

ENHANCE INCLUSIVE LEARNING SYSTEM: AN INSTRUCTIONAL INTERFACE OF COURSEWARE FOR MOLECULAR BIOLOGY

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ABSTRACT

This paper provides a research approach in developing an e-learning environment for inclusive learners. By capturing and modeling the multimedia 3-D knowledge into an instructional interface for teaching and assessing Molecular Biology Courseware for student in distance learning. The research implement the proposed Conceptual Design Model Courseware for Inclusive Education System, called C4IES. The experimental result from the subject experts that used the developed prototype has shown a great potential in the courseware usage. Where, out of 10 experts, 90% agreed that the proposed Multimedia environment has demonstrated a high usability in enhancing molecular concept and practical skills of student in distance learning and also for regular students in practicing the laboratory task while away from on-campus environment. This could also be as guidance to the developer or anyone who intends to develop courseware for an inclusive environment.

Keywords: *courseware; instructional; inclusive learners; molecular biology; strategy; usability.*

INTRODUCTION

Everybody has equal rights to quality learning activities. Technique to ease the learning acquisition needs to design for every user, including both disabled and non-disabled. However, for the inclusive, learning

instructional is quite demanding. With the setback facing those with impaired, various challenges in the learning instructional interface are higher, which finally could result to learning difficulty. Those with special needs have their own setback that makes them incapable to learn at the same pace with normal persons (Abdollah, Ahmad & Akhir, 2010). They require specialized interface learning instructions in order to maximize their potential and self-sufficiency learning attributes. Among many types of the disabilities, visual and hearing impairment is considered as non-mental disorder that has ability to learn with non-disabled learners in an inclusive environment. World Health Organization (2012) Reports anticipated that there are 15% of the world population has some form of disabilities. Department of Social Welfare has registered the total number of billion disabled people in December 2012 (Rashid, 2010). The report mentioned the total number of disabled people in Malaysia is 305,640. However, these data are incomplete as registration of persons with disabilities in Malaysia is not compulsory, and is done only on a voluntary basis. In addition, the data are not up to date, as the names of those who have died are not deleted from the main record (Tiun, Lee & Khoo, 2011)

The facts still remains that the number of disable keeps on increasing drastically. Therefore, exposing them to the inclusive education system is important because they should together be respected as part of the resources in the country. Unfortunately, study reveals that 80% of learning materials such as textbook and courseware are provided for different target learners (Chadha & Subramanian, 2010) but are not for inclusive users. This is because the main learning styles that are used for normal learning for disabled students are followed by text reading or kinesthetic (Aziz, Rasli & Ramli, 2010). In terms of definition, Inclusive Education is where learners with specific needs or learning disabilities learn alongside learners with no disabilities in the same environment (Slee, 2001). This is to place suitable special needs learners in tertiary institutions either part-time or full-time, and in-school or distance learning according to their capabilities. The effort of inclusive education system has been undertaken by both developed and developing countries. For instance, Malaysia Education Blueprint (MEB) 3013 – 2025 ensures to have students whose circumstances or needs are learning alongside with non disabled student

in the mainstream that are likely to fall through the gaps in education are especially catered for, while this will help them reach their full potential. Presently, there are several problems in the area of creating health community awareness through learning approach. For instance, the interface design is vague or complex for the users, and the content lacks motivational elements to serve usability strategies for creating community health awareness (Lyashenko, 2010; Tosho, Ariffin & Sobihatun, 2016b). In the area of instruction, learners have difficulties in using interface design tools to guide their learning (Maj, Tran, & Veal, 2007), and content acquisition methods are often not that effective (Quan, 2002). Consequently, learning abstractly about molecules regarding 2-D interface is often reported in literatures. This problem related to the poor user interface and inappropriate structure of instructional elements to present information (Vodanovich, Rohde, Dong & Sundaram, 2013). As a result, the learning model and means are rigid (Zhang, 2002).

This indicates that inclusive learners need typical learning materials that specifically could fulfill their needs in learning without facing any more difficulties, particularly in terms of content acquisition, navigation accessibility, and usability strategy aspects. Instructional interface with multimedia could be a better way that can enhance the understanding and content acquisition in learning materials for an inclusive environment, this occurs when the user can control 'what', 'when' and 'how' of such elements, which includes text, audio, video, graphics and animations (Haroon & Abdulrauf, 2015). It has the capacity to deliver learning materials in multiple forms which can motivate any form of learners with limiting in the specific learning difficulties.

In response to that, this study attempts to develop a prototype of courseware which specifically caters for the needs of inclusive learners in learning, which is named Courseware for Inclusive Education System (C4IES). Prior to developing the C4IES, a set of specific design principles has to be determined in making sure C4IES could fulfill the needs of both impaired and non-impaired learners. Hence, with the support of critical analysis carried out, this study comes out with two specific objectives as i) to determine the design principles of C4IES, and ii) to develop a prototype of C4IES based on the gathered design principles. Thus, in achieving both

objectives, two phases of activities were performed as discussed in the next section.

METHODOLOGY

I. PHASES OF ACTIVITIES AND METHODS

This study involves two phases of activities which are identification of element specification that result of conceptual design for C4IES model, and prototype development through IntView methodology as shown in the Figure 1. In the first phase, the activities involved include literature study and preliminary study. This technique is known as User Centered Design (UCD) approach. From this phase, data regarding the design concepts of C4IES model were gathered and the first objective of the study was achieved.

II. C4IES PROTOTYPE DEVELOPMENT

In the development process of C4IES prototype, **IntView** methodology was adopted. It involves two phases, which are pre-production, and production. In the first phase, 11 steps were implemented. In developing C4IES it is important to involve users and experts before the development of C4IES begins. The development of C4IES prototype takes up the challenge to ensure opportunities of multimedia interactive courseware presentation to cater for content acquisition and accessible to all learners, including those with various impairments. The learning materials for learners of different target were used to gather the input and comments in terms of the design of C4IES prototyping. All this input is important in preparing the script and storyboard of C4IES. Therefore, the subject area of learning content in C4IES is Molecular Biology

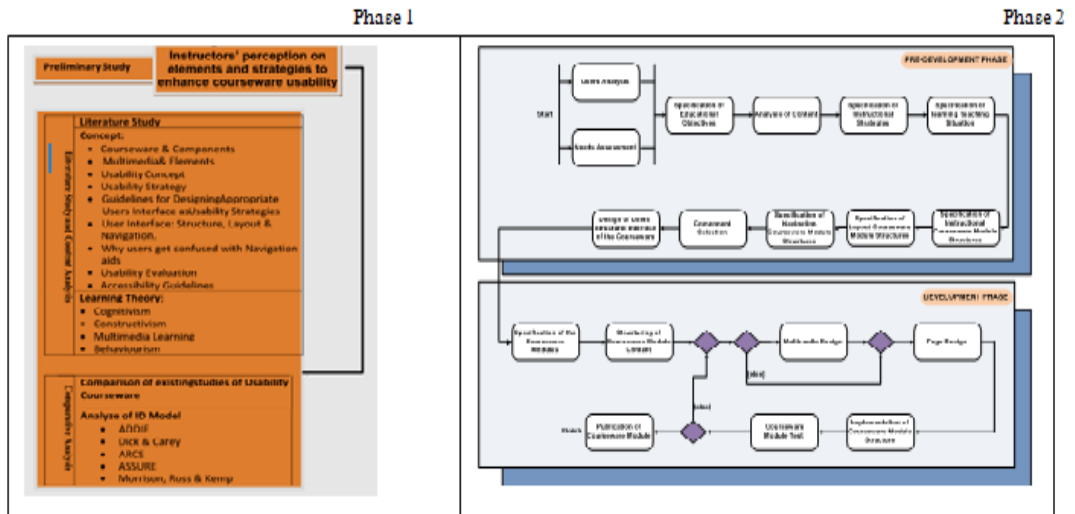


Figure 1: Summary of active

This is based on the finding from preliminary studies on the subject taken has shown that students have problems in learning biology course.

According to (Abdulrauf, Abdul Mutalib & Nur Abdul Salam, 2014; Abdulrauf, Ariffin & Sobihatun, 2016a; Abdulrauf, Ariffin & Sobihatun, 2016b), students having problem in visualizing the concept of the Molecular Biological Cell in abstract reading, in un-interactive environment and the images are represented in 2-Dimensional in the textbook. Hence, the prototyping of interactive courseware with multimedia elements was developed for this topic.

In the development phase, all the identified elements and design from the previous stage were referred for developing the working prototype. The early step, before commencing the development process is to identify the required tools. In this research, the development tool being chosen is Adobe Photoshop CS6 which plays different roles in the development process of the prototyping. Apart from the technological tools, the development process of "Learning Content" module highly relies on the learning material on the PDF lesson material, which as the main source of content development and design qbased on the identified instructional

strategies that proposed for the C4IES model (Abdulrauf, Ariffin & Sobihatun, 2015). Cross reference was also made by referring to several available reference books. This is to make sure that the multimedia courseware prototype is rich in contents and informative for the students. The modules for C4IES are divided into different units which are as shown in Figure 2.

Based on the determined usability strategies for the proposed conceptual model of C4IES, this study comes up with specific instructional elements that serve as usability strategy, design principles that has been enhanced the content accessibility and consider the needs of different abilities in the learning content (inclusive user). Theses make the courseware usable for particular disability groups; and they come in the form of implementing assistive technologies or retrofitting the courseware. Table 1 shows the lists of instructional strategy principle for particular user groups. However, Namatame, Kobayashi & Harada (2012) have been supposing that non-impaired people and hearing-impaired people have little difference in interface use, except for the sounds in the contents design. Therefore, the study provides equivalent alternatives to auditory and visual content for hearing-impaired learners. Specifically, this guideline has been stated as the following: "Describe the sound of auditory content" and "Provide non text equivalents of text" (Abdulrauf, Ariffin & Sobihatun, 2016b).

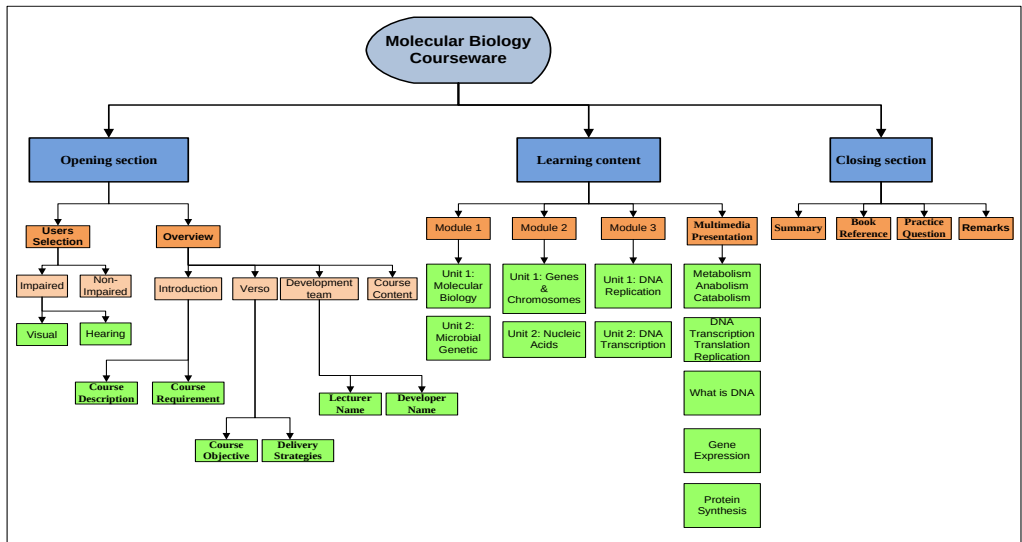


Figure 2: Courseware Modules

TABLE 1: INSTRUCTIONAL ELEMENTS FOR USABILITY STRATEGIES FOR DIFFERENT ABILITIES (DESIGN PRINCIPLES)

Non-impaired	Low Vision impaired	Hearing impaired
✓ Avoiding large graphics. ✓ Avoiding numerous graphics. ✓ Avoiding lengthy pages of content presentation. ✓ Offering navigation support. ✓ Simplifying user interface. ✓ Avoiding complexity design. ✓ making content succinct and relevant. ✓ Using text to label images. ✓ Provide users' control on sounds. ✓ Provide a text equivalent. ✓ Provide feedback. ✓ Provide role-over on navigation button key.	✓ Provide enough contrast between text and background color. ✓ Text -to- speech system. ✓ Provide an auditory equivalent. ✓ Colors Mindful for action Items. ✓ Provide closed captions for all audio content that contains useful information. ✓ Use the largest font size. ✓ Auditory feedback. ✓ Tactile interface. ✓ Closed captions. ✓ Screen/image-enlargement utility. ✓ Provide role-over on button key. ✓ Object magnification. ✓ Avoid blinking, flickering, or moving elements. ✓ Do not design something differently from user expectations just to be different. ✓ Eliminate unnecessary complexity.	✓ Speech-to-text system. ✓ Closed captions. ✓ Provide a text equivalent. ✓ Conform to current interface design standards. ✓ Provide transcripts for all audio content. ✓ Provide captions and descriptions of multimedia used. ✓ Using text to label images. ✓ Turn off graphics. ✓ Turn off sounds. ✓ Provide enough contrast between text and background color. ✓ Use descriptive links rather than "click here." ✓ Use the largest font size. ✓ Provide feedback. ✓ Avoid blinking, flickering, or moving elements. ✓ Do not design something differently from user expectations just to be different. ✓ Eliminate unnecessary complexity. ✓ Provide role-over on navigation button key.

Furthermore, Figures 3 through 6 show some interface samples of the C4IES prototyping snapshots that developed in this study based on the courseware module design and instructional strategy principles as determined in the previous phase.

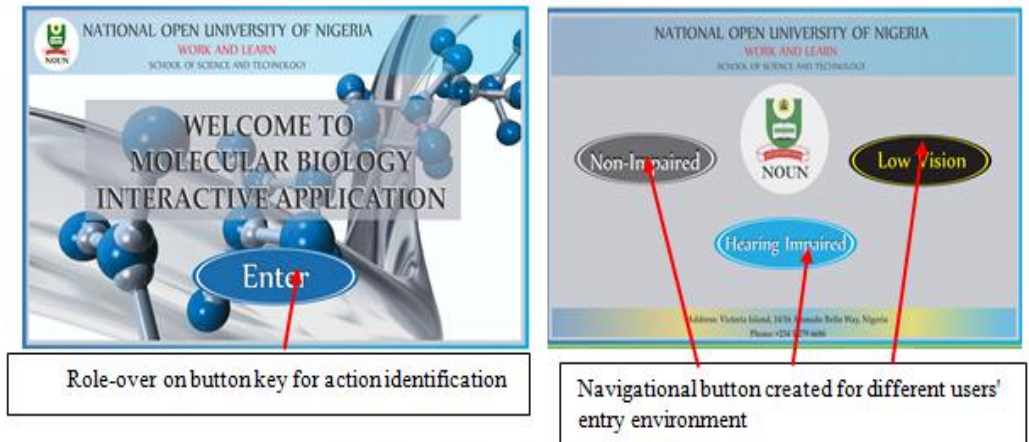
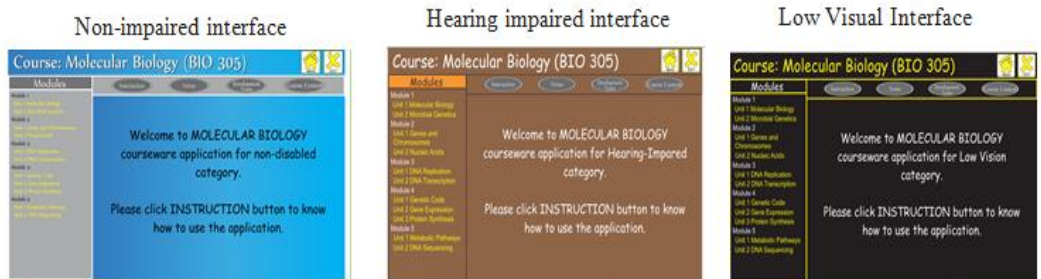


Figure 3: Structural (Opening section in C4IES)



Create good contrast color between background and foreground: As example use either black or deep color for text and bright color for background

Figure 4: Interface design (Layout section in C4IES)

Interface Layout in C4IES

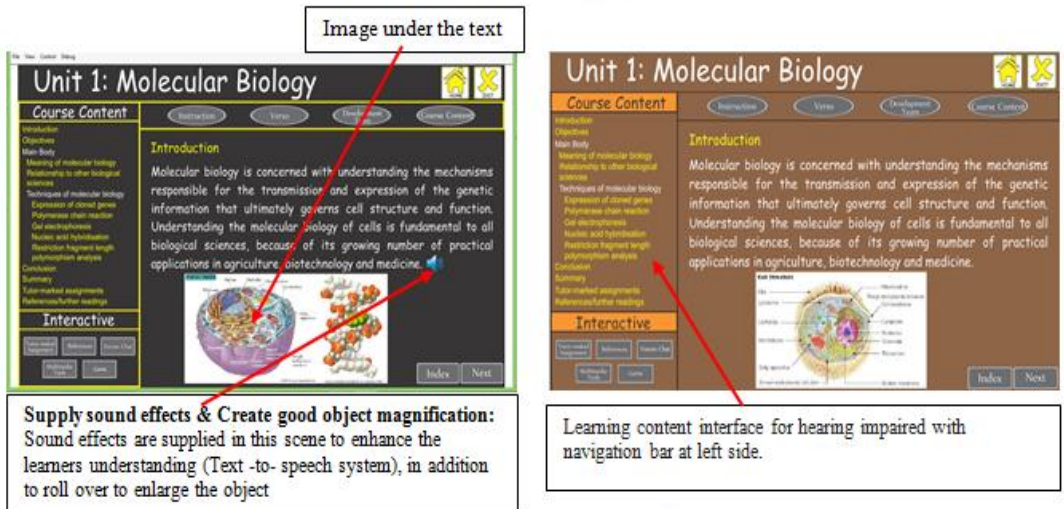


Figure 5: Content presentation in C4IES

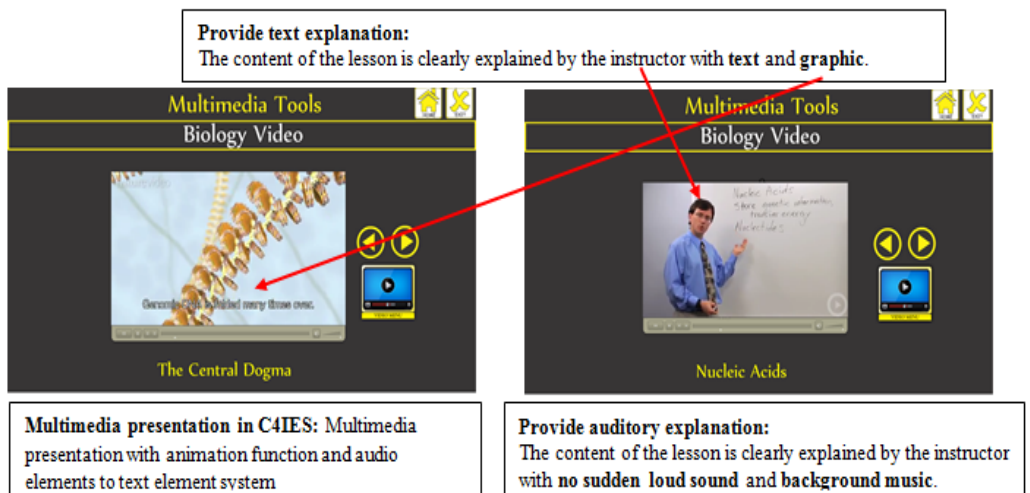


Figure 6: Multimedia interactive instructive section in C4IES

CONCLUSION AND FUTURE WORKS

Summarily, this study reports an ongoing project regarding the development of C4IES prototype. C4IES was developed based on the identified instructional strategy principles in an attempt to fulfill the needs of enhancing inclusive learners in learning activities. Content acquisition, navigation, accessibility, and motivation are applied in C4IES through the identified instructional strategy design principles. Future works of this study are to investigate the user experience of using C4IES in terms of motivation to use courseware again next time, efficiently in shorting the time to accomplishing a task, and effective for inclusive learning environment.

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