Research Journal of Applied Sciences, Engineering and Technology 11(7): 715-728, 2015
DOI: 10.19026/rjaset.11.2034
ISSN: 2040-7459; e-ISSN: 2040-7467
© 2015 Maxwell Scientific Publication Corp.
Submitted: March 31, 2015 Accepted: April 22, 2015 Published: November 05, 2015

Research Article

Designing Usability Strategies: Implications for Instructional Interface towards Courseware for Inclusive Education System (C4IES)

Abdulrauf Tosho, Ariffin Abdul Mutalib and Subihatun Nur Abdul-Salam
School of Multimedia Technology and Communication, Universiti Utara Malaysia (UUM),
06010 Sintok Kedah, Malaysia

Abstract: This study describes an ongoing study related to the development of usability strategies, which specific to instructional interface application for inclusive education systems. Reviews from literatures indicate that usability strategies that are incorporated in courseware which is specifically designed to motivating inclusive learners in e-learning environment is highly scarce. It was found that most of the existing content and navigation accessibility applications including courseware focus on the needs of certain target with most of this courseware offering too little to inclusive learners in terms of information accessibility, navigation ability and motivation concepts. In addition, the use of structure, layout and navigation to improve the coursewares' instructional interface as part of usability strategies was also problematic for them. Thus, this study aims at creating an alternative instructional interface as part of usability strategies particularly on courseware design for inclusive education systems. The study used comparative analysis technique to determine the usability strategies of instructional interface. Prior to proposed usability strategies a specific design model has to be proposed as guidance for the developer to refer to. So, this study found was to determine the usability strategies for instructional interface of C4IES by utilizing stages of activities. Future works is to validate the proposed strategies through expert review and prototyping method.

Keywords: Instructional interface, layout, navigation, structure, usability strategies

INTRODUCTION

It is evident that there is a strong international trend towards developing education structures to become more inclusive system. The transformative inclusion program is based on the assertion of the same right to a quality education within their communities for all diversify learners. Thus it can be seen to concur with the task of Education for All.

Educating disabilities children with e-learning aids challenge the users' interface design. Only a little percentage of the children with special needs were considered with e-learning materials in their schooling and those who do typically must attend an isolated school. Almost none of these children have the opportunity to attend a mainstream school with their non-disabled peers. In distance learning environment the situation is even worse. Study has proved that education is the key factor for driving growth, creating new value and providing the basis to remain competitive (Mihalca *et al*., 2008). Yordanova (2007) adding that instructional interface is an easier way of impacts and improves the process of learning and understanding knowledge for learners to meet their future needs.

Many studies have shown that different methods have been used in implementing computer-based learning and teaching for diversified learners, such as e-learning materials, educational game, PowerPoint presentation, virtual classroom, mobile learning for enhancing education system for all and while the most popular one is courseware (Efendioğlu, 2012). Coursewares are the contents provided for use in aiding course teaching in the e-learning environment. It has been described as actual computer applications used in a learning that implementing computer-aided teaching process.

Courseware is developed in accordance with difference purposes. According to Su (2013), the purpose of courseware can be categorized into various forms: guidance, demo, drills, data tools, test form, game, comprehensive form and open network form. The main objective of implementing the courseware in the teaching is to facilitate the learning process (Cut Nora *et al*., 2011). To achieve that objective, the courseware should be designed in the sense of able to: catch the learners' attention to the subject matter,

Corresponding Author: Abdulrauf Tosho, School of Multimedia Technology and Communication, Universiti Utara Malaysia (UUM), 06010 Sintok Kedah, Malaysia
This work is licensed under a Creative Commons Attribution 4.0 International License (URL: http://creativecommons.org/licenses/by/4.0/).

applicable for diverse learners, qualify as similar to teacher, demonstrate the facts clearly and easy to understand, provide learners with comprehension explanation and be interactive. In that sense, the courseware should have some fundamental pedagogical value that are similar to lecture (Efendioğlu, 2012) that includes learner interactive, user- friendly and able to assist both the abled and disabled learners to learn independently (Nurulnadwan *et al*., 2014a).

Based on the preliminary studies that have been carried out (Tosho *et al*., 2014), coursewares that are currently in used mean too little to the inclusive education systems. This is because the usability strategies to be considered on the instructional interface design to grasp the content presented in the coursewares' structure that includes both non-disabled and disabled learners are inadequate to access the presented information. The disabled learners are unable to utilize the courseware. All this factors lead to the frustration in learning through inappropriate design in instructional interface of courseware. In fact, having usability strategies in learning materials is important for the learners to grasp and understand the presented knowledge (Kidney *et al*., 2014).

Furthermore, a comparative by Tosho *et al*. (2014) and Nurulnadwan *et al*. (2014b) also found that many existing interface of coursewares, both general courseware for non-impaired learner and courseware for impaired learner have been designed based on targets' user and does not highlight the usability strategies to enhance the design courseware usage and also left behind the inclusive system learners as part of the target users. This indicates that the appropriate instructional interface to serves as part of usability strategies that specifically designed for inclusive system learners' courseware is highly lacking.

In addition, presently, Technology Strategy (TS) focus on the assistive tools on application system (i.e., screen reader (JAWs), screen magnification and voice speech) and hardware (i.e., Close Circuit Television (CCTV), magnifying glass, optical special optic mouse) which means content of instructional interface is not their main concern (Hameed *et al*., 2006; Freire *et al*., 2007; Gowases *et al*., 2011). Using TS, products require the impaired learners to have extra strategic skill on technical function, which is less possible for the disabled users to operate on amongst their counterparts' non-disabled learners. Therefore, the instruction interface elements as to serve as part of usability strategies that will guide the users have not been considered. All this problems address that the needs of instructional interface elements as part of usability strategies in the courseware design through content application is necessary. The problems also address that content accessibility, navigationability and motivation strategies are the main aspects that have to be emphasized in designing the instructional interface for content application for the inclusive education system. This means certain characteristics of instructional elements that will serve as supportive strategic for users' interface to match the needs for inclusive education systems have to be identified.

Based on the justified problems this study aims at proposing usability strategies for identified instructional interface elements of Courseware for Inclusive Education System (C4IES) to cater for both non-impaired and impaired learners, on the same content that can be applicable for both disabled and non-disabled learners. Prior to design the proposed usability strategies, the study has to identify the main elements of C4IES to be part of the usability strategies. To achieve all of the objectives, three stages of activities have been carried out as further explained in the next section.

METHODOLOGY

In this study a sequence of activities were carried out, as displayed in Fig. 1. The figure explains that this study involves three stages of activities which are problems analysis, elements identification and development of usability strategies for the identified elements. The activities involved in the first phase include interview with courseware designers and comparative analysis to determine the elements and usability principles for courseware using User Centered Design (UCD) approach. From this phase, data regarding the multimedia elements, strategies and design principles for C4IES were gathered. At this

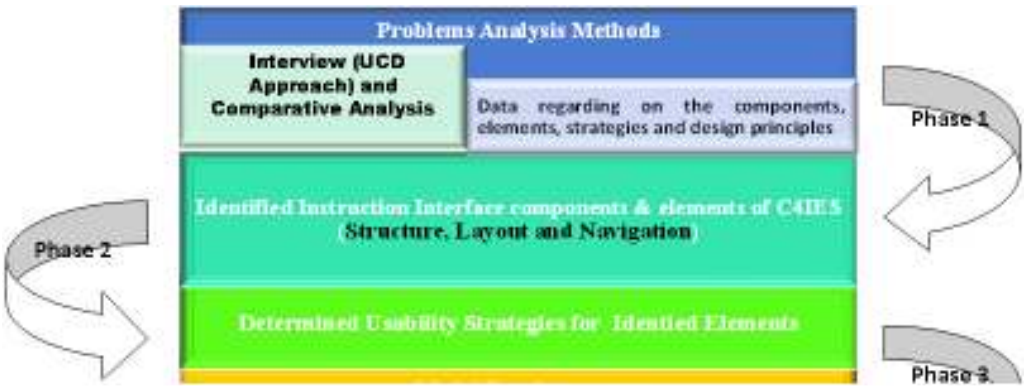

Fig. 1: Sequence of activities for development phases

Table 1: Criteria and justification of participants in UCD approach in determine appropriate usability strategies for C4IES

Users	Criteria	Justification
Non-disabled and disabled learners	They are higher institution level of distance learning centre (inclusive education) with average age range 18 to 35 years old (undergraduate and post-graduate)	Non-disabled, low vision and hearing impaired learners are the target users of C4IES. They are introduced to Molecular Biology. It involves them to find how helpful to the content accessibility and content navigation in terms of structure, layout and navigation design of the proposed model which could help them realize their needs in learning activities
Instructors/Designer	They have been lecturing in the inclusive education system with at least five years in lecturing experience and be part of courseware design in the distance learning	With five years experience of lecturing in inclusive education system and part of courseware design for the distance learning could increase the confidence of this study to seek and confirm the needs of inclusive learners in the learning activities

point, the first objective of the study was achieved. While, the second objective is to identify multimedia elements of the instructional interface for C4IES were also achieved. They are discussed in detail in the next section. The third stage is development stage, in which usability strategies for C4IES developed, it was developed based on the data gathered in stages one and two. At this stage, this study has achieved its third objective. Having finished the third phase, the whole objectives of this study is achieved.

As mentioned in the previous paragraph, this first stage includes interview with courseware designer (instructors) and comparative analysis through UCD approach. The activities of the phase have been carried out as further details in the next section.

User Centered Design approach (UCD): The identification approach of elements of instructional interface for C4IES explores the concepts of the existing studies through their prototyped designs. Most of the components has been were used as the basis in determining the proposed elements, as they share the same format and concept. However, it has to be emphasized that the content of the identified elements is different with the existing studies, because it encapsulates the three important concepts of interface design (i.e., structure, layout and navigation) toward multimedia interactive approach of learning and also addresses universality features for inclusive education system.

Many studies avow that most of the developed coursewares are inadequate in the aspect of instructional interface design to meet the requirement of users (Cut Nora *et al*., 2011; Nurulnadwan *et al*., 2011). Consequently, most of the available coursewares are not utilized repetitively by users after the first viewing. Furthermore, Tosho *et al*. (2014) also fund that the existing coursewares were inappropriately designed towards the instructional interface of structure, layout and navigation to improve the courseware usage for inclusive education system. So, there is a need for an improvement in the instructional elements, especially towards appropriate design to enhance the friendliness of the interface. Also, the existing courseware means nothing to consider inclusive education system in the courseware design (education system that merged both non-disabled and disabled learner together). Savita and Athirah (2011) has recommended a future research work to be carried out a much comprehensive courseware which focuses on interactivity, visual effects, dual language options, larger databases of words and multiple stages of exercises in granting value-added courseware for learners.

Nevertheless, for interaction to take place in the courseware, the instructional interface design with appropriate structure, layout and navigation is highly important to be part of measures in developing usability strategy. Consequently, based on existing strategies, guidelines, principles and learning theories and approaches, this study comes out with appropriate components and elements for structure, layout and navigation to establishing the usability strategies for courseware and eventually makes learning material usable. The elements of instructional interface for courseware is proposed to cater the needs of both non-impaired and impaired learners who learn in an Inclusive Education System, which has been identified through analyzing the contents in interviews, comparison of prototypes element and supported with literatures through UCD approach. Accordingly, based on the approaches, it was found that the focus of the proposed instructional elements for courseware is to ensure that the proposed usability strategies will enhance the usage of courseware and most adhere to content accessibility and navigation accessibility. This factors lead to the ideas of specifying the improvement of instructional interface as part of usability strategies of courseware, which are then useful in guiding usability strategies and to incorporate universality features. In which their criteria are justified in Table 1.

In UCD approach, the interview with designers has been conducted in seeking the learners' needs regarding the content design strategies towards multimedia instructional elements which are related to information accessibility, navigation and motivation to use the courseware frequently without being frustrated. Discussion also focuses on identify structure elements, layout elements and navigation elements, specification

towards instructional development process. In supporting the findings gathered from the UCD approach, comparative analyses were carried out which further details in the next subsection.

Table 2: justifications detailed

S/No	Usability studies	Justifications
1.	The development and Usability of Malaysian Sexuality Education (MSE) Courseware (Chan and Jaafar, 2010)	This study is chosen because of its clarification in implementing instructional design and learning theories. Hence, it is most perfect for the prototype design phase.
2.	Usability on Appropriate basic design layout for Courseware: Research Based Design Models (Khlaisang, 2010)	It was chosen for the reason that it highlights the details regarding the design approaches that could be attractive strategies to the learners
3.	Usability Satisfaction of Open Source e-Leaming Courseware (Ghalib-AI-Masoudi and Chandrashekara, 2010)	This study is selected because it stresses on learning activities and details on multimedia elements guidelines to motivate the users to learn.
4.	Effectiveness and Usability for Li2D development (Zaini and Ahmad, 2010)	This study is chosen because it details in terms of structural interface design and learning theories to support learning approach.
5.	Usability of Design Recommendations for Small Screens Key Concepts and Issues: base on learning objective model (Churchill, 2011)	This study is chosen because it recommends some specific guidelines to be considered in designing interface and the recommendation is good for this study.
6.	Usability of "Image Processing" in a net courseware design (Zhang, 2011)	It discusses the usability approaches in terms of content arrangement clearly (layout design) and it considers some principles that are useful for this study.
7.	Usability of Affective Impact of Navigational and Signaling Aids to e-Learning Material (Sung and Mayer, 2012)	This study implements the cognitive theory to motivate the learning processing and provides some instruction elements in the interface design, which is appropriate to adopt in this study.
8.	Usability, in relation to e-learning projects (Jeffels, 2011)	This study is chosen because it focuses on usable and accessibility of the learning materials. The usability factors that are considered are interface issues, pedagogical issue, information architecture, accessibility and delivery issues and multimedia issues.
9.	Usability Design for Video Lectures (Chorianopoulos and Giannakos, 2013)	This study is chosen because it implements an online educational video lectures with virtual reality and the system enhance the usage with the navigation (such as pause, play and random seek), sharing and editing.
10.	Usability of Multiple Intelligence in Ensures of Digital Storytelling for Preschool Children (Azizah *et al*. 2011)	This study is chosen because it incorporates multimedia digital content strategy components to improve the usability concepts of courseware. The concepts of courseware and digital storytelling are combined to deliver learning contents. Also, Multiple Intelligence is mapped into the development of learning material and the multimedia elements used are animation, imagery, text and voiceover that enable the students to stimulate for reading activity.
11.	Assistive Courseware for the Visually Impaired based on Theory of Multiple Intelligence (Nurulnadwan *et al*., 2013)	The study is selected because it develops an Assistive Courseware for impaired learners based on multiples intelligence theory. It discussed eight types of intelligences, in which different users may have good skills at different types.
12	Guidelines of assistive courseware (AC) for hearing impaired students (Mutalib and Maarof, 2010)	This study is chosen based on the IntView methodology employed in developing the courseware and it comprises some characteristics to design assistive courseware for hearing impaired learner that it will part of the element to consider in inclusive education system.
13	Malay Sign Language Courseware for Hearing-Impaired Children in Malaysia (Savita and Athirah, 2011)	The study uses colors and design, simple and easy navigation method and inclusion of 3D images with video capability and animated rotational view to design courseware with sign language, which are the part of content learning element to enhance learning for hearing impaired learners.
14	Interactive multimedia courseware of vowel training for the hearing impaired. (Chaisanit *et al*., 2010)	This study is chosen because it implements contents and the knowledge structure to the interactive multimedia courseware for the hearing impaired students. The courseware was used the technique of dynamic computer graphics to establish an animation display system to assist the hearing impaired learner.

Comparative analysis: Prior to identifying of C4IES instructional interface elements, a comparative analysis of the existing studies on courseware and usability was conducted. 14 existing coursewares (i.e., both for non-disabled and disabled courseware) from previous studies were selected. They were selected as part of this study on the basis that they are inline with this study. To simplify the discussion in this study, all of them are named as sample studies. The selected studies have been discussed and analyzed deeply including their limitations, in seeking the appropriate instructional interface elements. Consequently, this section compares them with the objective to identify their generic components and elements to implement to determine the usability strategies for courseware design. They were selected to be compared based on justifications detailed in Table 2.

Several Studies have carried out comparative analysis through existing prototypes or models to gather their features and appropriate components. For example, Haroon and Abdulrauf (2015) and Nurulnadwan *et al*. (2014b). This study implemented this method to gather features of all elements through comparing from various studies and separated their

elements in tabulate form accordingly, The similarities and the differences of the features contain in the studies are then plotted in the tables. With that, information for all models for certain features is seen on the same line,

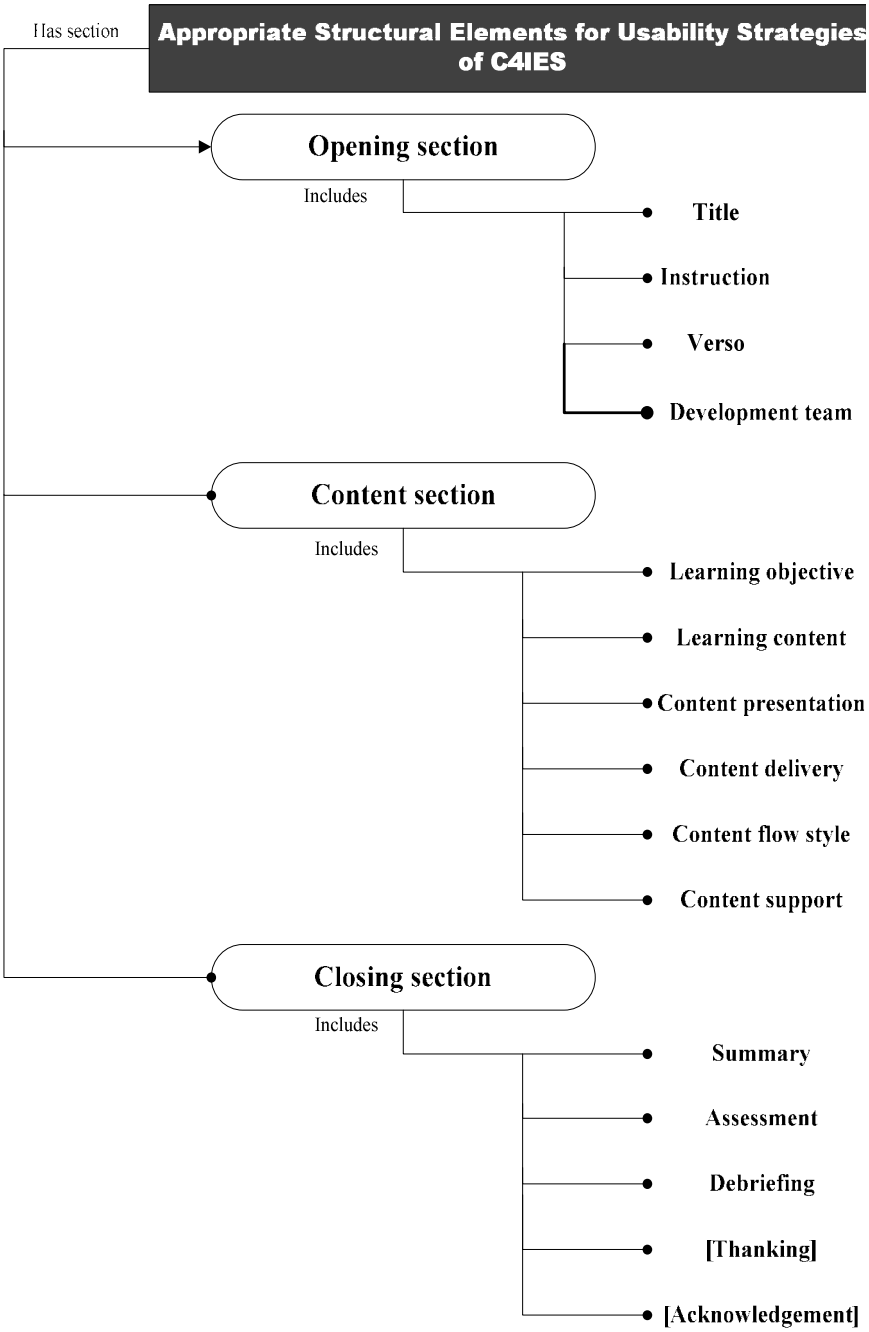

Fig. 2: Proposed model of appropriate elements for structural components

so that the decision is easy to form. In this study, the technique by Ariffin (2009) and Nurulnadwan *et al*. (2014b) is adopted. First, the tables containing features are discussed. Then results of the comparative study of all types of studies (i.e., non-disabled and disabled) are compiled and used as the input for determining the elements of instructional interface to be used as part of usability strategies for Courseware for Inclusive Education System (C4IES) and lastly the elements are merged together to form the Conceptual Design Model. Having done with the UCD approach and comparative analysis, the component and elements, content composition and design principles of Conceptual Design Model of instructional interface has been designed (Fig. 2 to 4).

RESULTS AND DISCUSSION

The developed approach of usability strategies of instructional interface for identified elements of instructional models explores the concepts in the existing studies. However, it has to be emphasized that

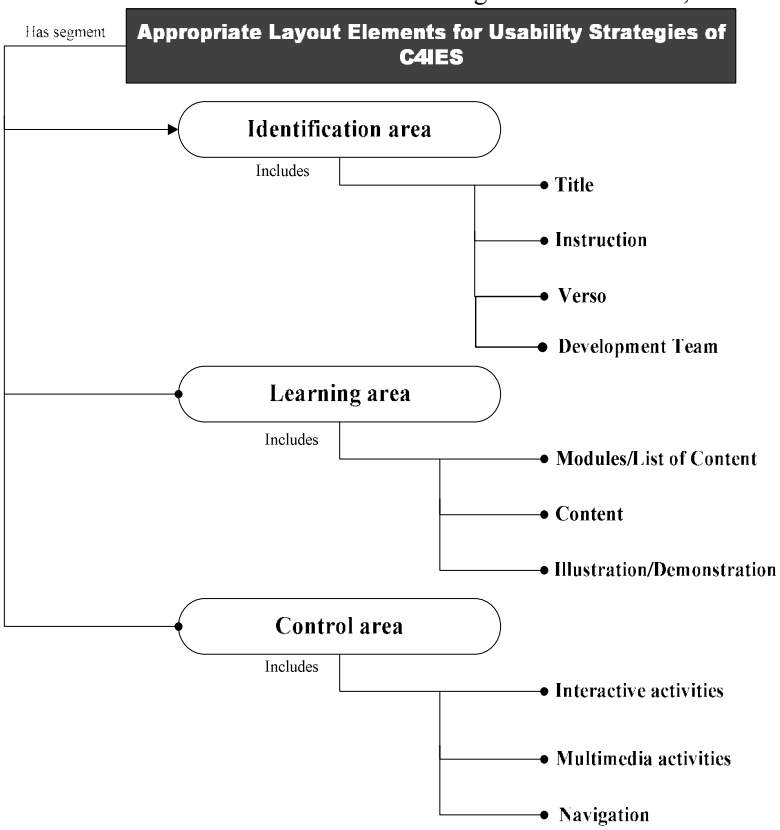

Fig. 3: Proposed model of appropriate elements of layout components

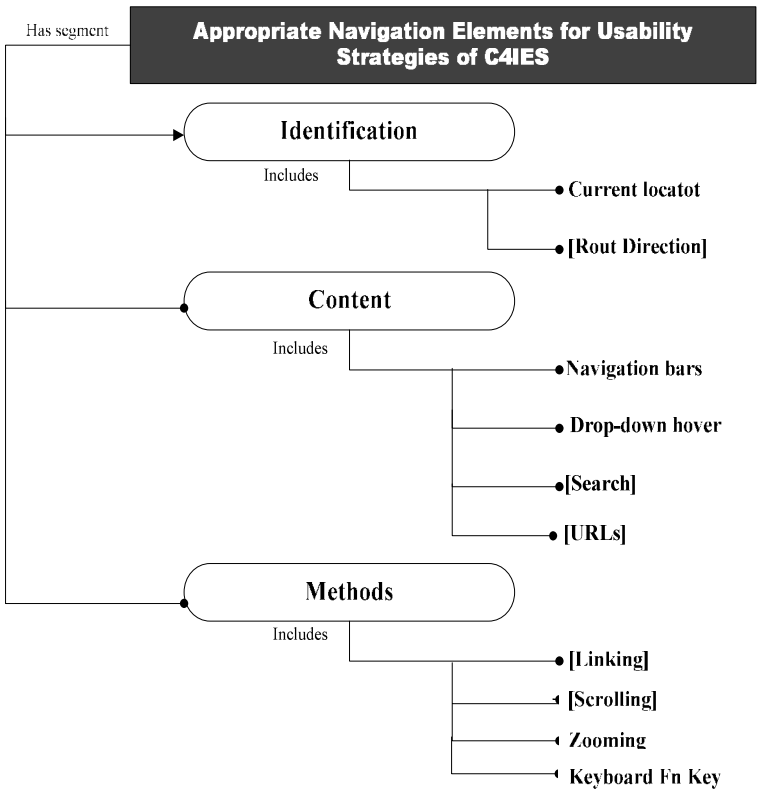

Fig. 4: Proposed model of appropriate element of navigation elements

Table 3: Identified usability strategies of appropriate elements for structural components

Proposed structural elements	Proposed usability strategies	Comments
Visual		
Texts	✓ Use of appropriate and familiar fonts, sizes (at least 12-point) and type that depend on the text position to achieve the best possible reading speed.	Black text colour and appropriate font size and type on a plane background will enhance the usability for up to 32% faster than light text and it improves the contrast between the text and background.
	✓ Use black text colour on a plan and no-patterned template background	
	✓ Use lower-case fonts and appropriate capitalization.	Users find it easier when upper-case is proficiently used to start sentences and indicates noun.
	✓ Ensure visual consistence	
	✓ Use bold text sparingly	
	✓ Highlight important information	
	✓ Use attention-attraction features when appropriate	
Images	✓ Moderate size, not too big or small image in three dimensions if possible.	A single, large and complex background of image can substantially slow page downloading down, while using small, simple images with low resolution enhances the interface utilization.
	✓ Use background images sparingly and they are simple, especially if they are behind text.	
	✓ Use images rather than text whenever possible to facilitate learning.	Using images that are close associated with the text can integrate the effectiveness of the interface usability.
	✓ Appropriately label all clickable images and make it readably understood for every users	Image of the common objects are recalled easily than their textual names.
Real objects	✓ Using virtual reality when it will help to convey and enhance more understanding of other content.	It is likely to be considered understandable and as a link when they are designed to emulate the real-world analogues and it will reduce the effort in labeling objects.
	✓ Use the images that look like real-world object when appropriate.	
	✓ Emulating real-world objects.	Its multimedia elements such as video can easily capture and retain the attention of users
Graphic	✓ Design the graphic in appropriate manner to avoid been looking like banner advertisement or gratuitous decorations.	Users might missed the item completely due to the decorative-like graphics or banners advertisement.
	✓ Use a graphic format to display data when users need to monitor data changing	Graphic display will make it easier for users to direct significant changes and monitor the values outside the normal rage.
	✓ Introduce animation and limit the use of static images.	
	✓ Ensure the images do not slow download	
	✓ Label clickable images.	
Animations	✓ Provision of an introductory explanation for animation prior to it being viewed.	The explanatory of animation before being used will enhance users to better integrate the animation and associated content.
	✓ Allow user-control of the animation, such as pause, replay, stop and play.	
Audio		
Sound	✓ Any visual design should include sound effect to sustain student interest.	Use voices or speech for providing information. When speech is used as the mainstream provider of information, text of the spoken words should appear on the screen, this will enhance learning.
	✓ Sound effect should design towards suitability of the learning requirement as text appear in the courseware contents.	
	✓ Sound effect need to design adhere and synchronized with the images-action or speech for providing information.	Provide clear pronunciations and use a friendly voice intonation.
Instruction-based		
Lecturing	✓ Showing a short segment from a video, using graphics, having an online chat, including some type of application activity, or initiating a question-and-answer period.	The lecture could possibly include outernal readings or similar resources as links from the course website.
	✓ Provide a strong online component content to supplement the course.	It allows students to know where material is located on and how to interact with both the content and the instructor.
	✓ Organizing the content by using a learning management system	
Demonstration	✓ Uses real virtual in learning to illustrate principles and techniques and advocates the inclusion demonstrations with the provision of supplementary supports and services.	Time-based sequences of demonstration are easily understood by users.
	✓ Structure the demonstration content so that the sequence is obvious and consistent.	Avoid forcing users to perform or learning tasks in a sequence that is unusual or awkward demonstrations.
Content components		
Briefing	✓ Explain the course content briefly to understand the accessible of the content.	Make the content brief to avoid users lost in their searching
	✓ Give a brief overview of the course content to allow users to remain focused on the desired task.	Displaying too much information may confuse users and hinder assimilation of needed information
	✓ Compose sentences in active rather than passive words	
	✓ Limit information only to what users need while on that page.	
Objectives of the course	✓ Identify course objectives consistent with institutional goals and the needs of outcome of the course.	It is important for designers to develop an understar of the users' expectations through task objectives.
	✓ Design the objective with outcome to show and convince that the objectives are met.	Set up the goals to achieve, make it easier for users to learn and remember the layout of a task.
	✓ Set and state the objectives.	The greater the number of information exchanges

	✓	Understand and meet users' expectation.	with potential users, the better the designers
	✓	Involve users in establishing user requirements.	understand of the users requirements.

Table 3: Continue

Closing	✓	Design the close instruction with the use of a pop-up window on top of the screen to display close instruction.	The concerns with the organization of sequences of actions, which involve beginning, middle and end. The informative feedback at the completion of a group of actions gives user the satisfaction of accomplishment, a sense of relief, signal to drop contingency plans and options from minds and indication to prepare for next group of actions.
	✓	Include the exit of the application in the menu bar task.	
Content learning activities			
Real learning media	✓	Using video for real learning when it will help to convey and support for more understanding of the learning content.	Multimedia elements such as animation, video and audio to demonstrate content information can easily capture the attention of the users; therefore it is important to have clear and useful reasons for using real learning media to avoid unnecessary distracting users.
Blended learning	✓	Using blended learning when it will help to convey and support for more understanding of other learning content.	Using blended for teaching thinking and promoting intellectual development in courseware usability.
	✓	The involvement of the instructors should be minimal and only when necessary.	This will enhance effective supportive interaction with the courseware and the instructors will serve as the help and initial guidance.
Storytelling	✓	Implementing the storytelling for more understanding of learning content.	Multimedia is used effectively to promote learning objectives and goals.
	✓	Supporting the story creation, with the user focus on structures such as temporal constraints and hyperlinks rather than just telling a story.	The courseware storytelling holds the interest of any diverse learners.
	✓	Using the control for play back and saving of the stories.	
Tutorial/Exercises	✓	Introducing tutorial to check how the learning is understood in the previous lessons that give more understanding of learning content.	Designs of tutorials in the courseware give opportunity to evaluate the learners' understanding in the course.
	✓	Design the instructional interface that includes drill-and-practice programs, tutorial programs and simulation programs to improve the utility of the courseware.	
	✓	Provision of writing exercise and activities such as drag and drop and choose the correct answer in the courseware exercise.	
Game-based	✓	Using of digital games for interactive and brain test for more content understanding.	Games play is primarily significant for knowledge-based motivation to retain learners.
	✓	Provide the games in perceived education form for useful tool for learning and designed to engage students in educational experiences for achieving specific learning goals and outcomes.	Digital games, as an interactive technology within the multimedia courseware could foster learning understanding effectively and interestingly among learners.
			Educational games have become one of the favorite online activities.
Separated	✓	Using the separators style in the contents section, such as topics, chapters and modules at left upper frame side of the interface.	For every design courseware the use of separator for course unit and module shows the connection and grouping of the study or subjects.
	✓	Implement linear connection for the separator contents	
Non-separated	✓	Implement real learning via media such as video, animation, virtual reality and demonstration in the interactive section to support the text format of the content.	Non-separated format supports the separated format of design courseware.
			This is called multimedia learning that works on learners' intelligent.
Navigation	✓	Provision of ability to control one's instructional sequence and with unrestricted control.	The learner (user) interface and navigation should make the courseware easy to use.
	✓	Use a clickable list of contents on long pages.	Create a common content navigation scheme to help users learn and understand the structure of the courseware.
	✓	Use site mapping.	
	✓	The amount of learner control and/or navigational control that is not limited to menu choices need to be available to the learner.	Use the same navigation scheme on all pages by consistently locating tabs, headings, lists, search, site mapping.
	✓	Clearly differentiate navigation elements from one another, but group and place them in a consistent and easy way to find locations on each page.	
Instructors			
Seen instructor	✓	Provide assistance for users who need additional help with the courseware.	Users sometimes require special assistance. This is particularly important if the courseware design to include inexperienced users or disabled users.
	✓	For any exercise or practical activities, positive and negative reinforcements are needed to provide.	
	✓	Minimal instructor (seen) should be made available to the learners, to allow self-exploration and practice.	
Unseen instructor:	✓	Every activity should have detailed description on how to be used.	A special help-links need to be prepared that allows both the new and disabled users to access more information about the content in the courseware and describes the best way to
	✓	The unseen instructor should encourage to reflect the e-learning as called the distance learning programme.	

			navigate the content in the courseware.

Table 3: Continue

Learners interactive			
Self/Forum-interactive	✓	Creating mouse-based and keyboard-based enable to all the diversified learners for enhancing their utility.	The learner should be actively involved in the learning process via interaction with the courseware and other learners.
	✓	Provide explicit interaction instructions in a simple and direct way. The audio interaction should not be too fast or slow.	
Interface design			
Assistive Tool	✓	The instruction assistive tools should base on both the software and hardware usage.	Much of the courseware content collected through the internet or self-accesses CD. All users should be able to access content and interact with field elements of assistive tools
	✓	It should be designed based on the disabled learners needs.	
Error recovery	✓	Creating error recovery tools to enable the learners to return to the original contents for enhancing their utility.	
	✓	Design the recovery in one click.	
Feedback	✓	Allowed the conclusion based on feedback from users.	This provides users with information they need to understand where they are within the content and for proceeding to the next activities.
	✓	Based the courseware revisions on evaluation sheets to be completed during or at the end of courseware usage	
	✓	Provide users with appropriate feedback while they are waiting	If process will take less than 10secs, use an hourglass to indicate status. If it will take up to 60secs or longer, use a process indicator that shows progress toward completion. If the process will take more than one minute, indicate this to the users and provide an auditory signal when the processing completes.
Reversal of actions	✓	Creating reverse of actions tools to enable the learners to recover the original contents for enhancing their utility in terms of time taken.	
	✓	Design the reverse of actions in a simple and easily used.	
Multi-Layer	✓	Providing multi-layer of entries (open) for different users, Such as Non-disable interface and disabled interface.	This allows different users to choose their needing environment to work. It gives more sense of belonging to disabled user to use the designed courseware.
	✓	Use a check box control to allow both the abled and disabled learners to select their working interface.	

Table 4: Identified usability strategies of appropriate elements for layout components

Proposed layout elements		Proposed usability strategies	Comment
Identification area (include)			
Course title/code	✓	Ensure that the various titles clearly reflect the information and contents contained in the course.	Various titles need to be understood by typical learners.
	✓	Use a descriptive, unique, concise and meaningfully different title on each courseware unit.	Users will likely have difficulty to understand vague points but it will find specific, detailed titles and descriptors.
	✓	Ensure that the titles visually distinguish (highlight).	Title refers to the text that is in courseware title bar (this is the bar that found at every top of the courseware screen). The titles are used by search engine to identify pages, therefore, more pages cannot have the same title.
Course description/ requirement	✓	Ensure that the designed courseware meet users' expectations, especially related to content, organization and navigation.	Detail of course description or requirement need to be clearly for every user.
	✓	Involve users to improve the completeness and accuracy of both course and user requirement.	The reward for meeting the requirement could be stated to motivate learners to learn with the optimum requirement.
	✓	Make descriptions about content, format, interaction and navigation before deciding on graphic development.	The requirement describes the attendance for the lesson and percentage for course assesement.
	✓	Ensure that the courseware is in the 30' references presented from major search engine.	
	✓	A screen that explains the meaning of the item shall be popped up. The explanation shall be in form of text, audio, animation or graphic.	
Course objectives/goal	✓	Set the performance objective that include success rate and the time it takes users to find the specific content or preference goals that address satisfaction and acceptance by users.	Course objectives help developers to build courseware to the requirement need by the institution and also help learners to work towards goal.
			It help to test usability of the courseware more effective
Course delivery strategi			
Name of instructor	✓	Have named of instructors on the courseware give the best of usable motivational that the elements of courseware have the best designers.	The instructor name provides learner a direction to know who to referring to for any question on the course taken.
			The developer name been included in the courseware opening section motivate learners interest to use the courseware due to the

confidence learner has on certain developer

Table 4: Continue

Name courseware developers	✓ Have name of developers on the courseware give the best of usable motivational that the courseware has the best elements from every developer. ✓ Use personas to keep the design team focused on the same types of users.	
Learning/pedagogical approach area		
List of course modules/contents	✓ Provide modules or content that is engaging, relevant and appropriate to the users. ✓ Design the list of contents to the users in the most useful and usable format as possible. ✓ It is best to display the list of content in a manner that is consistent with standards and conventions that most familiar to users.	List of the modules and contents are the information on a courseware. Do not waste resources, provide easy access and good usability to the wrong content. It has been reported that content is the most critical element of courseware and it is more important than visual design, navigation, interactivities and functionality.
Content design elements	✓ Ensure that design layout section for contents are design to include elements of texts, images, real objects, audio, graphic, animations and illustration /demonstration. ✓ Design the instructional section with use of attention-attracting features for content design element when it is appropriate. ✓ When using color-coding on the contents design be sure that the coding scheme can be quickly and easily understand.	Draw users' attention to specific of content elements with the appropriate use of animation objects, size differential between items, images, brightly-colored items and varying font characteristics. Use of color-coding needs to be ensured that the information provided does not require users to read and comprehend a lot of text to understand.
Quiz/Test/ Exam/Game	✓ Design an interface layout for activities (such as quiz, test, exam and games) that elicit responses from pupils to guide the users to discover or built the concept or skill in the particular course). ✓ The quiz, test and exam question section shall be organized into three levels: easy, average and difficult. ✓ At the end of the exercise, a score section shall be displayed and retrieved along with a summary report of student's performance/ achievement ✓ The layout section of the set question shall allow users freely to choose which question to answer first and enable the navigation to unanswered.	The activities section shows a short level of learners' understanding in the contents and the outcomes of the courseware utilization. It acts as a set activity to motivate users to the lesson.
Acknowledge and incentive	✓ Acknowledge section shall be included as incentive for the users. ✓ The section shall display the appreciative in participating in the use of the design course.	The incentive section motivates users in using the courseware interactively. Therefore, it retains the user intention to re-use.
Self/Forum - interactive learner	✓ The interactive section in the layout shall contain guided activities. ✓ The interactive section shall contain real life situation where applicable	These interactive activities shall elicit response from users as much as possible and not merely show animated explanation.
Control/navigation area		
Home/Backward/ Previous/Forward/ Next	✓ Design navigation elements to be clearly differentiate from one another, but place them in a consistent and easy to find in the page layout. ✓ On the long page toward the downward of the pages, provide a list of contents with links that take users to the corresponding content farther down the page. ✓ Provide feedback to let users know where they are in page layout. ✓ Place the content navigation menu in the left panel and other applicable menus together. ✓ Ensure that tab labels are clearly descriptive of their function or destination. ✓ Design the navigation tabs to be located at the top of the page and let it look like clickable version of real-world tabs.	This will create a common courseware navigational scheme to help users to learn and understand the layout of courseware. It will allow the same navigation scheme on all pages by consistently locating tabs, contents list, heading, search, site map. It assists the long pages with several distinct sections that are not visible from the first screen, add a short, clickable list of the section at the top of the page. The location feedback provides users with the information they need to understand where they are within the courseware and for proceeding to the next activities. It is faster when the contents menus are located in the left side of the layout panel.
Multimedia control: Play/Pause/Stop/Rewind/Forward	✓ Use sequential menus for simple forward-moving tasks and use simultaneous menus for tasks that would otherwise require numerous of backward button. ✓ Provide the multimedia control button at the bottom of the layout design interface.	Simultaneous menus display choices from multiple levels in the menu hierarchy and it provide users with the ability to make choices from the menus. Simultaneous menus that present in frames are best employed in situations where users would have to make extensive use of back button if presented with a sequential menu.

Table 4: Continue

Interface design		
Interface background and foreground images	✓ Provide background images sparingly and make sure they are simple, especially if they are used behind the text ✓ To enhancing finding target content on a page, create pages with background that are not too crowded with items or contents ✓ Visually align the background page with elements in vertically or horizontally.	The inappropriate design of background images can make it difficult for user to read foreground text. The display can be defined as the number of items per degree of visual angle within a visually distinct. Use consistent alignment across all the pages.
Content organization	✓ Design the layout by organizes the content at each level of courseware page so that it shows a clear and logical arrangement to users. ✓ Arrange each content page to facilitate reading by use clear, well-located heading, brief phrases and sentences and small readable paragraph ✓ Design to ensure that all needed content is available and displayed on the page where and when it is needed. ✓ Design to group all the related content or topics or function in order to reduce time spent in searching. ✓ Design the layout so that the most common tasks can be successfully completed in the small number of clicks ✓ Limit the content only to that which is needed by users while using the courseware. ✓ Used coloured image or animation to help users understand what does and does not go together in the page background	When designers present content in a structure that reflect user needs and course objective that show a well-organized at content level, page level, list level and paragraph level, this will retain the intention of users. A well- organized can help the users find desired content at short time. Remebability is one of usability outcome, a related group content will help user to remember data from one page to the next.. The group related content will minimize the need for user to search the whole content at all time. The critical information that provided at the homepage will help the users in the content understanding
Page layout	✓ Ensure to create pages that are not to be considered as cluttered by users. ✓ Put the important, clickable items in the same locations and closer to the top of the page, where their location can be better estimated. ✓ Put the most important item at the top (center) of the courseware main page to enhance the usability for the users' in finding the content information. ✓ To enhance usability in finding information on a page, create pages that are not too crowded with items of content. ✓ Ensure to design the visual align page elements either vertically or horizontally. ✓ Design the page length decisions that support the used content page. ✓ Use frames when certain functions must remain visible on the layout screen as the user accesses other contents on the layout page.	The clutter is when excess items on a page lead to a degradation of performance when trying to find certain information. On an uncluttered display, all important search targets are highly clearly available. When the screen items remain constant, users learn their location on the page and use their knowledge to improve task performance. Users can anticipate the location of items near the top much better than those farther down the page. User generally look at the top center at a page first, then look left, then right and finally begin systematically moving down the total designed courseware page. This show that most major choices should be visible with no or a minimum of scrolling. The page layout should help users find the most important content.
Assistive tool	✓ Ensure that users using assistive tools to be considered in the layout design. ✓ Design towards magnification and contrast design for low vision users ✓ Design towards sign language and appropriate image display for hearing impairment users.	All users should be able to access and interact with the field elements such as buttons and text boxes.

Table 5: Identified usability strategies of appropriate elements for navigation components

Components	Elements	Proposed usability strategies	Comments
Current locator	Number page	✓ Provide feedback to let the users know where they are in the current page. ✓ Use page numbering or visual cues on each page to let the user identify their current page.	Feedback provides users with the information they need to understand where they are within the courseware and also for proceeding to the next activities
	Visual cues	✓ Place the primary menus in the left panel and the secondary and tertiary menus together. ✓ Ensure that tab and pages are clearly descriptive of their function or destination ✓ Use sequential menus for simple forwarding-moving tasks and use simultaneous menus for tasks that would otherwise require numerous of the back button.	
Navigation bars	Items listed	✓ Ensure that navigation designed bars located at the upper part of the page and look like clickable versions of real-world tabs. ✓ Ensure that the labels in the bars are clearly descriptive of their function. ✓ Avoid use tab, when there are not enough space on the page design	Users find it easy to start their function at the top of the page and moving down but users can be confused about the use of tab bars when they do not look like real-world tab. Therefore, users find it easily usable of any tab that look like real-world object.

				A label tab with descriptive allow free error selection.

Table 5: Continue

Drop-down hover	Text	✓	Ensure to display the related items in the same list of the drop-down hover	
		✓	Use text for the list items.	
		✓	Ensure visual consistency	
		✓	Place the important item at the top of the list.	
		✓	Use appropriate text lengths	
Search	Text box	✓	Ensure the feedback results of user searches provide the precise contents or information being sought for and in a format that meet users' expectation.	Users want to be able to use the results of search to continue solve their problems but if user confused or unable to find the contents, they become frustrated.
		✓	Ensure to design the search designed box to search the entire pages or clearly links with part of the available reference point.	Designers should not rely heavily on search engine because they are not suitable for good content organization and not usually improve users' search performance.
		✓	Ensure to provide a search option on each page of content to enrich the content design.	Search functions should be easy to use and allow for users to be successful when searching.
		✓	Ensure to design a courseware with searchable engine to respond to users' terminology.	
		✓	Provide templates to facilitate the use of search box on the interface design.	
		✓	Include specific hints in the search box to improve search performance.	
URLs	Text	✓	Ensure to use text links rather than images links	Links are use to provide the description to clarify technical concept or meaning.
		✓	Ensure that important contents can be accessed from more than one links.	A single word text link may not give enough information about the link's destination.
		✓	Ensure to differential the visited links with indicating a colour changes	It is the best to use the default text link colours, such as blue for unvisited while purple for visited links.
		✓	Provide link to other referencing book or pages that are related to the course content.	Text links are more easily to recognized as clickable, it download faster and preferred by users
		✓	Ensure to use link labels and concepts that are meaningful, understandable and easily differentiated by users rather than designers	Establish more than one way for links accessibility.
		✓	Ensure that the link text is consistent with the title on the destination page.	
		✓	Ensure to provide sufficient cues to clearly indicate to users that a provided link is clickable	
		✓	Ensure to provide links to support the contents.	
		✓	Make the text links longer to be understood, but shorting to minimize wrapping	
Buttons (jumping)	Symbols pictograms icons	✓	Ensure to provide pointing-and-clicking button rather than mouse over is design when selecting menu items from cascading menu structure.	Check boxes buttons elicit the faster performance and preferred over all other widgets
		✓	Ensue to use location and highlighting to prioritize pushbuttons.	Placing of the button at the left side allows the user to read the first button label and it will be likely to be clicked immediately.
		✓	Ensure to use a check button box control to allow users to select one or more items from a list of possible choices.	User should be able to click on the button for making selection.
Scrolling (panning)	Arrow keys	✓	Ensure to use an appropriate page layout to eliminate the need for user to scroll horizontally	Designed lengthy pages of content resulted to scrolling that takes longer time.
		✓	Ensure to facilitate fast scrolling by highlighting major contents.	The scrolling allows users to advance in the text without losing the content of the learning.
		✓	Ensure to implement scrolling pages when pages are design for users that are reading for comprehension	Horizontal scrolling resulting to tedious and difficult way to view an entire screen
		✓	Ensure to design page with a smaller well-organized pages of contents rather than lengthy pages	
Zooming:	Mouse Contrast magnification	✓	Facilitate the reading by structure each content page with contract: use clear readable format.	Using appropriate front and contrast background to facilitate usability of the courseware
		✓	Ensure to design the content page to allow zooming from smaller to bigger size and otherwise.	Zooming enhance the visual of the text and the images of the interface.

the content of the usability strategies in this study is different with the existing studies because it is encapsulates three important concepts of interface design (i.e., structure, layout and navigation) toward enhancing the courseware usage, motivating the users in the learning approach and also addressing universality features for inclusive education system (that is having supporting assistive tools for disabled users).

As discussed previously, the third objective of this study is to determine usability strategies for the identified elements of the instructional interface for

C4IES to be used by students of Inclusive learning. Nevertheless, for proper utilization to take place in the courseware, the instructional interface design with appropriate usability strategies need to be in place while designing the courseware. Consequently, based on the existing strategies, guidelines, principles and learning theories and approaches, this study establishes usability strategies for the identified elements of instructional interface based on software design. Also in this study, the usability strategies are proposed to cater the needs of both non-impaired and impaired learners as an Inclusive Education System, which have been identified through analyzing the content in the literatures and analysis of studies. The development of usability strategies adapts and applies methods of software design principles mainly to ensure that the developed strategies are effective (Azizah *et al*., 2011).

Accordingly, based on the software design approaches, it was found that the focus of proposing instructional elements for courseware is to ensure that the usability strategies will enhancing the usage of courseware and most adhere to motivating and retaining users' attention. This factors lead to the ideas of specifying the improvement of usability strategies of courseware, which are then useful in guiding courseware development. Accordingly, Table 3 and 4 provide the identified usability strategies for appropriate elements for structure, layout and navigation that make-up instructional interface for C4IES respectively (Table 5).

CONCLUSION AND RECOMMENDATIONS

In overall, this study reports an ongoing project regarding the proposing usability strategies for coursewares' instructional interface. UCD approach and comparative analysis have been carried out in identifying the appropriate elements, content composition and design process of the C4IES and its usability strategies. Derive from those methods, three main components usability strategies were proposed which are structural, layout and navigation. This is in support with instructional element and design approach, all to incorporate instructional interface as part of usability strategies for courseware. The three components of C4IES instruction interface elements are the core part of the proposed usability strategies in which it was formulated as part of usability strategies towards the needs of inclusive education learning activities which are information accessibility, navigationability and motivation to use the courseware again. Future works of this study is to validate the proposed usability strategies through expert review method.

ACKNOWLEDGMENT

The researchers wish to thank to the NOUN and other conventional university distance learning for their cooperation participating in this study. This study also has been financed by Universiti Utara Malaysia (UUM). The authors gratefully acknowledge the credibility of the institution.

REFERENCES

Ariffin, A.M., 2009. Conceptual design of Reality Leraning Media (RLM) model based on fun and entertaining constructs. Unpublished Ph.D. Thesis, Universiti Utara Malaysia.

Azizah, C.N., A.A. Mutalib, N.N. Aziz and R.M.A. Bakar, 2011. Multiple intelligence ensures usability of digital storytelling for preschool children. Int. J. Adv. Sci. Eng. Inform. Technol., 1(2): 117-123.

Chaisanit, S., S. Suksakulchai and R. Nimnual, 2010. Interactive multimedia courseware of vowel training for the hearing impaired. Proceeding of 2010 International Conference on Control Automation and Systems (ICCAS, 2010), pp: 1196-1199.

Chan, S. and A. Jaafar, 2010. The development and usability of Malaysian Sexuality Education (MSE) courseware. Proceeding of IEEE 2010 International Conference on User Science and Engineering (i-USEr).

Chorianopoulos, K. and M.N. Giannakos, 2013. Usability design for video lectures. Proceeding of the 11th European Conference on Interactive TV and Video, pp: 163-164.

Churchill, D., 2011. Conceptual model learning objects and design recommendations for small screens. Educ. Technol. Soc., 14(1): 203-216.

Cut Nora, A., A.M. Ariffin, A. Nurulnadwan and A.B. Rozana Mastura, 2011. Multiple intelligence ensures usability of digital storytelling for preschool children. Proceeding of International Conference on Advanced Science, Engineering and Information Technology, pp: 117-123.

Efendioğlu, A., 2012. Courseware Development Model (CDM): The effects of CDM on primary school pre-service teachers' achievements and attitudes. Comput. Educ., 59(2): 687-700.

Freire, A.P., S. Carlos, D.M.B. Paiva and M.A.S. Turine, 2007. Using screen readers to reinforce web accessibility education. Proceeding of the 12th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education (ITiCSE '07), pp: 82-86.

Ghalib-AI-Masoudi, M.A. and M. Chandrashekara, 2010. Usability satisfaction of open source elearning courseware websites. J. Inform. Sci. Technol., 7(2).

Gowases, T., R. Bednarik and M. Tukiainen, 2011. Text highlighting improves user experience for reading with magnified displays. Proceeding of Annual Conference Extended Abstracts on Human

Factors in Computing Systems CHI EA'11, pp: 1891-1896.

Hameed, O., J. Iqbal, B. Naseem, O. Anwar and S. Afzal, 2006. Assistive technology-based navigation aid for the visually impaired. Proceeding of 2006 International Symposium on Practical Cognitive Agents and Robots (PCAR '06), pp: 192.

Haroon, S.O. and T. Abdulrauf, 2015. A virtual reality prototype for learning maize planting. Commun. Appl. Electron., 2(1).

Jeffels, P., 2011. Usability, in Relation to e-learning Projects. Retrieved from: https://www.abdn.ac.uk/eLearning/documents/Jeffels_Usability2011.pdf.

Khlaisang, J., 2010. Proposed models of appropriate website and courseware for e-learning in higher education: Research based design models. Proceeding of the E-LEARN World Conference on E-Learning in Corporate, Government, Healthcare and Higher Education, Florida, 2010.

Kidney, G., L. Cummings and A. Boehm, 2014. Toward a quality assurance approach to e-learning courses. Int. J. E-Learn., 6(1): 17-30.

Mihalca, R., A. Uta, A. Andreescu and I. Intorsureanu, 2008. Knowledge management in e-learning system. Rev. Inform. Econ., 2: 60-65.

Mutalib, A.A. and F. Maarof, 2010. Guidelines of Assistive Courseware (AC) for hearing impaired students. Mental, 43: 49-340.

Nurulnadwan, A., M.R. Nur Hazwani and A.M. Ariffin, 2011. Visually impaired children‟s acceptances on assistive courseware. Am. J. Appl. Sci., 8(10): 1019-1026.

Nurulnadwan, A., A.M. Ariffin, S. Siti Mahfuzah and J. Mohd Saifullizam, 2013. Preliminary Investigation on Creative Educational Content for Visually-Impaired (VI) Learners. In: Badioze Zaman, H., P. Robinson, O. Patrick, T. K.Shih and S. Velastin (Eds.), Advances in Visual Informatics. 3rd Edn., Springer International Publishing, Switzerland, pp: 408–417, Doi:10.1007/978-3-319- 02958-0.

Nurulnadwan, A., A.M. Ariffin and S. Siti Mahfuzah, 2014a. Critical analysis in proposing a conceptual design model of assistive courseware for low vision (AC4LV) learners. Int. J. Comput. Appl., 92(10): 18-25.

Nurulnadwan, A., A.M. Ariffin, J. Mohd Saifullizam and S. Siti Mahfuzah, 2014b. A comparative analysis on conceptual design model of Assistive Courseware (AC) for visually-impaired learners (AC4VI). Aust. J. Basic Appl. Sci., 8(4): 75-80.

Savita, K.S. and A.N. Athirah, 2011. Malay sign language courseware for hearing-impaired children in Malaysia. World Appl. Sci. J., 12: 59-64.

Su, M., 2013. Research of Flash Interactive Features in Courseware Design. In: Du, W. (Ed.), Informatics and Management Science II. Lecture Notes in Electrical Engineering 205, Springer-Verlag, London, pp: 537-545.

Sung, E. and R.E. Mayer, 2012. Affective impact of navigational and signaling aids to e-learning. Comput. Hum. Behav., 28(2): 473-483.

Tosho, A., A. Abdul Mutalib and S. Nur Abdul Salam, 2014. Usability of instructional interface: Accessibility strategies of courseware design for distance learning, Nigeria. Int. J. Comput. Appl., 106(18): 32-36.

Yordanova, K., 2007. Integration of knowledge management and e-learning: Common features. Proceeding of the 2007 International Conference on Computer Systems and Technologies, pp: 94.

Zaini, Z.H. and W.F.W. Ahmad, 2010. A study on students' motivation in learning mathematics using multimedia courseware. Proceeding of 4th International Symposium on Information Technology. Kuala Lumpur Convention Centre.

Zhang, Y.J., 2011. A net courseware for "image processing". Proceeding of the 6th International Multi-Conference on Computing in the Global Information Technology (ICCGI, 2011).