Perceived Effectiveness of Multimedia Lectures in Non-Major Subjects

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Abstract

This paper reports on the design and implementation of a multimedia supportive package intended for a subject for non majors at a university in Hong Kong. The report also includes survey results of its perceived effectiveness in large classes over a two year period. The report details the design process, its implementation using the action learning paradigm and the problems encountered along the way.

Introduction

It is generally recognized that teaching campus-wide required subjects is much more difficult to teach than subjects more related to students' majors. This project is an attempt to find a way to improve teaching effectiveness of such a subject.

The starting point of our search is to find a more varied and less monotone lecture style. The choice was quickly narrowed to a form of multimedia lecture, since multimedia has long been recognised as a more stimulating communication medium. The recent surge in Internet activities and multimedia equipment further supports the validity of such a choice (Choi, 1996; Schank, 1994). The multimedia lecture style has also been advocated and predicted to increase by some researchers in the education field (Lennon and Maurer, 1994).

Many multimedia teaching packages are now available. These packages are mainly designed for self-learning and are generally not suitable for classroom use. In this paper we examine the general problems of teaching a required subject — An Introduction to Computing, sections. These problems are gathered by many instructors at the university who have taught the subject over the past few years. These problems help us to decide on a form of lectures that would meet our needs to increase the perceived effectiveness of lecture delivery. Implementation details and methodology are described later in the paper. Our multimedia lectures are then extensively tested. The results of testing are given, followed by a discussion of some problems we have encountered along the way.

Perceived Effectiveness of Multimedia Instructions

Although the effectiveness of multimedia is clearly established, there has been debate over the *perceived* or *apparent* effectiveness. This effectiveness is *perceived* by the users and the learners. We believe that perceived effectiveness depends on many factors and that its performance is local rather than universal. The findings in one area cannot be generalised to cover all multimedia presentations. Some of the influencing factors include:

- *The interest of the audience.* If the audience is deeply interested in the subject of the lecture, any improvement of the presentation format would be manifested many times by self interest. On the other hand, if a person is forced to take a subject that he/she hardly cares about, it is hard to believe that any format would make a significant difference.

- *The importance of the subject to the audience*. A student would clearly apportion his/her time more on a subject deemed important to his/her career or study plan. The more time spent on a subject, the more likely the student would appreciate the merits of different presentations. For example, a student knows that he/she has to learn the multiplication table. Thus he/she would naturally appreciate any method that makes the learning easier.
- *Students' aspiration*. If the subject is related to a student's research interest or personal hobby, he/she would be much more motivated to gain knowledge in that subject. Thus, a multimedia lecture featuring graphics on animals will be highly appreciated by animal lovers, while its effectiveness is minimal to a person who has no interest in animals.
- T*echnical level of the subject*. An abstract subject or a subject with a high level of technical skills only attracts the interest of more devoted students. The abstraction and difficulties in understanding technical details would diminish general interest in any format of presentation. On the other hand, a good visualisation of abstraction would clearly win the attention of the audience.
- *Relevance to the society*. Relevance refers to the presentation's content in relation to our daily experience. A subject considered irrelevant hardly retains student interest and the perceived effectiveness of such a presentation would necessarily suffer.

Design Goals

In addition to the global factors mentioned in the previous section, we frequently faced the following problems for a non-major subject. Please note that some of the problems may only be local to Hong Kong or just to our university.

- *Noise in the classroom and dozing students*. It is commonly noticed that at the beginning of a class students take their time to settle into their seats while chatting with their neighbors, which creates considerable noise. This noise problem is further compounded by numerous tardy students. Another unpleasant problem is the number of students who sleep in class. Some would even doze off before the lectures begn even though they are told that attendance is not required.
- *Attendance problem*. The class for which we plan to introduce multimedia is large. While the attendance problem would not be severe if we take roll call, it is impractical to do so if the class is large. Besides, the noise and other disturbance would greatly increase if roll call were taken. If we do not enforce the attendance regulation, the attendance generally drops off significantly.
- *Complaint of abstraction*. The lectures mainly cover computer hardware and less concrete concepts. Such abstract ideas are sometimes difficult for students to absorb when words or pictures are used alone.
- *Passivity of the audience*. Secondary school students in Hong Kong are particularly passive after years of learning that does not encourage classroom participation. Hong Kong tertiary education lasts three years, in which there is very little room for students to experiment and to mature due to the lack of free time. They retain most of their secondary school habits, one of which is passivity or shyness. This passivity prevents students from interacting with the instructor and makes them reluctant to ask questions.
- *Class notes*. A great number of students do not buy textbooks, but ask or even demand instructors to provide copies of their transparency lecture notes. These students treat these very brief notes as substitutes of the lectures. Any material or discussions not covered specifically in the notes draw no attention to the students. This poor practice does great disservice to students and is generally noted by many instructors. However, since refusal to give notes constitutes a most negative impression when teaching evaluation time comes, almost all instructors comply with the students' requests despite their misgivings.

There are of course other concerns, such as material overloading in a subject and a system of inflexible grade distribution. However, since these issues cannot be affected by lecture designs, we will not address them in this research.

The subject for which we were to construct the multimedia lectures concerns an introduction to computing to non-major students of the university. It has a large enrollment, usually in multiple large sections. At the time of the design, it was understood that some instructors might prefer to use their own notes. We actually welcome such possibilities. Over the years, the classes are often team taught, in which several instructors share one class, with each teachng a few topics. To make our survey on the effectiveness of our package all the more meaningful, we hoped that some teachers would use the traditional lecture formats while others adopt multimedia. We could then make comparisons of the two methods on an equal footing. This predicted situation did indeed happen later when the whole set of lectures were completed and available for use by all the instructors of this subject.

At the outset, the team agreed to use the action learning paradigm (Kemmis and McTaggart, 1988) to approach the project. This action learning paradigm is quite similar to a typical software design model such as the waterfall model. This model is a cycle of design, implementation, reflection and modification once the design specifications are found. The design specifications in our case are relatively simple. The major contents were dictated by the subject syllabus. Other requirements include the usual seven step design goals (Howles and Pettenfill, 1993; Vetter, Ward and Shapiro, 1995) as well as conditions mentioned earlier. Specifically, we made the following additional decisions to general design practices:

- To combat the noise problem, we decided to start each lecture with some highly audible music. The music was to have the calming effect and settle the class down for the coming lecture. Audio clips would also occasionally be played during the lecture. We believe that this would reduce an instructor's monotone speech, especially if he / she seldom changes his / her pitch. (This decision was of course based on our later choice of an instructor dominant lecture format, which is further discussed below).
- To reduce boredom and to capture students' attention, each lecture was to include video clips and possibly animation sequences. Animation, video clips and attractive graphics were also generously used to illustrate abstract and / or difficult topics.
- Each lecture was organised in sub-units and in a hierarchical design. This type of design should enable a user to select and sequence materials covered in the lecture with flexibility. It would also make navigating easier if one needs to briefly review a lecture.

Other problems, such as lecture notes and attendance, were not directly addressed in our design goals but implicitly entered into our decision process. We believe that the problem with the class lecture notes would evaporate once students saw the difficulty in obtaining hard copies of the multimedia presentation. It is hoped then they would learn to take notes and study their textbooks. In practice, we could not verify our conjecture with certainty, because when the new lectures are tested, some sections will use traditional methods where students would have access to class notes. However, our reasoning seems plausible and logical. The attendance problem is more implicit and difficult to measure as we do not have attendance data from previous years. We only hope that the liveliness of the lectures would entice students to attend class. This point of view was indirectly verified in our questionnaires in which we asked students to rank factors affecting their attendance, (see below for futher details).

With these rough design specifications, we now had to choose the right format of the lectures. Computer based education and training (CBET) is becoming more and more popular these days. We had to choose one of at least *five* categories of these CBET formats for our package.

i. *Teaching aids*. These are short pieces used to illustrate a particular concept or topic. Film clips shown during a traditional lecture are such examples.

ii. *Teaching supplements*. An example of these is various software usage primers. Teaching supplements are usually narrowly focused. Most commercial CBET products belong to this category.

iii. *Self learning tools*. These are complete *just-in-time* learning packages. Users are supposed to learn a substantial subject without an instructor. Many such packages have been produced by various universities around the world. Some of the packages have found their way into commercial markets. These packages are also widely used in industry and in military training.

iv. *Resource banks*. These are similar to a library of material related to a subject. A user is given some guidelines to look for what he/she wants to learn. An example is World Wide Web surfing.

v. *Interactive supporting teaching plan*. By this we mean packages at the disposal of an expert. It is a combnation of a lesson plan and teaching resources. Instruction is given by a teacher and enhanced and supplemented by multimedia materials.

Our choice was number (v) and was guided by past experience and practicality. In the past when we lectured using transparencies, we strongly advised students to use CBET supplements in the *Media Service Section* of our library. However, the usage record showed very little student enthusiasm.

Self learning formats were also considered. Self learning packages are by far more numerous than other multimedia learning packages. However, we felt that it was not practical in such large classes as its implementation would have required substantial technical and equipment support. Besides, a self learning package lacks human contact which is essential for the subject we are approaching. Moreover, a self learning package can easily fall into a game type of exercise for a casual learner who may play over and over again the 'dramatic and fun' portions and quickly skip over others. It is used in isolation and easily induces boredom. We think that self study works only for the motivated or very serious students. It may be also useful to augment lectures and used for subject reviews but is not adequate to be used in large classes.

We believe human contact is important in learning. It projects an image of caring and concern on the part of the institution. It provides students chances of interaction with the instructor and classmates. It brings the subject more lively. It is more like a class in school rather than an isolated task! For these reasons, we chose to implement our plan in an interactive supportive package. An interactive supporting package combines all the advantages of traditional lectures and multimedia resource databases. The design we chose would add flexibility and variety to a class where apathy is high and which needs special stimulation. We tried to make sure that the package was designed to be helpful but not a distraction. It augments and adds to the lecture just like a well-tailored suit adds to the appearance of a magnificent figure but it should not become the center of attention itself.

Implementation

Once the designs were fixed, the implementation followed the action learning cycle paradigm. The package was divided into units of an hour duration. Each of us delineated from the syllabus the basic requirements of each lecture, draft a list of must topics with specifications of graphics, animation and/or film clips. Before we handed the lists of specifications to our technical assistant, we chose an authoring software tool ourselves. There were a few of these authoring tools available to us at that time. These include Hypertext, Quick Time, Compel and Authorware. After some experimentation, we chose Authorware because of its easy production of standalone units. This decision was confirmed only after one of us produced a small unit to make sure of its functionality. In

screening this test unit, we found that pictorial display was very small compared with the screen. The small screen problem was caused by the data size and compression problems. It is a problem shared by almost all multimedia software at the present. While this phenomenon may be acceptable to self learning, it is less than desirable for a classroom projection where full screen is needed for visibility and clarity. After much deliberation and search, we finally decided to use some hardware device to help with the compression problem. This solution, however, destroys partially the stand-alone nature of the multimedia lectures. It raises the chance of operation in the classroom but there was really not much choice. We believe such difficulties would eventual disappear with future technology.

After all technical problems were ironed out, the specifications were then handed over to the technical assistant. He would undertake library search for graphic material, filming video segments and solicit film clips from local companies to implement the lectures. A weekly meeting was scheduled to discuss progress and improvements. These design and implementation meetings continued until all lecture units were finished.

The Action Learning Cycle

The usual action learning cycle was observed even during the initial implementation stage. When a unit was finished, it was screened by all of us. Suggestion and modifications were made after careful reflection. The units then were demonstrated among our colleagues and their opinions and comments were solicited for further improvements. Finally the lecture units were tested in classrooms. Outside education experts and technical experts in our own department were invited to sit in and their comments were requested.

Students' reaction and comments of the new lectures were of course important. We circulated our first questionnaire after a few multimedia lectures were given. The timing of the first questionnaire was to avoid the shock and temporary effect of a new lecture format. With a few modules the feedback would be more reliable and reflective of the overall situation.

After collection and analysis of questionnaire data, a careful review and discussion ensued. This led to another round of modifications. This live testing – evaluation – modification process never stopped and it still continues presently. In fact, we hope to continue the process as long as the package is used and as long as funds for maintenance are available.

Test and Evaluation

- *Perceived effectiveness of the lectures*. The multimedia lectures were partially introduced in the spring of 1995. The lectures were possible through a grant from the local government. The funding and the academic calendar restriction allowed only a small portion of the lectures to be screened at that time. There was just not enough time to produce a complete set of lectures when needed. This limited form of testing was done on purpose as it afforded us a good opportunity to compare students' reaction of two lecture formats given by identical instructors. Thus, although these students might not see the polished versions of the lectures of the present day, their comments and reactions were more reflective of the effectiveness of multimedia in the classrooms. Our evaluation of the perceived effectiveness of the lectures came from two sources: experts and students.

We had invited experts from the university's Education Department as well as several departmental colleagues to give their impressions of these lectures. Some of the colleagues had taught this subject before and some were never exposed to these classes. In addition to our prepared questions, each of them made additional comments on the effectiveness of the new presentation for-

mat. These were in addition to comments from departmental colleagues during a demonstrative lecture earlier.

The experts' comments to our specific questions were almost all highly positive. Here are what the experts' responses to our question 3 on the advantages / disadvantages of *our* multimedia presentation:

> ...there are far more advantages than disadvantages. Multimedia lectures can fully capture the attention of the audience.
>
> When you need to drive an important point home, 'Multi' (multimedia presentation) has significant advantages over 'traditional'.
>
> Using multimedia can arouse interest and motivation of students.
>
> It is an excellent attempt to use multimedia to teach Comp1110 (Computer Literacy)... Multimedia can vividly and graphically present the lectures which can eliminate boredom and arouse the interest of students. (translation)

In addition to the responses to our prepared questions, the experts also made the following general comments:

> I very much like this method of presenting our lecture. I wish I could try this method in my own lecture. I've a very good impression of this method.
>
> The pace of lecture could be made quicker, I believe.
>
> I enjoyed the lecture very much. I am excited to learn more about these new educational technologies (maybe new to me and not to [the] experts).

In addition to academic experts' opinions, we gave two student surveys using questionnaires twice in each surveying semester, one near the middle of the semester and the other near the end. The practice was to observe the change in attitude towards multimedia throughout the semester. The first survey clearly indicates an overwhelming majority of them prefers multimedia lectures to traditional presentations using overhead projectors. The overall vote for multimedia lecture versus traditional presentation was 112 to 1. It is interesting to note that the only student who indicated his / her preference of traditional lectures said that he / she considered multimedia lectures more interesting and more helpful in learning. The second questionnaire results further confirmed the sentiments expressed in the first survey. The ratio choosing multimedia lectures over the traditional presentations was 92 to 4.

In the second questionnaire of each surveying semester, we asked students if they changed their indicated preference in the first questionnaire. The number of responses indicating changes was again small in each case as seen in the following table.

Table 1: Students' preference change during a semester

	Spring 94-95	Fall 95-96
Change from traditional to multimedia	7[1]	15
Change from multimedia to traditional	1	4

In the second survey, there were four such cases but again all of them expressed no negative opinions about multimedia. Specific statistics of the two surveys are summarised as follows:

- Perceived effectiveness of the multimedia package — students' preference of lecture formats.

This is clearly the most important test of using the package. The experts' opinions have been very positive and the students' reaction was also exceedingly favorable. The extreme favoritism of the first survey may have been partly due to the novelty of the new way of lecturing. However, it cannot be entirely just that because the second questionnaire was equally positive. In what follows, responses were tabulated in terms of percentages so that comparisons could be more easily visualised.

Table 2: Students' preference of multimedia presentation versus traditional presentation

	Spring 94-95		Fall 95-96	
	1st survey	2nd survey	1st survey	2nd survey
Traditional	0.9	4.2	11.6	15.8
Multimedia	99.1	95.8	88.4	84.2

Table 3: Students' view on the interesting of multimedia presentation

	Spring 94-95		Fall 95-96	
	1st survey	2nd survey	1st survey	2nd survey
More interesting	95.6	84.4	81.5	79.4
The same	3.5	12.5	14.6	19.0
Less interesting	0.9	3.1	3.9	1.6

[1] This number, seemingly inconsistent with the statistics on lecture style preference, was based on students' response to the question whether they had participated in the previous questionnaire survey.

Table 4: Students' view on the usefulness of multimedia presentation in learning

	Spring 94-95		Fall 95-96	
	1st survey	2nd survey	1st survey	2nd survey
More helpful	81.3	74.0	53.3	56.9
The same	17.9	26.0	38.4	37.9
Less helpful	0.9	0	8.3	5.1

Table 5: Change of opinion on the preference of presentation method since the first survey

	Spring 94-95	Fall 95-96
Keep traditional	2.9	11.2
Keep multimedia	74.3	74.6
Change from multimedia to traditional	2.9	3.0
Change from traditional to multimedia	20.0	11.2

Module maturity

We gauge the maturity of the lecture in our recent survey by asking students about the need to improve the multimedia package. The following are responses to our question:

Do you think the current multimedia lecture presentation needs further improvement?

Table 6: Students' view on the quality of presentation materials

	Fall 94-95	Spring 94-95
Further improvement needed	43.8	43.2
No further improvement needed	56.3	65.8

Attendance

As we have no records of past attendance figures, we can only evaluate this by asking indirect questions. We asked students to rank the importance of 12 factors that may affect their decisions on their attendance. Responses to the two questionnaires show that the following four factors were constantly ranked at the top of each survey.

- Preparation for immediate tests
- Teaching method
- Usefulness of lecture topics
- Self knowledge of lecture topics.

Of these four factors, teaching method came out either as number 1 (1995-1996 survey) or as number 2 (1994-1995 survey). Since we saw that an overwhelming majority of both surveys was highly impressed by the multimedia lectures, it is therefore natural to infer that this lecture format would have positive effects on their attendance.

In addition to responses to multiple choice questions, we also asked students to add personal comments. A great majority of the comments favor multimedia lectures. There are a few comments on the lighting in the classroom and the contents of the lectures. We will comment on the lighting situation later in this paper.

Problems with Multimedia Lectures

Despite the tremendous popularity and hype of CBET in general and multimedia in particular, we experienced many problems with this new form of learning and teaching.

- *Learning curve of authoring tools.* Most authoring software is not easy to use and the multitude of new products makes it even harder to choose and stay with the same tool. For instance, if we would start the project again at the present time, it is very likely we would choose a new authoring package. The technical skill requirement makes it very difficult for an average college instructor to plan a subject in multimedia. With increase awareness of computing and the rapid advance of the technology, this difficulty may soon disappear.
- *Slow production time*. It takes a tremendous time investment and perseverance to produce a substantial lecture set. A 1994 survey reports (Reinhardt, 1995) that on the average it takes 228 hours to produce an hour lecture. Our experience supports this finding. In addition to time, it requires high level of technical skills. This makes it impractical to design multimedia presentations for subjects that are not taught repeatedly. It is also prohibitive for average instructors to attempt using multimedia.
- *Data compression and small graphic display*. Most graphic files are huge and it requires data compression for storage. When these files are displayed or played, the files need decompressed. This process takes time. Most of the authoring tools today have no choice but to reduce the size of displays. Thus most graphic displays such as animation and video clips are displayed on only small windows on a monitor. Such displays may be acceptable to self learning in front of a monitor but it is really not acceptable for large classroom use with a good size screen.
- *Classroom innovation*. The current classrooms are not designed for multimedia lectures. In addition to the lighting problem, we experienced interruptions of the sound system and projection problems. This makes it often necessary to have some traditional lecture notes as a back-up. However, even with this back-up precaution, the interruption often causes a poor image of the lectures. In our situation, we have the additional problem of the decompressing hardware.
- *Software and hardware robustness.* Our experience also shows that the software and hardware devices are not 100% robust and interruptions do occur. Our problem of relying on hardware to display graphic images is even more severe. Once we had problems in using the lectures because the lecturer in a previous lecture had changed the setting of our plug-in board. These problems were hard to detect before the lectures begin. Hardware failures were not uncommon during our initial use of the package. In addition to the usual mean time failure problem, we

also have problems caused by portability of a new lecture module.

Despite all these problems, we believe that the multimedia-on-demand format will flourish and future technology will be friendlier and more robust. However, multimedia will not become main stream unless most, if not all, of the following can be realised.

- There is a software solution or a simple standard hardware plug-in board to help with the small display problem. A complicated toy is difficult to become popular. A cumbersome lecturing style will never become main stream. Multimedia lectures can be common mode of lecture only when they can be devised and display with simple efforts.
- Each teaching institution has a technical center to help with implementation and design of multimedia presentations. Even with the advance of technology, designing a multimedia package requires artistic skill and computing skills that may be beyond an average non-technical instructor. Thus a multimedia centre is critical if this form of lectures would become popular.
- The current practice of search library for graphic, video and / or audio material for a package is simply too slow, expensive and difficult. The royalty problem is also a factor. A solution may be that soon textbook publishers will publish textbooks containing multimedia supplements on CDs. These supplements are allowed to be used in multimedia presentations for instruction purposes if the book is adopted.

Summary

A set of interactive supportive multimedia lectures was tested on a non-major subject. This subject was required by all non computer major students of a university. Our statistic data shows that the new forms of lectures were indeed perceived more effective than the traditional lectures. However, we offer no conclusion as to whether the degree of this advantage will remain after the newness of multimedia wears off. Although the long term effectiveness of multimedia on demand is not clear over traditional lectures, the trend is clearly irreversible. It is just like linking happiness to richness. Multimedia is similar to being rich. One thing is clear though. Although we cannot lay claims to happiness when we become rich, it is equally evident that we would have a very difficult time to live poorly after getting rich. In our estimation multimedia lecture popularity will continue to grow and may even become dominant in time, although it may not develop as fast as it was predicted because of the problems cited.

Despite the tremendous acceptance and hype of multimedia, we experienced many problems with this new form of learning and teaching. The problems stem from the fact that delivery of lectures of this type does not depend on the instructor alone. It requires supports from other sources: classroom innovations, technical support and technology improvements. Furthermore the tremendous time required in its production makes it impractical for use on subjects that are transient in nature.