Multimedia Teaching Development for Physics Courses

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ABSTRACT

In this paper we present some examples of our work on the use of multimedia as a strategic instructional tool to help members of faculty design and develop their courses. We shall start with examples of computer animations that are used for explaining abstract concepts that are otherwise difficult to communicate to students. We shall also discuss another example of how we can help a teacher who is not familiar with multimedia tools to design web-based course materials in the way he or she prefers.

Keywords

Multimedia teaching, computer animation, web-based course

INTRODUCTION

Multimedia development in teaching is not so very new in the teaching industry. Many individual parties have initiated this kind of work at HKUST. However, the technique is still not popular among teachers because of the initial difficulty in learning a new technology. Our team was quick to start the development of multimedia teaching and has accumulated considerable experience in using and designing multimedia components in teaching. We would like to encourage and offer help to other interested members of our department to join our efforts. This is the aim of our present project.

One main task in our project is to help interested physics teachers to apply multimedia teaching materials in their physics courses when teaching complicated concepts. This is important because many of the concepts in physics are rather abstract. If students cannot visualize them, they probably cannot get the correct picture/meanings, and this might affect their understanding of physics. To overcome these hurdles, computer animations and other multimedia teaching aids are needed. The computer animations we provided were developed by our own undergraduate physics students. We also offer help to faculty teaching large classes to build up a web-based database so that teaching can be carried out effectively with a large number of students.

COMPUTER ANIMATIONS FOR TEACHING

Who Prepares the Animations?

The animations are produced by UG physics students who took physics courses PHYS191/291/391. Under the supervision of the course instructors, they are required to develop their animations on a specific physics topic.

Student Training

We started with a series of workshops offered by CELT during the winter semester. The name of the workshop was 'How to prepare multimedia instructional materials for physical science subjects.' The workshop provided initial training to students on basic techniques in producing animations, video editing, etc.

At the end of the workshop, students were required to give a presentation in front of their professors, staff from CELT and also their fellow students on their work (exercises) that involved multimedia techniques. Feedback from the audience offered hints for the students to understand their weaknesses and improve their subsequent productions. It is believed that students not only learn IT skills from the workshop but also learn some presentation and project development skills.

Some five productions [1] were completed during the last academic year (2002 - 2003). These included animations to explain the celestial sphere, neutron stars, gravitational waves of binary pulsars, relativity, and the phases of the moon. Some of the productions were later used in physics course.

Implementation of Computer Animations in the Physics Course

PHYS002 is the course that adapted the students' computer animations in 2003. Dr Michael Wong and Dr Philip Sou are the course instructors of PHYS002 in 2003-04 Fall and Spring semesters. They both encourage the use of multimedia teaching aids in the course. Four animations are being used: The Celestial Sphere, Moon Phases, Gravitational Waves of Binary Pulsars, and Relativity'.

The animations are delivered as reference materials corresponding to the relevant topics in the course. If interested students want to watch the animations, they can click on the hyperlink in the course web site and study the content. Some students asked Dr Wong questions on various topics after watching the animations.

The animation 'Moon Phases' was also used in a training course offered by HKUST and EMB for primary school teachers teaching the Science component of 'General Studies'.

Instructor's Response

Comments from Dr Michael Wong

Overall speaking, the animations are quite good, the content of the animations are relevant to the topics taught in the course, and the layouts of the animations are also attractive. Some abstract concepts can be explained by the animations, for example, concepts involving three-dimensional motion such as the visualization of the celestial sphere in space, star motions etc. Students difficulties can be somewhat reduced through watching the animations instead of thinking by themselves.

However he also thinks that there is room for improvement. The production work did not fully utilize the advantages of computer animation to present concepts or ideas. For instance in 'Moon Phases', there is too much text inside the animation and viewers may be tempted to read the text instead of watching the animations. He suggests that more graphics can be drawn to replace the text.

Students' Responses

In the middle of April 2004, a survey was conducted in PHYS002, through email and distribution in class, on the usefulness of the computer animations produced by our physics students (see Appendix 2). Since the survey was carried out in the middle of the semester, only three of the animations used in the course could be evaluated.

There were six questions in the survey. The response rate was about 30%. Figure 1 reveals that the animations used in PHYS002 help the students to understand the topic more; this result agrees with the comments provided by the students in the survey. At the same time, they also suggest that the animations should be shown in lecture time rather than during self-study and they hope that more such animations will be developed for other topics as well.

There were also some negative comments from the students. However the feedback in general encourages us to continue this kind of work in the future.

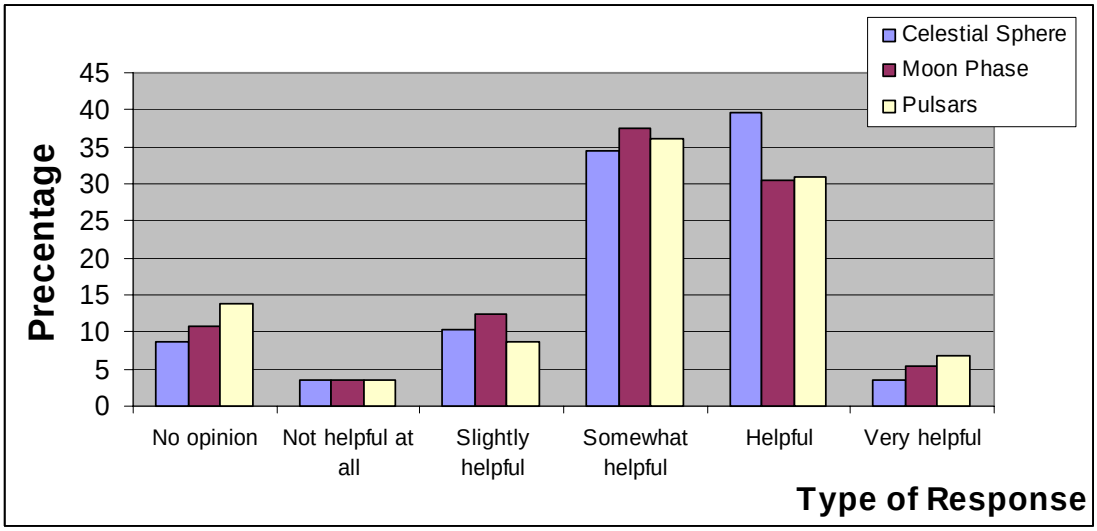

Figure 1. Answers to the question: 'Do the animations help you understand the topics?'

REQUEST FOR BUILDING A WEB-BASED PHYSICS COURSE

In addition to preparing animations, we also offer help to faculty members who have other demands for their courses. Here is an example case.

Background

It is expected that there will be a large intake for the Year-One physics course, PHYS121, starting Fall 2004. To prepare for the increase in student enrolment over the next few years, the learning material must be adequately standardized, so that future instructors can access the material and get prepared in a reasonable amount of time. Our project team is helping the present instructor to set up an online learning framework on the WebCT platform to meet future needs.

With large classes, it is often difficult for the instructor to pay attention to every student. The present instructor believes that extra material should be prepared for the students before lectures.

Using the WebCT Platform

The WebCT platform is being used to serve the instructors needs, since it provides an easy pick-up environment for instructors to upload or download their materials from the web. There are also plenty of ready-to-use functions for users, for example the Quiz function, the assignment function etc. We can prepare and upload the required materials on WebCT quite easily.

The web-based course is still under construction and some of the components are not yet finished. In any case, the web base will contain the following items:

(1) Past years instructors' notes, exam papers, homework problem sets etc. for future instructors to use or for their reference;
(2) Reference links of the websites corresponding to the topics are given to both instructors and students;
(3) Question bank developed for the pre-class online quiz;
(4) Rationale of homework solution with hints given to students to further understand the problems;
(5) Video of demonstrations will be recorded for students' revision after class;
(6) Animations, if needed, will also be prepared for appropriate topics.

The present instructor is very concerned about developing materials that students can use before or after class. Item (3) and (4) are developed to meet this need. These materials are being tested in another physics course, PHYS104, General physics, offered in this semester (Spring 2004). PHYS104 is a course for non-physics students in science or engineering students. The class size is 25, and the level of the course is similar to the course work in PHYS121. Therefore it functions well as a test-run and the materials prepared for PHYS121 can also be used in PHYS104 after some minor modifications.

The quizzes and the homework solution rationale with hints in PHYS104 are offered through WebCT. A questionnaire is conducted on the usefulness of the pre-class quiz and solution rationale hints. The results from the questionnaire provide information for the instructor to understand the effectiveness of the new components in the course.

Difficulties in Promoting the Use of Multimedia Teaching Aids in Physics Courses

The multimedia approach often requires the course instructors to modify their familiar teaching approach to teach in a more multi-dimensional way. This is not always easy for newcomers. Therefore, a critical factor that affects our project is the dedication of the course instructors. If they are not willing to use this kind of product, there is not much we can do. For instance, some animations originally planned for the course PHYS007 were not used due to the arrival of a new course instructor.

CONCLUSION

What we have done so far is only the preliminary work to help our faculty to develop course materials using multimedia techniques. We believe that importing multimedia technology in education is a worldwide trend. Although our work is still in the early stages, our work with our faculty has widened our horizons in understanding their needs and attitudes toward the implementation of multimedia teaching materials. We believe the multimedia approach is indispensable in maintaining a quality education in our rapidly changing world.

Appendix 1

[1] Year 2002 – 2003 Physics Students' Animation Production Work
http://www.phys.ust.hk/genphys/Flash/

Appendix 2

Results of survey conducted in Spring 2003 -2004.
Number of students responded = 78
Response rate = 30%

Q1 From all the courses you have taken in UST, what is the portion of those carrying multimedia teaching aids?

	Frequency	%
below 25%	32	41.03
26 - 50%	18	23.08
51 - 75%	25	32.05
over 75%	3	3.85
Total	78	100.00

Q2 How many times have you visited the animations in PHYS002

	Frequency	%
0	20	25.64
1 - 5	33	42.31
6 - 10	12	15.38
10 - 15	5	6.41
over 15	8	10.26
Total	78	100.00

Q3 Do you find the animations user friendly?

	Celestial Sphere		**Moon Phase**		**Pulsars**	
	Frequency	%	Frequency	%	Frequency	%
No opinion	7	12.07	8	14.29	11	19.64
Very user unfriendly	0	0.00	0	0.00	4	7.14
User unfriendly	5	8.62	1	1.79	1	1.79
Fairly user friendly	14	24.14	15	26.79	16	28.57
User friendly	28	48.28	27	48.21	20	35.71
Very user friendly	4	6.90	5	8.93	4	7.14
Total	58	100.00	56	100.00	56	100.00

Q4 Do you find the animations attractive?

	Celestial Sphere		Moon Phase		Pulsars	
	Frequency	%	Frequency	%	Frequency	%
No opinion	4	6.90	5	8.62	8	13.79
Very unattractive	0	0	2	3.45	0	0
Unattractive	3	5.17	3	5.17	5	8.62
Fairly attractive	27	46.55	27	46.55	25	43.10
Attractive	20	34.48	17	29.31	17	29.31
Very attractive	4	6.90	4	6.90	3	5.17
Total	58	100.00	58	100.00	58	100.00

Q5 Do the animations help you understand the topics?

	Celestial Sphere		Moon Phase		Pulsars	
	Frequency	%	Frequency	%	Frequency	%
No opinion	5	8.62	6	10.71	8	13.79
Not helpful at all	2	3.45	2	3.57	2	3.45
Slightly helpful	6	10.34	7	12.50	5	8.62
Somewhat helpful	20	34.48	21	37.50	21	36.21
Helpful	23	39.66	17	30.36	18	31.03
Very helpful	2	3.45	3	5.36	4	6.90
Total	58	100.00	56	100.00	58	100.00