

Development Of A CD-Rom Based Learning Courseware For Physics Form 4, Chapter 5 Light By Using Tutorial Strategy

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Abstract : The objective of this research is to produce a Computer Aided Learning (CAL) courseware for Physics Form Four, chapter 5: Light. in English. The software applies tutorial strategy to develop the software. This CBL courseware is based on Systematic Instructional Design by Hannafin and Peck Model. Syllabus applied in this software is from the Integrated Curriculum for Secondary Schools - Curriculum Specifications: PHYSICS FORM 4 which is made by *Pusat Perkembangan Kurikulum, Kementerian Pelajaran Malaysia 2007*. This software is also user-friendly and interactive in nature as the immediate response will be given to the user for each of their action. The user can fully controls the CAL and has the freedom to use the courseware anytime they like. Other than that, practical activities such as objective and subjective exercises will be provided to enhance students' comprehension in a fun and enjoyable way. The courseware was developed using Macromedia Authorware 7.0 software as the main tool and supported by other development software such as Adobe Photoshop 7.0, MP3 Cutter and Joiner, and Flash MX 2004. This courseware was packaged into CD for easy use. It is hoped that this software can be utilized to help students master the scientific concepts and skill in this chapter effectively.

Keywords : development, CD-Rom, Courseware for Physics, light

Introduction

As we embrace the world of science and technology, we can see that computers are widely used regardless of being at home, school or workplace. In this multitasking age of technology, computer is applied on various occasions such as research, business application, administration and so forth. These applications have become highly sophisticated as the computer technology evolved rapidly throughout the years, enabling users to benefit more from the ever changing advancement of the computer. In British Open University, the University has used the personal computer as a teaching medium, as well as using it to handle the administrative side of its business with students. (Greenberg ,1999).

As we embark on the 21st century, our lives chores and activities are being taken over by technological tools such as computers and robots. The emergence of information technology plays into the vital role of changing our lives as a more effective and efficient community. In other words, our world has become more effective and faster since the day when computer are used as a tool to replace our role in daily tasks. The Open University (British) is confident that by exploiting the new computer based technologies in its teaching, it can enhance the teaching process and make the process cost effective (Greenberg ,1999).

People need to understand that the use of information technology is so important and will benefit the society by providing knowledge in terms of science, literature, history and so on. It is an essential change of mentality as the globalize society is moving towards a future with science and technology as the primary foundation to push the world into a more advanced and highly civilized society. Ignoring the importance of IT would be allowing our society to move backwards. Not only that, we need to use information technology as a mean to conduct our daily

tasks especially in the task of teaching and learning. In fact, it is most essential that our universities that have already taken the pioneering steps towards building a society that is proficient in the use of Information and Communication Technology through education.

It is important that computer-based learning (CBL) is integrated while teaching difficult subjects. This includes science subjects such as Physics or Chemistry. Physics is not easy for students to master since it requires our ability to visualize, understand, and apply the concepts learnt in the subject with precision in the most practical sense. Laws and theories such as Charles' Law and Bernoulli's principle need not only the comprehending skill, but also the ability to apply the theories into real life situation. On the other hand, the plain memorization of such theories will prove to be a setback for students who aspire to utilize the knowledge in the most effective way. Thus it is important that various methods such as CBL are applied in enhancing the teaching and learning effect on students.

Statement of the Problem

Physics is a subject that is not easy for students to master. Learning physics concepts such as Light can be quite challenging for students due to several reasons. In the study of light, students tend to become confused easily while learning the fundamentals of the concepts as these concepts often sound similar but are completely different in truth. It is difficult for a physics teachers to alleviate the problem as teachers need to remind the students regularly about the distinction between each definition and ensure that there are not misconceptions, making it a complicated and time consuming task for them. There are also mathematical questions in the topic that students constantly find it tough to solve as strong understanding is required while memorizing the formulas alone will not be sufficient.

Most of teachers in our country have yet to integrate computer-based learning into their teaching. Some do not apply technological teaching aids in their teaching due negative attitudes while others due to the lack of computer-based learning tools such as education softwares. Researches has been made and showed that most schools lack sufficient electronic teaching aids such as education softwares and computers to help teachers in their teaching. This has also led to computer illiteracy amongst some students. More efforts should be done to improve the computer literacy rate in school and improve the teaching and learning process in the school.

There are many types of strategies that can be applied in developing this software. The problem is choosing the most suitable one. The topic of Light is a very difficult topic to master due to its abstract concepts and the huge amount of principles and concepts. To master the topic, students need to do a lot of reading and have a strong understanding on the topic. This is why tutorial is a more appropriate strategy in developing this software. The tutorial software provides new knowledge, based on examples; and followed by questions...which is suitable in explaining a concept that is difficult to understand (Baharuddin, Rio & Manimegalai, 2002).

Objectives of the Project

The objectives of this project are stated as below:

- i. To design and develop a computer-based learning system for the topic of Physics Form 4, Chapter 5: LIGHT
- ii. To apply the tutorial strategy into the courseware development.

Importance of Research

The development of this software highlights the purpose of helping students in understanding the topic as well as help providing an alternative for teachers especially those who feel that this topic is difficult to be presented in the classroom. It focuses mainly on key points that more often students are found to have misunderstood or do not understand the concept at all.

Creating this software will benefit students who may have possibly felt lost in trying to make sense of the topic or even in physics as a whole. There are always students who might feel that physics as a subject is difficult and abstract and thus will ultimately have given up on trying to excel in the subject. Developing this software may help increase students' confidence by helping them understand the topic better thus inspire them to invest more time and interest in the subject itself.

Since conventional or 'chalk and talk' teaching method are sometimes less interesting and less appealing to students, graphics and animation in the courseware will help arouse students' interest in learning the topic. By allowing students to interact with the computer while learning, students can feel more in control of their learning progress, thus, creating active learning. While the lesson is taught in multimedia, it is believed that students are exposed to various kinds of stimuli and information in the courseware.

This courseware also provide computer access for students to which is vital for their personal development. Students particularly those who come from less wealthy background may not be able to afford or own a computer in their home. Hence the courseware allows them the opportunity to use a computer in the school compound to their benefit. This will also help improve students' interest in learning to use computer and their confidence in using it.

The Three Phases in Hanafin and Peck's Model

There are three phases in this model:

- i. Need Assessment Phase
- ii. Design Phase
- iii. Implement Phase

Need Assessment Phase

In this phase, many evaluations are done especially on the characteristics of the targeted group. We have to determine the teaching topic in terms of who will be the user of this software, what is the prior knowledge possessed by the software user, what will be the expected change of behaviour on the user end after using the software, what is the objective that has to be achieved, what is the software and hardware requirement and so on. These are important questions to be evaluated from the beginning stage of the software designing to ensure that the software produced will bring upon a desirable result.

Designing Phase

The designing process starts with determining the objective that the user has to achieve after using this software. It is then followed by the process of deciding the types of activities that should be included into the software completed so far. The developer has to ensure that the content presentation method is suitable to the users and is comprehensive through the respective method. In this phase, some of the important elements are also decided such as the content of lesson, the page screen designing and other elements that is chosen for the software. In this phase, there are several elements that we must first establish, that is:

- i. The objective of the users
- ii. The activity, exercise and test of the software

- iii. The content of the software
- iv. The method of presentation of the content
- v. The flow of the presentation (flow chart)

Implement Phase

This phase involves the process of developing or constructing the software designed. All the elements designed in the previous phase will be interpreted into a practical form with the help of primary software that is Macromedia Authorware 6.5 and other assisting software namely Adobe Photoshop CS, Macromedia Flash MX, Sonic Foundry Sound Forge 6.0 and Adobe Illustrator. With the help of a systematic designing during the design phase, this phase will be completed considerably without much complications.

Results

Topic Presentation Displays

This software is initiated with an animation that shows four pictures of key phenomenon related to the topic of this software. The four pictures contain the phenomenon of reflection, refraction, convergence and divergence. The main purpose of these animations is to give a brief introduction on what users will learn in the respective topic and help strengthen their impression of key phenomenon concerned. These animations are developed using *Macromedia Flash MX 2004* software while background music is prepared with the help of *Sound Forge 7.0* software.

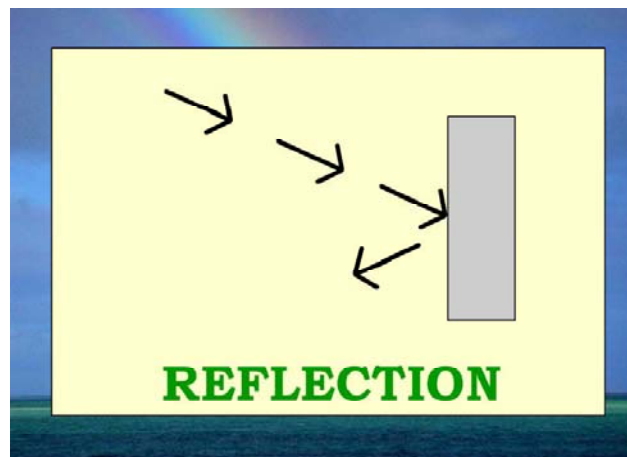


Figure 1: Reflection Display

Main Menu Display

Main menu is designed in a simple style so that the users can browse through the options easily with easy access to them therefore smoothing the learning process. There are five options in the screen namely Reflection, Refraction, Total Internal Reflection, Lenses and Practices. User can go through the four subtopics or do exercises by clicking on the practices button. The four subtopics are displayed on the four buttons above that is the buttons showing Reflection, Refraction, Total Internal Reflection and Lenses. When users move their cursor over the button, the button will change colour to indicate its accessibility. It is design to compliment the screen, appeal to users and increase the degree of interactivity between users and computer.

There are two pull-down menu options available for the user while using the software. The first option is the 'File' menu where the user can choose to exit the software by pulling down the 'File' menu and click on the 'Quit' button. Whereas the 'Music' menu is provided to

allow the user to choose whether or not to play the background music while using the software. When the user enters the main menu, background music is automatically switched on to create a harmonious atmosphere that encourages learning activity. When the user does not want to listen to the music, he can choose to switch it off by going to the pull-down button and select 'Music', then click 'off' in order to switch off the music. On the contrary, if the user wants to listen to the music again, he can click 'Music' continued by 'on' to switch on the background music. These pull-down menu options will be available for each page so that the user can have a better control of the software usage.



Figure 2: Main Menu Display

Notes

As mentioned before, the notes in this software are presented in step by step sequence. The notes are given with examples and followed by exercise questions. This method is in parallel with the tutorial strategy. And this method is used for each subtopic for the whole software.

The notes in the software are divided into four parts. Each part contains a new subtopic. The sequence of the subtopics is placed from left to right and from top to bottom. When users enter any of the featured notes such as reflection, users will be exposed to constructive learning. In the beginning of each note or lesson, users will be given a question and they can choose to answer based on how much they know about the subtopic and the previous knowledge that they have learned that is related to the subtopic.

As the users proceed to the third page, the software will play an animation that provides a simple explanation on what the subtopic is all about. For example, when users go to the third page of reflection (notes), the software will display an animation showing a simple phenomenon and depicting the concept of reflection. This is pivotal in helping the users to attain a deep first impression on the topic itself.

After that, the users will be exposed to notes containing text and animation of further lesson on the subtopic to help the user understand the lesson thoroughly. In the final page of each subtopic, a real life example on application of the concept or tools will be given to help relate what the users have learned based on their own experiences throughout the lessons.

There are also a few extra buttons in each page of the notes that is prepared to help provide access to the selected topics according to the button. These buttons provide hyperlink for the user. There are three main buttons in each page that is *main menu*, *next* and *back*.

Table 1: Functions of the buttons in Notes

BUTTONS	FUNCTION
<i>Main Menu</i>	Bring user back to the <i>MAIN MENU</i> screen.
<i>Back</i>	Bring user back to the previous screen.
<i>Next</i>	Bring user to the next screen.

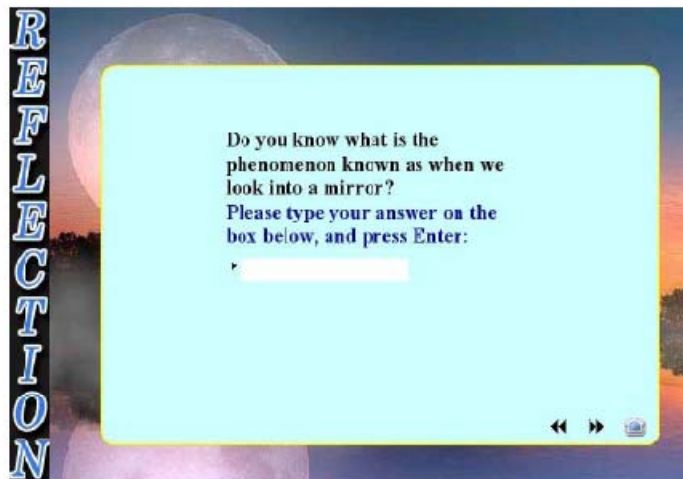


Figure 3 Notes (Linking to previous knowledge)

The notes in this software also contain examples using relative graphics and animation. The purpose of using these elements is to attract the interest and focus of the users and also provide a real picture of how the phenomenon of light occurs. The animated Flash that is provided along with the notes also plays the role of encouraging the users to think, relate the previous knowledge to the new knowledge and construct a personal understanding. This is in conjunction with the application of Constructivism Theory in the courseware development.

For each chapter, there will be 4 to 5 movie clips (in Flash animation) that is provided to help students learn in a more dynamic way. The movie clips are used to explain key definitions in each chapter such as the definition of convergence and divergence (Chapter 1), ray diagram (Chapter 2) and so on. It is also applied whenever there are important points or concepts that the users need to grasp, such as the similarity between total internal reflection (Chapter 3), reflection and refraction and how to draw a ray diagram (Chapter 4). These movie clips are added with play button so that the users can have the freedom to control the progress of the movie.

For objective questions, each question is given 4 options in hotspot for the users to choose from and 10 questions in total. When the users choose the correct answer, an animation will be displayed to congratulate the users and to give a positive reinforcement to them. Whereas negative reinforcement will be given when they choose the wrong answer along with the actual answer before the software asking the users to click on the mouse to proceed to the next question. When the users complete all 10 questions, the result of total correct answers and marks obtained by the users will be displayed on the last page for them to evaluate their own performance.

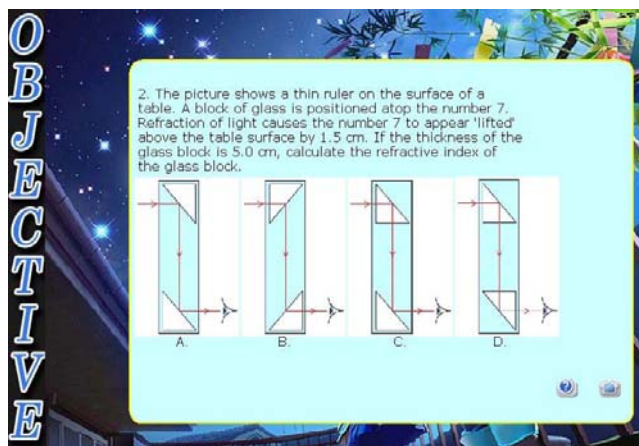


Figure 4 : Objective Question

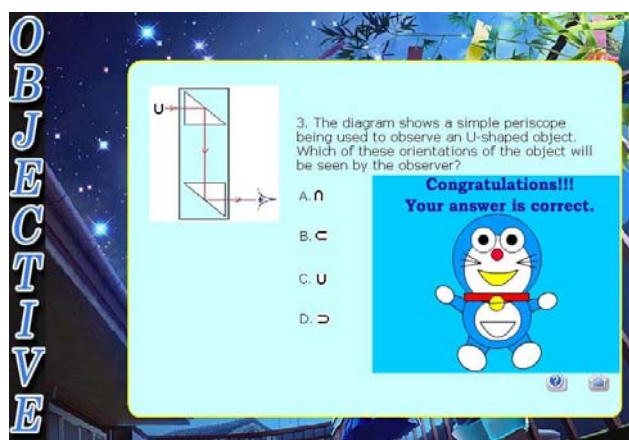


Figure 5 : Correct Response

For subjective section, the users are given 3 questions to test their memory, all 3 questions focus on key concepts that are important in learning the chapter. The users are required to type the answer into the empty space provided in the page and press enter to see if they get it correctly. The response will be similar to the ones in the objective questions. Once the users get the wrong answer, the correct answer will be given so that the users will learn from their mistakes.

Last but not least, the activity consists of a drag and drop interactive activity that the users can try out. These questions consist of 4 questions which will cover questions on all four subtopics in the whole chapter of 'Light'. These questions will test on the users' ability to grasp on all four subtopics.

Credit

The 'Credit' is used to display a brief introduction to the software developer and acknowledgement to the supervisor. A 'Main Menu' button will be prepared to allow the users to return to the menu page.

Exit

When the users click on the 'Exit' button in the 'Main Menu' page, the users will be given a prompt with two options as to confirm whether they choose to exit the software. The

button 'Yes' and button 'No' will appear to help the users make their decision. If the users choose 'Yes', then they will immediately exit from the software. If the users choose 'No', the software will bring the users back to the 'Main Menu' page so that the users can continue to use the software.

Discussion

Just as what was discussed in chapter 2, the theory of behaviourism, constructivism, and cognitivism are being implemented into this CBL software. This software is completed with the characteristics of a software development designing that is based on the theory of behaviourism, constructivism, and cognitivism as stated by Baharuddin Aris et al. (2002). These characteristics include providing positive and negative reaffirmation, content that is related to students' experiences, student centered, providing exercises, and so on.

On the whole, this CBL software can support the students in self-learning. The student has the authority in terms of controlling the rate of learning process. Besides that, this software can also be used in anywhere at anytime with the aid of a computer.

The CBL software entitled 'Light' is developed based on the designing model of Hannafin & Peck. The model of Hannafin & Peck contains 3 main phases that includes need assessment phase, design phase, and implement phase. Other than that, the evaluation and repetition process are done in each process continuously. According to Jamalludin Harun et al. (2001a), a process of software development should include the process of analysing the needs of the software, planning process or software designing process, development process, testing process and software evaluation.

This CBL software hopefully can be used as a source for other researchers to evaluate and determine the weaknesses and deficiency that may arise from a CBL software and work on how to develop a better CBL software.

This software is developed based on multimedia elements that is the combination of text, graphic, animation, video and audio. These multimedia elements are used the help enable the software to become a more interactive and user-friendly software. This CBL software enables the user to be directly involved in the process of learning. Moreover, this software encourages the user to use multiple senses while in the learning process. With this, the information can be passed on to the user more efficiently and the chance of the user remembering the information for the long term is higher. Theoretically, the lasting of information in a human mind will be 20% from hearing, 40% from hearing and seeing, and 75% from hearing, seeing and doing (Jamalludin Harun dan Zaidatun Tasir, 2000).

The text prepared in this software is interesting and easy to read. While the graphics in the CBL software designed are mostly based on natural phenomenons in our life so that the user will be able to relate what he has learned with his previous experiences. The background music creates a peaceful environment to the user while learning. The animation or video that is prepared in the software providing a more concrete picture to help the user to visualise the concepts and theories in the content.

The process of developing multimedia software is a process that requires a lot of professional skills. These skills are crucial in creating interesting and interactive software. Since this project is an individual project, the software developer had experienced several problems. The main problem endured was the lacking of professional skill and experience in designing and developing a software.

In the effort of developing this software, the developer is more inclined to using Macromedia Authorware 7.0 as the main programming tool. Although the developer has used the software before on previous assignments, it is still difficult to use the software since previously, the developer used it in doing group assignments whereas this is an individual assignment, thus a much higher and thorough skill is needed while using this software. While developing the software, in most cases when a problem arises, coursemates' assistants could not be readily available since there are few people who were doing similar project and they are more inclined to handle the related problems.

Due to the lack of experience in using the Macromedia Flash software, a lot of time was spent in learning how to use the software and how to develop animations that was previously planned. Tens of hours were used to create all the animations in this software. And a few animations were not as well as were hoped for and were not included in the final CBL software product. The developer also faced problem in terms of inserting the flash movie into the Macromedia Authorware. While trying to insert the flash movie into the Authorware, the developer found that the flash was not viewable in the Authorware, and for a long period the developer could not find out the problem even with the help of the supervisor. Hence the progress of the software development was postponed for around one month due to that. After a long period of fault finding, it was found that the reason behind this problem was that the software can only play the flash movie by using version 5 of Macromedia Flash. But the oldest Macromedia Flash that the developer could only find was version 6.0. After a long period of contemplation and trial and error, the developer was able to find a solution to this problem.

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