

# **Effectiveness of Multimedia Courseware Design: Towards Quality Learning in ODL**

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## **Abstract**

Computer-based learning materials, especially interactive multimedia courseware are widely used in higher education today. These technologies allow learners to experience among others, virtual simulation environments, which are similar to real world situations. The objective of this paper is to highlight findings on the pedagogical effectiveness of a multimedia courseware on “Basic Techniques and Laboratory Safety.” The courseware was developed to complement the print modules and was distributed to learners enrolled in the Bachelor of Education (Science) programme at the Open University Malaysia (OUM). For the purpose of this study, a survey was conducted among learners who registered for the course in the May 2007 semester. Forty learners had responded through the courseware evaluation form. The form was specially designed to assess the instructional delivery of the content and learner-friendliness of the courseware design interface. In particular, the study looks at the effectiveness of a simulated laboratory experiment, screen interface design as well as the technical aspects of the courseware. The findings from the survey suggest that, in general, this interactive multimedia courseware was an effective and useful learning material and had complemented the print modules provided to the learners.

## **Introduction**

With its vision to be a leader and innovator in open learning, OUM has attracted over 63,000 learners spread over 61 learning centres throughout the nation. In addition, it has about 600 learners outside the country, primarily in Yemen, Bahrain and Indonesia. In delivering its programmes at both the undergraduate and graduate level, OUM uses a blended learning model, which includes a combination of face-to-face tutorial sessions, self-managed learning, and e-learning or online learning facilitated by the Learning Management System (LMS).

Learners in an Open and Distance Learning (ODL) environment such as that of OUM typically face several challenges during their studies. Learners are, most of the time, physically separated from the instructor. In addition, most of the learners tend to be older with several years of work experience, hold full-time jobs, have families to look after and are often found to be struggling with time as they try to cope with their studies and various other commitments.

Of late, open distance learning institutions today have been leveraging on information communication technologies to deliver some of their course materials and to provide a virtual learning environment to help overcome the time, distance and geographical barriers. This is in addition to face-to-face tutorials and print modules. Once the predominant learning material, print modules are being complemented or supplemented by a variety of media such as multimedia courseware, learning objects, online discussion forums, podcasts and so on. Such a media mix contributes to a “blended” pedagogical approach deploying multiple modes and technologies (Major & Levenburg, 1997).

At OUM, one of the blended approaches for a science course is “virtual” learning via an interactive stand-alone multimedia courseware. This is supplemented by a series of active discussions through online forums made available through the learning management system. The predominant learning material however, is the print module. In addition, there are five fortnightly face-to-face tutorials. As stated by Kamlaskar (2007), distance learners require “additional innovative learning” support to enhance, enrich or improve laboratory courses. A viable solution is an interactive multimedia experimental simulation, a technology with the potential to revolutionize the way we work, learn and communicate with distance learners to meet the laboratory requirement.

In this paper, the provision of a virtual laboratory situation in the form of a multimedia courseware (on CD-ROMs) to help learners understand basic techniques and laboratory safety was investigated. The main objective was to determine its effectiveness in helping learners learn the subject matter better. This courseware was designed so that learners will be able to create a safe environment when using the science laboratory in the future. It provided a simulated learning experience through a virtual simulation of the school laboratory environment, thus closely resembling the real world. The virtual simulation was believed to be valuable particularly because learners taking the course are given theoretical exposure through the modules without going to the science laboratory. Therefore, developing an interactive multimedia courseware rich in graphics, sound, video, as well as animation to help learners to visualize and understand concepts and practices in laboratory activities was found to be necessary (Zoraini, Rosliza, Thangapragasam and Kumar, 2007).

### **Rationale for the Study**

It was important that feedback is obtained to determine the instructional value (Regan & Sheppard, 1996) and the effectiveness of the courseware design in communicating the content (Moore & Kearsley, 1996). As identified by Schlosser and Anderson (1994), some

of the important issues identified by learners in the needs assessment for distance learning include technology selection and adoption, design issues, strategies to increase interactivity and active learning, learner characteristics and policy and management issues. The findings of the study are expected to contribute to further improvement of the courseware or towards implementation strategies on how to integrate the courseware into the existing blend for the course.

### **Background of the Study**

This study focuses on one of the programmes offered, which is the Bachelor of Education (Science) degree program offered by the Faculty of Science. One of the compulsory courses is the course on Basic Techniques and Laboratory Safety. For this course, a print module was given to learners together with a multimedia courseware to supplement the printed module. Both the print module and multimedia courseware were developed in-house by the Centre for Instructional Design and Technology (CiDT) at OUM.

Development of the print module involves a team comprising a Subject Matter Expert or Writer, Instructional Designer, Graphic Designer, Language Editor and Desktop Publisher. The content of the module is based on the curriculum approved by the local accreditation body. The multimedia courseware for this course was developed to complement the content of the print module using a team comprising a Subject Matter Expert, Instructional Designer, Graphic Designer, Language Editor and Multimedia Programmer.

Knowing that learners who registered for this course are not required to attend any “hands-on” laboratory practical sessions, the faculty felt that an interactive multimedia courseware will make up for the lack of actual laboratory experiences.

The development process began with a content analysis conducted by the Subject Matter Expert appointed by the faculty and the Instructional Designer cum Project Manager from CiDT. From the discussions, three topics from the print module were selected for the multimedia courseware. These were developed into three lessons:

Lesson 1 - Safety Procedures in the Laboratory: Chemistry, Biology & Physics

Lesson 2 - Basic Techniques in Chemistry: Titration Techniques, and




Lesson 3 - Basic Techniques in Sterilisation





It is to be noted that the courseware was designed so that it complements the print module, face-to-face tutorials and online forums that took place among learners and between tutors and learners. During development, each lesson underwent an instructional design process. This involves a systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction.



Each lesson was structured based on an instructional model called Gagne’s Nine Events of Instruction. These events should satisfy or provide the necessary conditions for learning and serve as the basis for designing instruction and selecting appropriate media (Gagne, Briggs & Wager, 1992). Gagne’s model is based on the information processing model of the mental

events that occur when adults are presented with various stimuli. The nine-step process incorporate nine events of instruction, which correlate to and address conditions of learning. The nine-step model was applied when developing the three multimedia lessons. Table 1 shows the screen captures illustrating each event of instruction.

**Table 1**  
**Design of SBSC3303 Courseware: Application of Gagne’s Nine Events of Instruction**

Instructional Events	Internal Mental Proces	Screen Captures from the Courseware
1. Gain attention	Stimuli activates receptors	
2. Inform learners of objectives	Creates level of expectation for learning	
3. Stimulate recall of prerequisite learning	Retrieval and activation of short-term memory	

<p>4. Present new content</p>	<p>Selective perception of content</p>	
<p>5. Provide learning guidance</p>	<p>Semantic encoding for storage long-term memory</p>	
<p>6. Elicit performance (Practice)</p>	<p>Responds to questions to enhance encoding and verification</p>	
<p>7. Provide feedback</p>	<p>Reinforcement and assessment of correct performance</p>	

8. Assess performance	Retrieval and reinforcement of content as final evaluation	
9. Enhance retention and recall	Retrieval and generalisation of learned skill to new situation	

In addition to the application of Gagne’s nine events of instruction when developing multimedia courseware, Keller & Kopp’s (1987) ARCS model ensures that the learning environment created is motivating to the student was also incorporated. As Keller and Kopp advocated, the learner must feel that the right amount of **attention** is given to the material so that his thoughts and actions are prepared in advance as he goes through the material. The material and learning experience must also be **relevant** to the curriculum, objectives and knowledge and skills that are to be learned. The material must also be able to build **confidence** in the learner as he peruses through the content. Finally, the student must derive a sense of **satisfaction** in knowing whether or not he has understood the material and can retain as well as recall what has been learnt.

The incorporation of Gagne’s Nine Events of Instruction and the ARCS model signifies a significant application of behaviorist principles of learning. However, it is to be noted that OUM makes it compulsory for its learners to participate actively in the online discussion forums. The latter supports the cognitivist and connectivist principles of learning in line with the need to ensure that learners, not the instructor, are the focus of learning. The online discussion forums provide flexibility in terms of time, elements and context of discussion as long as the discussions do not lose focus or go off tangent but kept relevant and meaningful for learners.

Gagne's Nine Events of Instruction	Keller's ARCS Model
1. Gaining attention	Attention
2. Informing the learner of the objective	
3. Stimulating recall of prerequisite learning	
4. Presenting new material	Relevance
5. Providing learning guidance	
6. Eliciting performance	Confidence
7. Providing feedback about correctness	
8. Assessing performance	Satisfaction
9. Enhancing retention and recall	

**Figure 1: The relationship between Gagne's Nine Events of Instruction and the ARCS Model (Source: [blog.podagogy.com](http://blog.podagogy.com))**

Apart from the content, the screen interface design and layout of the multimedia courseware also plays an important role to determine the learner-friendliness of the instructional media (Baharuddin, Maizah, Kok, Mohamad Bilal, Jamalludin & Zaidatun, 2006). This includes aspects such as creating a navigational system to orient users, being consistent in screen design, designing screen layout so that it adapts to human biological factors, e.g. ensuring text reads left to right on the page to adapt to natural eye movement, and implementing acceptable colours (Howard, 2003).

Proper positioning of the navigational buttons, content area, as well as the use of suitable graphical elements and colours can minimise distraction. Learners should be able to navigate easily from one screen to the next and feel in control of his learning.

### **Purpose of the Study**

This study was conducted to determine the effectiveness of the multimedia courseware in terms of its instructional as well as screen interface design. At the instructional level, the study was conducted to determine whether the content presentation and the inclusion of a virtual simulation was well-presented, organised and useful in that it helped learners to better understand the subject matter. The study also sought to ascertain whether the screen interface design such as the colour scheme, screen layouts, fonts, graphics and 3-D elements used were appropriate. Finally, the study also sought to find out whether the navigability of the courseware, provided in the form of, among others, buttons and active links contributed to the learner-friendliness of the courseware.

## Procedures of the Study

The researchers designed a courseware evaluation form for the multimedia courseware prior to the offering of the course in May 2007 semester. This form was distributed among the selected learning centers in the Klang Valley to obtain their feedback. The form was also uploaded in the Leaner Management System (LMS) to provide options for those who prefer to submit the survey online. Among the 503 learners who registered for the course, 40 learners from three learning centers responded to the survey.

Twenty-nine statements in the evaluation form focused on the three research areas, namely instructional, screen interface design and navigability. The statements require the learners to evaluate certain components such as the learning objectives, content presentation, screen design, visuals, navigability as well as virtual lab and user-friendliness of the courseware. All the 28 statements require the learners to indicate their response according to the rating based on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The final statement in the evaluation form asked learners to rate the courseware according to the rating below (1 = Very Poor, 10 = Excellent):

Very Poor	1	2	3	4	5	6	7	8	9	10	Excellent

Learners were given both the print module and CD-ROM containing the multimedia courseware at the start of the semester. The course coordinator posted an announcement online in the learning management system to promote the courseware to learners taking the course. They were informed that their knowledge gained from the courseware would be assessed. Tutors were encouraged to promote the use of the multimedia courseware to their learners. At the very least, this was expected to encourage most if not all learners to view the courseware.

## Findings of the Study

The findings from the feedback received showed that in terms of instructional design, 80% strongly agreed or agreed that the objectives in the courseware were clearly defined. Similarly on whether the content presented in the courseware had met the courseware objectives, 80% strongly agreed or agreed. Hence the courseware succeeded in having learners understand about ensuring safety in the science laboratory.

On whether the instructions provided in the courseware were easy to understand 27.5% of the 40 respondents strongly agreed whilst another 57.5% agreed to the statement. On whether the content was clearly explained, about 90.0% strongly agreed and agreed. Only 10% of the respondents were neutral. Most of the learners also found that the content was well organised as 12.5% indicated that they strongly agreed and another 72.5% agreed on the matter. Besides that, 80.0% respondents agreed that the content was easily understood. This clearly



shows that the instructional design model adopted in designing the content flow has contributed to the effectiveness of the multimedia courseware.

**Table 2**  
**Learner Feedback to the SBSC3303 Multimedia Courseware Design**

No	Statement	Frequency				
		1 (Strongly Disagree) N (%)	2 (Disagree) N (%)	3 (Neutral) N (%)	4 (Agree) N (%)	5 (Strongly Agree) N (%)
1.	The objectives provided in the courseware were clearly defined.	0 0%	0 0%	8 20%	23 57.5%	9 22.5%
2.	The content presented in the courseware has met the course objectives.	0 0%	0 0%	8 20%	23 57.5%	9 22.5%
3.	The instructions were easy to understand.	0 0%	0 0%	6 15%	23 57.5%	11 27.5%
4.	The content was clearly explained.	0 0%	0 0%	4 10%	27 67.5%	9 22.5%
5.	The content was well organised.	0 0%	0 0%	6 15%	29 72.5%	5 12.5%
6.	The content was easily understood.	0 0%	0 0%	8 20%	23 57.5%	9 22.5%
7.	The interactivity in the courseware allowed me to understand the content better.	0 0%	0 0%	11 27.5%	22 55%	7 17.5%
8.	The simulations helped me to understand the content better	0 0%	0 0%	8 20%	23 57.5%	9 22.5%
9.	The questions were clear.	0 0%	0 0%	9 22.5%	21 52.5%	10 25%
10.	The feedback to my responses was helpful.	0 0%	0 0%	11 27.5%	22 55%	7 17.5%
11.	I felt motivated to complete the courseware.	0 0%	0 0%	11 27.5%	22 55%	7 17.5%
12.	The interface was user-friendly.	0 0%	0 0%	6 15%	30 75%	4 10%
13.	The navigation links in the courseware helped me to move from screen to screen.	0 0%	1 2.5%	16 40%	16 40%	7 17.5%
14.	The placement of navigation buttons (Next, Back and Page Number) was suitable for easy navigation.	0 0%	1 2.5%	9 22.5%	22 55%	8 20%
15.	The placement of accessory Buttons (MyOUM, Self-Test, Sitemap, Glossary and Exit) was appropriate.	0 0%	0 0%	12 30%	24 60%	4 10%
16.	All the buttons and links functioned as expected.	0 0%	1 2.5%	11 27.5%	21 52.5%	7 17.5%

17.	The colour scheme used was appropriate.	0 0%	1 2.5%	8 20%	22 55%	9 22.5%
18.	The font size used was readable.	0 0%	1 2.5%	8 20%	19 47.5%	12 30%
19.	The background on the screen was suitable.	0 0%	1 2.5%	9 22.5%	24 60%	6 15%
20.	The background music added value to my learning experience.	0 0%	2 5%	12 30%	19 47.5%	7 17.5%
21.	The narration was clear.	0 0%	1 2.5%	9 22.5%	24 60%	6 15%
22.	I did not experience any technical difficulties while using the courseware.	0 0%	2 5%	11 27.5%	23 57.5%	4 10%
23.	The graphics helped me to understand the content better.	0 0%	0 0%	11 27.5%	21 52.5%	8 20%
24.	It was easy to exit the courseware.	0 0%	0 0%	10 25%	18 45%	12 30%
25.	The screen design and arrangement for the virtual lab was easy to navigate.	0 0%	0 0%	9 22.5%	28 70%	3 7.5%
26.	The step-by-step instructions for the virtual lab were easy to follow.	0 0%	0 0%	9 22.5%	25 62.5%	6 15%
27.	The graphics/simulations/3D animations presented in the virtual lab helped me to understand how to conduct an experiment virtually.	0 0%	1 2.5%	13 32.5%	22 55%	4 10%
28.	The virtual lab helped me to visualise the real experiment in the lab.	0 0%	0 0%	12 30%	21 52.5%	7 17.5%

On the interactivity of the courseware, 17.5% respondents strongly agreed and 55.0% agreed that the interactivity allowed them to understand the content better. Only 27.5% stayed neutral. Besides the interactivity, a total of 80.0% respondents strongly agreed or agreed that the simulations in the multimedia courseware helped them to understand the content better.

In addition, the majority of learners found that the questions provided in the courseware were clear as a total of 77.5% respondents strongly agreed or agreed. This indicates that the learners were able to follow the whole content of the courseware and performed the questions provided to test their level of understanding. In terms of whether the feedback given to their responses was helpful, a total of 72.5% respondents strongly agreed or agreed on the matter with only 27.5% respondents stayed neutral.

The virtual lab seems to have reasonably attracted the respondents attention, where a majority of 72.5% respondents strongly agreed or agreed that they felt motivated to complete the courseware. The remaining 27.5% were neutral.

On the interface design, 85.0% of the respondents strongly agreed or agreed that the interface design was user-friendly. Besides that, 57.5% respondents strongly agreed or agreed that the navigation links in the courseware helped them to move easily from screen to screen. About 55.0% agreed that the placement of the navigation buttons (Next, Back and Page Number) was suitable for easy navigation whilst another 60.0% agreed that the placement of the accessory buttons (MyOUM, Self-Test, Sitemap, Glossary and Exit) was appropriate. When asked whether all the buttons and links functioned as expected, 70.0% respondents strongly agreed or agreed on the matter. Only 27.5% stayed neutral while 2.5% of the respondents disagreed. In terms of the appropriateness of the colour scheme used, 55.0% agreed and 22.5% strongly agreed.

The respondents were also asked whether the font size used was readable. On this, 77.5% respondents strongly agreed or agreed. Besides that, another 60.0% agreed that the background on the screen was suitable. In terms of audio or background music, although 5% disagreed that it adds value to their learning experience and 30.0% stayed neutral, almost half of the respondents or 47.5% agreed that it adds value to their learning experience. This was also supported with 60.0% respondents agreeing that the narration was clear.

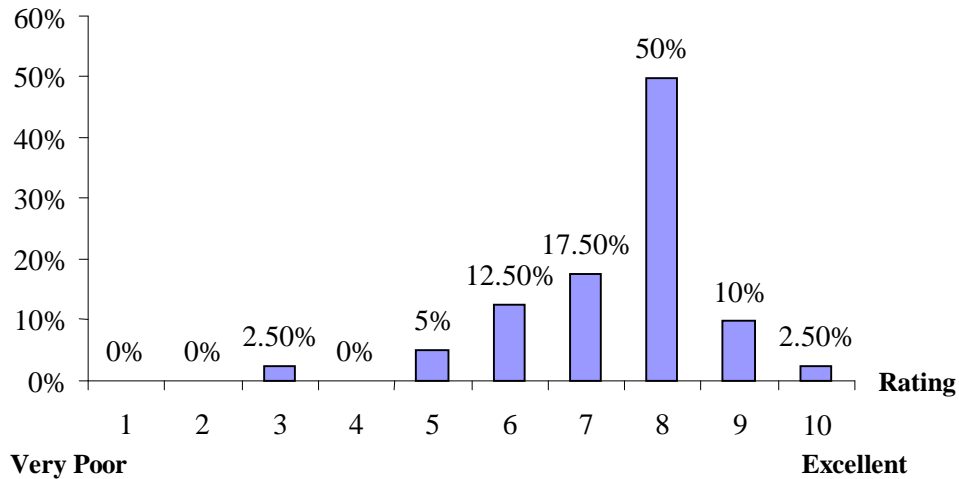
On ascertaining that they did not experience any technical difficulties while using the courseware, a majority, that is 67.5% of the respondents strongly agreed or agreed. This result implies that the courseware was learner-friendly, a feature that should be critically considered when developing multimedia courseware. Besides, 72.5% respondents strongly agreed or agreed that the graphics that were used in the courseware aided their understanding of the content.

Seventy five percent of the respondents also seemed to strongly agree or agree that it was easy to exit the courseware. When asked about the screen design and arrangement for the virtual lab content, 77.5% strongly agreed or agreed that it was easy to navigate. The remaining 22.5% stayed neutral.

On the virtual lab demonstration, when asked whether the step-by-step instructions for the virtual lab were easy to follow, a total of 77.5% of the respondents strongly agreed or agreed. Only 22.5% stayed neutral to the statement. Then, when asked whether the graphics/simulations/3D animations presented in the virtual lab helped them to understand how to conduct an experiment virtually, 10.0% strongly agreed, 55.0% agreed and 32.5% remained neutral. This was also supported with 70.0% respondents strongly agreeing or agreeing that the virtual lab helped them to understand the real experiment in the lab.

Finally, when asked to rate the courseware on a scale of 1 (very poor) to 10 (excellent), 30% of the respondents rated it as above average (score of 6 and 7). A large majority, that is, 62.5% rated it as almost excellent (score of 8, 9 and 10). Figure 2 indicates the responses on the overall rating of the courseware.

## Frequency



**Figure 2: Overall Rating of the SBSC3303 Courseware**

## Summary and Conclusion

There are certain challenges when developing an interactive multimedia courseware especially for open distance learners. Being adults, they have unique requirements in that the learning material must be useful, meaningful, relevant and sufficiently challenging. Combining Gagne's Nine Events of Instruction with the ARCS motivational model appear to have been quite effective when applied to the development of courseware developed for the Basic Techniques and Laboratory Safety course. Feedback received from learners was positive. It appears that the courseware effectively complemented the print module. In addition, learners were provided with face-to-face tutorials and were strongly encouraged to actively participate in the online discussions with their tutor and peers.

The courseware created was intended to give learners the flexibility of learning at their own pace and promote engagement between the learners and content. As part of its blended learning pedagogy, it may benefit learners who otherwise would not have been able to use actual physical facilities such as the science laboratory in this case. The findings of the study based on the perception of the learners indicate a generally strong positive attitude towards the use of multimedia courseware. The researchers believe that similar courseware should be developed to add value to practical-based courses. Similarly, feedback should be sought from learners in order to ascertain the educational value of the multimedia courseware.

In conclusion, it has been shown that a good multimedia courseware design focusing on the specific needs of the learners can be an effective learning tool especially for ODL learners. With the right application of instructional design models, use of appropriate motivational strategies as well as appropriate technologies, multimedia courseware can contribute to quality learning. It was suggested that making compulsory use of both print and digital

learning materials (multimedia courseware) for selected courses could contribute to positive learning experiences. The findings highlighted are by no means conclusive. It is recommended that the next time the course is offered, feedback is again sought to further confirm the contribution of the courseware towards the learners' understanding of the content.

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