Electronic Presentation of Lectures - Effect upon Student Performance

PAPER

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The effects of transferring lecture material from overhead acetates to the computer presentation package Microsoft "PowerPoint" are described. The advantages of this method and some simple additional techniques are described. There is a marked increase in the students' performance in the end of module examination which has been sustained over two years. The possible reasons for this increase are discussed, together with the results of informal feedback from the students.

Introduction

The lecture has been described as "a grossly inefficient way of engaging with academic knowledge[1]". No doubt it is reasoning like this which has prompted a few examples of lectureless course modules[2,3]. Nevertheless, the lecture is likely to play a key part in the learning experience of university students in the foreseeable future[1,4,5]. Paradoxically, one of the arguments in favour of the lecture is that it is 'efficient'[6]. The paradox arises because the lecture provides an opportunity for a very large number of students to be exposed simultaneously to a large amount of information. The lecturer needs to be aware that not everything that has been covered has been learned: in the words of an anonymous quotation "the verb 'to cover' and the noun 'information' are responsible for much mischief"[7]. Indeed, Johnstone and Su[8] have concluded that students may record in their notes as little as 52% of the 'units of sense' delivered in a lecture. One reason why information is not transferred efficiently from the lecturer to the student is that students suffer from 'attention breaks'[9]. Any device which can prevent these breaks in attention can therefore lead to improved learning.

Sanctury[10] has reported that student interest in lectures can be greatly increased by incorporating sophisticated audio-visual techniques.To follow this example would require more preparation time than most people would be prepared to spend.However,it seemed possible that student interest could be raised (and therefore student learning improved) by a much more modest introduction of technology into the lecture.

I therefore decided to test the effect of using a PowerPoint presentation to replace all the OHP transparencies in a single lecture course.

Methodology

The Lecture course

The series of lectures selected for this trial is given to first-year students on the BSc course in Environmental Science at the University of Plymouth. The course is taken by 130 – 180 students who have a wide range of backgrounds in terms both of academic subjects studied and of the type of course taken prior to university (A-levels, foundation years, etc). The syllabus comprises topics in physical chemistry in two main areas: water (hydrogen bonding, solubility, pH, redox) and energy (first and second laws of thermodynamics, Carnot efficiency, enthalpy, entropy, Gibbs free energy).

The course is scheduled for the first semester, and is allocated 12 contact hours (normally lectures); a further 12 hours of private study is expected. This series of lectures comprises one twelfth of the workload of the students in the first semester. Students are expected to study for approximately 40 hours per week.

Previous method of presentation

Until 1995 the course was presented in ten 1 hour lectures and two 1 hour problem solving sessions. The lectures made extensive use of OHP transparencies created by a word processor or graphics package. The sheets were then printed out in monochrome and 'spot colour' added using fibre-tipped pens. Complicated diagrams were built up by overlaying several layers of acetate and, if multiple points were on a single transparency, these were revealed one-by-one using a sheet of paper to cover part of the OHP.All lectures were preceded by a transparency outlining the essential points that would be covered and the final acetate contained a summary.

The problem solving sessions were organised as follows:-

- students were given a sheet of numerical problems the week before the session;
- during the week, students would attempt to solve the given problems;
- during the session itself, the tutor would go through model answers.

These sessions did not allow any one-to-one interaction between tutor and student and many students were unable to attempt the problems because they could not see how they should be approached.

Current method of presentation

In 1995-96 all the material previously presented on OHP transparencies was instead presented in Microsoft PowerPoint (V4) running in the Windows 3.1 environment. Like all presentation software, Microsoft PowerPoint[11] offers

- consistent use of colour;
- easily created signposting/summaries;
- gradual building of text;
- simple animation of diagrams;
- facilities for simple editing and updating.

Without the use of specialist software such as PowerPoint these features can only be achieved with considerable time and effort.

Every effort was made to restrict the changes in the presentation to the exchange of OHP transparencies for screens presented by PowerPoint.The use of PowerPoint is possible because the large lecture theatres at Plymouth are equipped with standard PCs connected to a video projector (VGA resolution or better), and the PC screen is projected at the front of the lecture theatre to form an image of a size suitable for the room. All the screens were created in PowerPoint and used a range of colours from a standard palate. Diagrams were re-drawn using the tools available in the program and clip-art was only used where a similar illustration had been used previously (e.g. photocopied cartoon). No images were scanned in. Simple animation was used for some diagrams, see Figure 1.

The use of PowerPoint made it possible to revise the problem solving sessions to allow better tutor-student interaction. The new process is as follows:

- students are given a problem sheet the week before;
- during the week, students attempt to solve the given problems;
- during the session, the correct answers are read out (at which point students who have solved the problems correctly may leave);
- the PowerPoint presentation is started;
- the first screen shows a flow diagram outlining *how* the problem should be approached;
- subsequent screens slowly reveal a model answer: the internal clock of the PC is used to change the screens; each step in the answer is displayed for about two minutes before the next step is added.

Students who were previously unable to see how to tackle the problem or who had problems with the initial steps are thus led through them at a reasonable pace, and are motivated by the opportunity to 'beat the computer' to the final answer. Meanwhile, the tutor has been freed from the task of giving the explanation to the class and is available for one-to-one discussions with any student in difficulties.

Figure 2 shows screens from one of the more simple problems.

Assessment

A 45 minute multiple choice test containing 30 questions is taken by the students at the beginning of the second term. The questions are marked by a PC linked to an optical mark reader and the package also generates reports containing frequency histograms. No changes were made to the method of assessment during the period covered by the study. Student feedback was obtained by requesting students from the 1996/97 cohort to complete a short questionnaire at the end of the course.

Figure 1: Simple animation sequence to illustrate the Carnot cycle

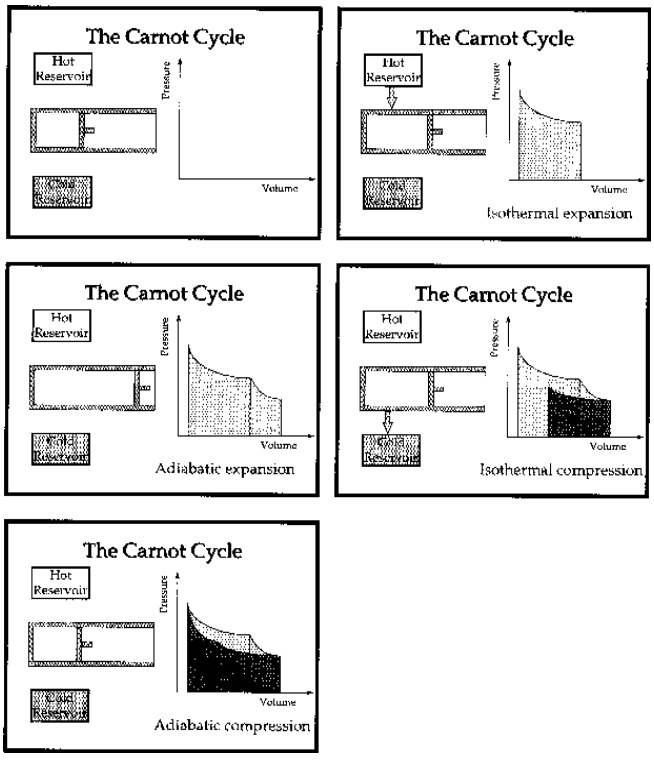

Figure 2: Progressive reveal of model answer

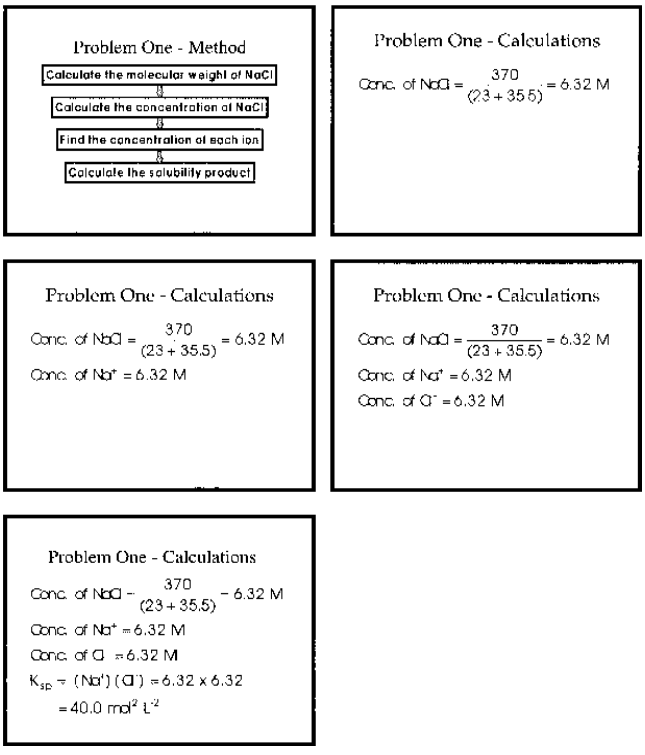

Figure 3: Effect upon examination performance

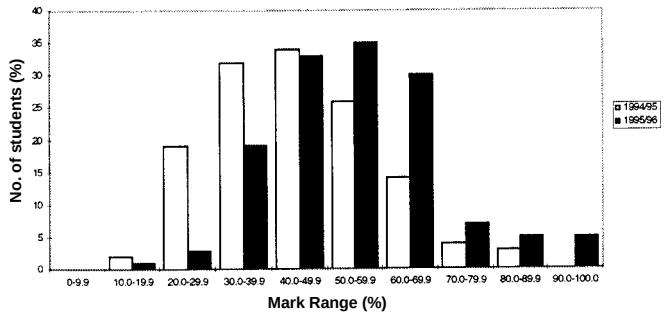

Table 1: Summary Statistics

	1994/95	*1995/96*	*1996/97*
No. of students	134	145	160
Mean mark	43.5	51.8	51.9
Standard Deviation	14.4	16.2	15.6
t_{obs} (cf 1994/95)		4.5	4.7
t_{crit} one-tail		1.7	1.7

Table 2: Written Responses from Students

Feature	*Number of responses*	*% age of returns*
Use of PC	37	43 %
Visual aids	19	22 %
Presentation	14	16%
Lecture plan / structure	14	16%
Clarity	10	12 %
Pleased with lecturer	8	9 %
Well explained	8	9 %
Humour	8	9 %

Results

Examination performance

Figure 3 shows the distribution of marks for the academic years 1994/95 (before the introduction of PowerPoint) and 1995/6 the year that PowerPoint was introduced.

There is a clear impression that the marks increased after the introduction of the PowerPoint presentation. This visual impression is confirmed by statistical analysis shown in Table 1 in which a one-tailed test is used to compare each of two cohorts of students who experienced the PowerPoint presentation (1995/6 and 1996/7) with the 1994/5 cohort who had not.

The t_{crit} (critical values for t) given in the table are for the 95% confidence level. It is clear that the differences in the means between each of the two cohorts and the 1994/95 students (which is the basis for the t-test) are statistically significant. Indeed, the probability that the differences in the examination means are due to random factors is less than 0.01%. The effect has been sustained over two academic years. Thus, the enhancement is unlikely to be due to the increased enthusiasm of the lecturer caused by a new experience.

Student perception

The questionnaire given to students from the 1996/7 cohort asked what could be improved and included a section for comments. 86 forms were returned from the 160 students. 76 rated the course "very good", and 10 "good", the top two of the ratings offered.

The majority of the comments were very positive, with some students remarking on the clarity of both the material and the structure. Table 2 lists the comments written by the students when asked to complete the sentence "A good feature of this series of lectures was".

Discussion

For two successive years after the introduction of PowerPoint presentations, the mean examination performance of the cohort of over 130 students was significantly increased. Furthermore, the student perception of the new learning experience is positive, with a majority of students picking out some aspect of the presentation method as a good feature of the course.

Naturally the use of a previous cohort of students as a control has limitations. The validity of the comparison depends on four main assumptions:

- That the lecturer's own style and enthusiasm are unaffected by the change;
- That the only change in the presentation is in the exchange of PowerPoint screens for OHP transparencies;
- That the student cohorts are of equal academic ability;
- That the assessment procedure each year was equally demanding.

The fact that the improvement was sustained for two successive years is an indication that the PowerPoint presentation led to a substantial improvement in learning. There are at least four possible explanations for this.

- The ability to change the screen display with the click of a mouse button means that the structure of the lecture is not obscured by the need to replace transparencies, and/or cover up selected material.
- The opportunity to introduce animations and to build up diagrams sequentially can be particularly instructive. Furthermore, PowerPoint imposes a discipline on the lecturer which makes it particularly easy to present clear signposts and summaries. Brown and Atkins[5] conclude that this is one reason for associating audio-visual aids with the process of learning.
- The new style of the workshop sessions may provide a significantly better learning environment for some students.
- The quality of the presentation may go some way towards preventing the attention breaks which limit the effectiveness of lectures as a learning experience[9]

Of course, this last point may suggest that it is the novelty

effect of PowerPoint, rather than its quality, which attracts the attention of the students. If this is so, then the success of the approach depends on it *not* being adopted universally! In spite of this, and of other reservations about the interpretation of the improvement reported here, the data are sufficiently encouraging for it to seem worth recommending a much wider use of PowerPoint to present lecture material.

References

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