistency in *Math Explorer*
○ Selecting appropriate fonts and colors in *Math Explorer*
○ Highlighting and color-coding texts in *Math Explorer*
• Adaptive interaction interface
○ Providing interactive and ability/effort feedback in *Math Explorer*
○ Having adaptive multimedia in *Math Explorer*

In response to that, some of the guidelines are appropriate to be embedded in developing the conceptual design model of AC4LV, such as the use of animated characters to foster the students' motivation and attention. This guidelines are appropriate for children but for students with LV the character must be created carefully to avoid them being confused with the desired information [5]. Furthermore, based on the prototype the selected colors are also inappropriate for LV learners since the contrast of foreground and background color is highly lacking. Consequently, *Math Explorer* still requires a large modification to suite LV learners.

eBIM: *eBIM* is a prototype of AC project by [25]. It specializes for hearing-impaired children in Malaysia. There is a little discussion on the main components of the prototype, either in terms of learning approach or learning theory embedded in the AC. However, it can be concluded that static graphics and animations have been utilized to attract the young deaf children utilizing the courseware. 3D characters help showing the alphabet signs where the students can pause, stop, and rewind the show. There is also a search engine function provided in the AC that allows the students to search the Malay word stored in the database. Overall, *eBIM* seems interesting in terms of its functions; however there is no enough discussion in terms of the components which then make this model seems similar to other courseware model that are designed for deaf people. Additionally, the analyses on the empirical evidence provided in evaluation part are also found prosaic, which then show that this model does not impact positively to the users. Also, the interface design features such as in terms of formatting style and text, combination of colors between the desired information and the background are found highly poor for the use of LV learners.

AC for VI learners: AC for VI learners has been explored by [5]. Although it is specially designed for VI learners, it was found that there is no illustrative and structured conceptual design model presented in the study. Additionally, discussions on specific component to form the prototype as well as learning theory, learning approach, and instructional strategies, are also poor. On the other hand, the model stresses on characteristics on developing the prototype of AC for VI learners which are divided into (i) audio, (ii) formatting style and text, (iii) graphics and animation, and (iv) general interaction. Although this courseware highlights the VI learners as the main user, it still requires much more works particularly in terms of components such as ID model, approach, and theories. Also, the evaluation could be further carried out.

MEL-SindD: The scaffolding concept is reinforced in the courseware called *MEL-SindD* to assist the down syndrome (DS) children in learning activities. [26] introduced three types of scaffolding models which are designed to support the DS children in using the *MEL-SindD*. The models are (i) scaffolding models to explore the courseware module, (ii) scaffolding models to hear and read stories, and (iii) scaffolding models using sub-modules to explore the minds. The basic elements contained in each of the scaffolding model are screen/module/sub-module, scaffolding strategy, guideline, and action. The important element is scaffolding strategy, which refers to a form of assistance to support the learners to perform the tasks. There is no learning approach or theories applied in this model. The characteristics of the content are also not well-discussed, which automatically means this model is irrelevant to be applied for developing an AC4LV learners.

Digital Storytelling for Remedial Students: The framework of digital storytelling for remedial students is proposed by [27] with the aim to identify the background color that present affection to remedial students in reading environment via storytelling approach. This framework has been developed

based on previous studies by analyzing the user characteristic in relation with affective engineering, color psychology, and digital storytelling. There are several components that surround the framework. It includes educational theories (i.e. cognitive, behaviorist, and motivation), holistic development (i.e. cognitive and affective), storytelling elements (i.e. fun and engagement), development (objects and 2D background), design (i.e. task design, interface design, interaction design), and learning activities (i.e. play with the characters). This is an interesting framework, in which the remedial students' motivation and feeling were researched based on their color psychology. Meanwhile, language, educational theories, and holistic development are the key aspects in designing the framework. Although this framework serves as the guideline and reference for the developer to develop digital storytelling applications and for teachers in teaching remedial students, still the framework ignores the LV learners to be a part from them.

3. METHODOLOGY

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

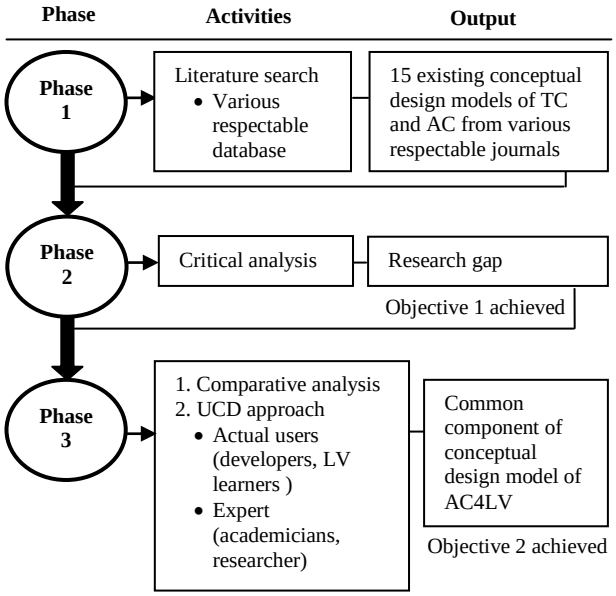

Fig 1: Summary of Activity

The first phase is to gather the previous conceptual design models of courseware. At this stage comprehensive literature search were performed. As the outcome, 15 existing conceptual design models of typical courseware (TC) and AC were gathered. The gathered models were critically reviewed and analyzed in the second phase which could achieve the first objective of this study. The third phase utilizes the similar conceptual design models gathered in the first phase in order to achieve the second objective of this study. It involves a comparative analysis technique and UCD approach. The comparative analysis is purposely utilized in this study as it is one of the significance techniques in gathering information. Besides, User Centered Design (UCD) approach was also applied to confirm the common components gathered from the comparative analysis is applicable to be applied in the proposed model. It involves actual users which mean the target user of the proposed model. They are developers particularly novice developer and non-technical developer. The actual users also include the target user of AC4LV. They are VI learners particularly low vision learners. In addition, UCD approach also involves experts including academicians from higher institution and researcher. Their roles are to review and comments the proposed components with the expertise they posses prior to propose the validated model. The findings and discussions of this study are provided in the following section.

4. FINDINGS AND DISCUSSION

Critical analysis and comparative analysis over the 15 design models has been carried out to identify the research gaps and to identify their common components.

4.1 Research gaps

So, based on the critical analysis, the following research gaps are extracted:

i) Conceptual design model of AC specifically for LV learners is highly scarce.

ii) Most of the conceptual design models of courseware exclude the LV learners as part of the user.

iii) Some design elements and guidelines that should be considered when developing the AC for LV learners are not clearly identified in the existing models.

iv) Most of the proposed courseware often pose a number of different problems that have to be faced by LV learners such as mouse interaction, crowded objects, fancy font face, inappropriate font size, and unsuitable animations.

v) Most of the existing courseware is unusable for LV learners particularly in terms of information accessibility, navigationability, and pleasure.

4.2 Comparative analysis

Accordingly in seeking the common components for the proposed model, the comparative analysis is important to ensure the proposed model is constructed based on the established root. The analysis was done line by line through the model illustration, snapshots of the prototype, and their elaboration. Then, the common components across all models are recorded. Table 2 and Table 3 plot the similarities and differences of each of the selected conceptual design models for TC and AC and categorized it in terms of their common components.

Table 2. Comparison of common component for TC

Common component	1	2	3	4	5	6	7	Total
Structural component	√	√	√	√	√	√	√	7
Content composition	√	√	√	√	√	√	√	7
Design guidelines		√	√		√	√	√	5
Learning theories	√	√	√		√		√	5
Learning approach	√	√			√	√		4
Development process	√	√				√	√	4
ID model		√		√				2
Technology	√	√	√	√	√	√	√	7

Table 3. Comparison of common component for AC

Common component	1	2	3	4	5	6	7	8	Total
Structural component	√			√	√	√	√	√	6
Content composition	√	√	√	√	√	√	√	√	8
Design guidelines	√	√	√	√	√	√	√	√	8
Learning theories	√	√						√	3
Learning approach								√	1
Development process			√	√	√	√		√	5
ID model				√			√	√	3
Technology	√	√	√	√	√	√	√	√	8

After analyzing all the models, it has to be summarizing to represent the common component for both types of models. This is to confirm which component would be selected in constructing the proposed model. It is exhibited in Table 4 and the classification of components follows the rules in Table 5.

Table 4. Summary of common component of TC and AC

Common component	TC	AC
Structural component	A	M
Content composition	A	A
Design guidelines	M	A
Learning theories	M	F
Learning approach	M	F
Development process	M	M
ID Model	F	F
Technology	A	A

Table 5. Indicator for categories of component

Indicator	Description	Condition
A	All models apply	All models apply
M	Majority of models apply	There are four models apply
F	Few models apply	There are between one to three models applying
X	Not applied in any model	There is no model applying

The results from the above summarization will be used as guidance in constructing the common component for conceptual design model of AC4LV. Accordingly, Table 6 provides the common component gathered from the existing model followed by Figure 2 showing the conditions in determining compulsory and recommended components.

Table 6. Common component of existing models

Generic component	AC4LV
Structural component	◙
Content composition	◙
Design guidelines	◙
Learning theories	◙
Learning approach	◙
Development process	◙
ID Model	◙
Technology	◙

Condition 1:	The component is compulsory ◙ to apply when there is any A OR there is at least one M with no X in the row.
Condition 2:	The component is recommended ☼ when there is only F and X in the row.

Fig 2: Conditions for classification

The results in Table 6, indicate that all the eight components are compulsory to be included in the conceptual design model of AC4LV. It can be seen that all of them are commonly contained in the existing models. As most of the courseware shares the similar format, so it is compulsory to have the structural component to formulate the structure of AC4LV. AC4LV is a type of educational content application that stresses on the information accessibility and navigationability so, it is compulsory to include content composition component. Also, most of the existing models have their own specific design guidelines to cater their target learners. But, the design guidelines are merely close to content which means content, are designed based on the design guidelines. As the content of AC4LV has specific elements, this study decides to include it in the content composition component.

Besides, it is necessary to include instructional design as a generic component since AC4LV is also considering as a type of instructional aid. In this case, the developer may also refer to other instructional design models as guidance while developing AC4LV. Additionally, learning theories and approaches are pedagogical aspects that must be referred to as the basis to tackle the LV learners in learning. So, it is compulsory to include both of them in the proposed model.

The main aim of this study is to propose a conceptual design model that acts as guidance for those who have interest in developing AC4LV. They can be technical or non-technical people. The main important aspect in AC4LV is the content design itself. Therefore, this study does not concern on the steps involved in the development process. The methodology used to develop AC4LV is depending on the users' preference. However, they have to follow the proposed elements provided in content composition component. As a result, this study decides the development process as "recommended to apply". Accordingly, Table 7 lists the proposed common component of AC4LV. It is represented in an illustrative model in Figure 3.

Table 7. Proposed common component of AC4LV

Common component	AC4LV
Structural component	◙
Content composition	◙
Design guidelines	◙
Learning theories	◙
Learning approach	◙
Development process	☼
ID Model	◙
Technology	◙

Description of symbols	
◙	Compulsory to apply
☼	Recommended to apply

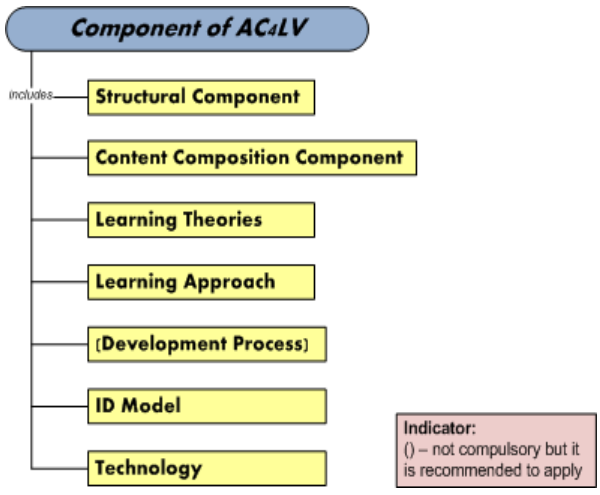

Fig 3: Proposed model for common component of AC4LV

5. CONCLUSION AND FUTURE WORKS

Overall, the previous literatures clarify that all the reviewed models have come out with certain guidelines to ensure it matches with their target learners. However, it was found highly lacking that the conceptual design models or prototypes address the LV learners to be the main user. Only two models draw attention to LV learners, yet there are still much more to be filled in producing a conceptual design model of AC4LV. The content aspects are also poorly emphasized for the needs of LV learners. Thus, it is ought to be noted that this is the research gap that should be the focal point to extend this study.

Moreover, the comparative analysis suggest that the development of conceptual design model of courseware should include ID models, content composition component, learning theories, and learning approach as the basic components. It would be unreasonable to ignore these four basic components in an endeavor to create any learning application [28]. On top of that, applicable learning approach is really important to motivate and attract the learners especially VI in making sure they participate in using the courseware. Besides, another three components (structural, development, and technology) were also found significance as guidance for novice developers.

At this point, this article has achieve both of the stated objectives which are the research gaps and the common component for conceptual design model of AC4LV. Both of them are gathered through the comprehensive critical reviews and comparative analysis which performed on 15 existing conceptual design models of TC and AC. It is important to emphasize that more studies need to be carried out in order to propose a complete conceptual design model of AC4LV. Definitely, the meaningful guidelines or principles specifically for LV learners have to be provided into the content composition component. This is to ensure that the proposed model successfully fulfill the LV needs'. Common component proposed in this article is not the final model for AC4LV. The next step is more comparative analysis has to be carried out in gathering the sub-component and elements contain inside the common component. Also, UCD approach has to be performed to confirm the gathered sub-components is applicable for AC4LV. Afterward, the complete conceptual design model will be reviewed by the experts prior to propose the conceptual design model of AC4LV. All this is planned to be published in other articles.

6. REFERENCES

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