Can Video (Created with PowerPoint and TTSAPP) Replace "Normal" Lectures?

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Abstract. PowerPoint, a ubiquitous tool used by lecturers and customizable with animation and now with video producing possibilities, and Microsoft Text to Speech Application (SAP15 TTSAPP), now including the more naturally sounding voices of Zira and David, have facilitated the setting up of a video lecture on boiling and condensation, which was presented to a class of 45 fourth year chemical engineering students in a computer laboratory. The original PowerPoint lecture on boiling and condensation was used in this study, and augmented with additional animation and audio to simulate normal lecture practice. The audio was produced by typing the spoken words into the notes section of the PowerPoint slides, and processing these with the TTSAPP. The resulting audio wav files were then included in the sequence on the animation pane, and the presentation saved (also) as a MP4 file video. Students rated the video lecture relative to a normal lecture and supplied additional, mostly positive, comments, and these results are discussed and compared to their performance in the following test. Hence it was concluded that there are initial indications that the learning of students is not adversely affected by having lectures online. This can now be tested for a whole subject, after which one may start thinking of collaboration with other universities to ultimately aim for increased teaching efficiency.

Keywords: PowerPoint, Online Lecture, TTSAPP.

1 Introduction

Globally, there is a trend of reduced government spending for education and an increase in student numbers [1], and more pressure on lecturers to perform in research rather than in teaching and learning [2]. Authors on online engineering education have indicated that to be broadly accepted and utilized, the quality of online courses must be comparable to or better than the traditional classroom [3]. They state that two of the pillars to judge for quality online learning is student satisfaction and learning effectiveness. The author of a comprehensive book on online teaching often gets asked whether online or on-campus teaching is better, but feels that they are so different that no comparison is possible [4]. Creating visual and auditory learning objects can be challenging, involving learning of new software tools [5].

This work focusses on a lecture of a (one) semester subject, Heat and Mass Transfer, which is presented to fourth year chemical engineering students at seven tertiary institutions around South Africa. For the current lecture, the knowledge content has hardly changed over the last 14 years, and recently passed the 5-year cycle scrutiny of the accreditation body (Engineering Council of South Africa). Hence there is considerable duplication of the lecturing effort, not only across the country, but also from one year to the next. (Note that the author is not suggesting that a static knowledge content is ideal; however, in defense of this, one argument could be that the principles of heat and mass transfer are fairly well established and relevant for a long period of time.) The author and many of the author's colleagues' lectures are based on PowerPoint presentations in lecture halls, with the lecturer talking to the slides. And writing on a board is unlikely to disappear from an engineering lecture soon either [3]. The author suggests that the talking and additional writing can be included in a standard PowerPoint presentation, eliminating the need to learn new software tools as in [5]. The video of this PowerPoint presentation can be posted online, and the hypothesis of this work is that this simulates an on-campus lecture more closely than the online teaching of [4]. This is then compared to an on-campus lecture by interrogating student satisfaction and learning effectiveness, two of the quality pillars as discussed in the literature [3].

Some lecturers, including the author, are not keen to have their voice and/or persona recorded on a typical video of a lecture as in [6]. In addition, if it is required to modify what was said at a later stage, the author feels it would be inconvenient to set up the equipment, record the modified speech, cut the old audio out of the video and splice in the new. The voice may have changed, or not be available, and the whole lecture may have to be recorded again. Hence the author thought of the idea of rather using a text to speech application (TTSAPP) to produce audio, as has been done before [7]. If audio needs to change, the text can be modified and run through the app again to produce new audio. This will prove to be useful changes to the lecture are proposed over the years.

Recent development has made it possible to save a PowerPoint presentation as a video file. PowerPoint also has an animation facility, which amongst other capabilities can be used to simulate the movement of a laser pointer as the lecturer would use it during a lecture. It can also be used to show an explanatory note on the slide, and then remove it again if required. In addition, audio files can also be included in the animation sequence. It was found that the free software, Microsoft SAP15 TTSAP, was improved with the additions of the more natural sounding voices of David and Zira for Windows 10. The importance of good voices will be revealed in this work. The author feels that the available voices' quality will be improved further in future, adding to the attractiveness of using the technology.

It is the author's contention that, as PowerPoint is universally used in tertiary education, and using the animation and TTSAPP is not beyond most academics' grasp, it is possible for most lecturers to set up their own online lectures without additional cost (except for their time). In order to get an indication if it would be possible to replace traditional lectures in this way, an online lecture was set up and presented in a computer lab in this work. Students were asked for their feedback, and their performance in an assessment was evaluated, to determine whether the simulation was indeed equivalent to the original lecture.

2 Method

2.1 About the Students

59 students were registered for the Heat and Mass Transfer course. The author estimates that more than 90% of the students do not have English as a home language, although most have been in contact with English as a second language at school. Of the registered students, 45 attended the online lecture in the computer lab. The participation in the survey following the lecture was voluntary, and not all students partook. None of the students that had missed the lecture participated in the feedback.

2.2 About the Lecture

The lecture is the fifth one of six offered to the students for the Heat and Mass Transfer course. By the time the fifth lecture was reached, the students already had dealt with the basics of heat transfer, and had gone into detail in the conduction mode of heat transfer as well as internal and external convection.

The first half of the fifth lecture concerned heat transfer during the boiling of liquids. This included the boiling curve and the use of heat transfer correlations for the various boiling regimes.

The second half dealt with heat transfer during condensation. This focused on film condensation and various heat transfer correlations based on Nusselt's analysis.

2.3 Producing the Online Video

The PowerPoint file, used to lecture for the last 14 years by the author as lecturer, was used as the starting point. For a given slide, the author visualized what he would normally do (actions) and say (spoken words) during a lecture.

The normal actions could include moving a laser pointer to a certain position of the slide. In such cases, additional animation was added, in the form of an arrow which moved over the slide, for example. Normal action could also include the appearance of explanatory text or objects on the slide, in which case the animation probably already was present. The additional animation would then have to be timed as required and inserted in the sequence of existing animation.

The spoken words were typed into the notes section underneath the slides. The words for each concept explained were typically listed in separate paragraphs, each of which were allocated an identifying number. Each paragraph was then separately entered in the Microsoft SAP15 TTSAPP. The speak button was pressed to listen to the audio. Words were changed if required, with the speak button being pressed again to listen to the effect of this. Several iterations were often required, which resulted in clear, succinct audio. Once the author was satisfied with the spoken words, these were saved to a correspondingly numbered wav file. The wav audio files were then inserted as media onto the PowerPoint slide. The loudspeaker icon of a given audio file was then moved to the appropriate position on the slide close to the area on the slide relevant

to the concept explained. Microsoft Zira, a lady's voice, was used for the boiling section of the lecture, while Microsoft David, a gentleman's voice, was used for the condensation section.

The iterative process described in the paragraph above meant that more preparation went into the delivery of the lecture, and the author wishes to believe that this increases the likelihood of learning by the students. Another effect was the reduction of time as compared to a normal lecture, with the two-hour lecture being reduced to half an hour of online lecture. The author imagines that the spoken part of a normally presented lecture is much less compact and to the point than that in the online lecture of this work.

If a student is has just opened a PowerPoint presentation at a given slide, the loudspeaker audio icon can be clicked to hear the audio applicable to the concept represented in that area of the slide. This can be used if the student is interested in hearing the audio for a specific concept without having to run the whole video or without playing the whole slide from the beginning.

Having the spoken words typed in the notes section of the PowerPoint slides has the beneficial effect of providing a record which can be modified in future if the need arises. In addition, students also have access to the PowerPoint slides, and therefore can read the words if they have problems in understanding the spoken words, or if they just want to learn by reading instead of listening, or if they happen not to have sound on the device used to access the PowerPoint files or videos. One French-speaking post-graduate student told the author it would have helped him a lot to see the words as he struggled to understand English during lectures back when he was busy with his undergraduate studies.

After including all the additional animation and all the audio into the PowerPoint file, it was saved as a normal PowerPoint file and as a video file. The video may be viewed on You Tube [8].

2.4 Presenting the Online Lecture and Collecting Data on Student Perceptions and Performance

The students were notified that the lecture would be presented in a computer lab, and 45 of the 59 students turned up for the lecture (representing about the average attendance of designated lecture periods). They were asked to bring their earphones. Some students were sharing earphones. Two peer tutors were in attendance. After half an hour, the requests for feedback were displayed to students as shown below.

First feedback question. The students were asked to rate the video lecture relative to a normal lecture as follows:

"Please score the lecture relative to one of my other lectures;

"10" means that the online lecture, as it happened in the lab with the tutor, and as it will remain available, is as good (or as bad) as one of my normal lectures with only the normal power point slides being available.

i.e. no better and no worse than a normal lecture.

"0" means it had no value to you.

"20" means it is twice as good as a normal lecture.

Note that consultation, tutorials, tests, formative and corrective assessments would remain as they are.

Choose one of the following numbers that best reflects your judgement:" The students could then select one of 0, 1, 2, etcetera, up to 20.

Second feedback question. The students were also asked to share more thoughts as follows:

"Any other thoughts you would like to share?"

Test 3. Following the online lecture (number 5), another traditional lecture (number 6) was presented to the students regarding radiation and heat/mass transfer analogy. An online test was then written by the students. In the test, a question on boiling regimes from a previous year was repeated, to see if the online lecture had an effect on the transfer of knowledge to the students. In the online video, and arrow was used to indicate the position of the boiling regime, and audio named and described the regime. In addition, a question was asked which the students would have been able to answer had they listened carefully to another audio clip included in the online lecture.

3 Results and Discussion

3.1 Student Rating of Online Lecture

Another lecture (lecture number 6) followed the online lecture, and a test was written based on these two lectures (Test 3 on lectures 5 and 6). The score as a percentage obtained by the students was plotted against the rating of the online lecture between 0 and 20 (10 being just as good/bad as a normal lecture). The results are shown in Fig. 1.

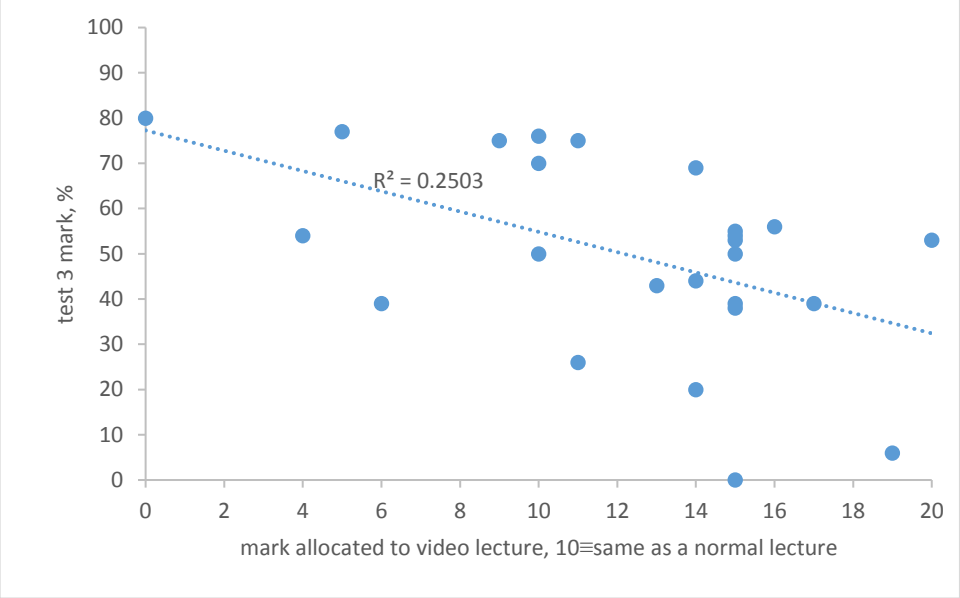

Fig. 1. Mark obtained in test following online lecture (plus another normal lecture) as a function of student allocated mark to online video.

Firstly, it can be seen that 80% of the students rated the online lecture as good as or better than a normal lecture (20 of the 25 data points are on or to the right of 10 on the x-axis). This is in accordance with another study that found that nearly all students found (shorter) online lectures "entertaining enough" or "very entertaining" [9]. A linear trendline was fitted to the data, and although there is a lot of scatter (R2 is 0.25, whereas 1 indicates a perfect fit), it can be seen that students that struggled in the test were more likely to have given a higher score to the online lecture. This seems to indicate that students that struggle academically see more value in online lectures.

3.2 Student Performance for a Repeated Question

In the third test, a question was posed as follows: "Consider the boiling curve for water and identify the boiling regimes". Online Blackboard software was used to set up this test (see Fig. 2).

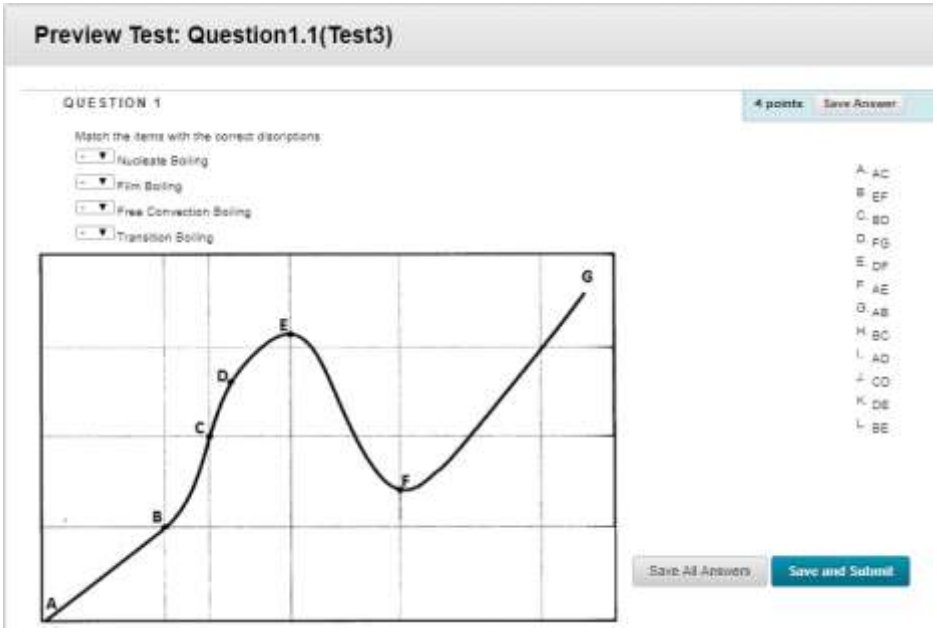

Fig. 2. Question in Test 3 regarding boiling regimes.

This question was also asked a couple of years back, with an average mark of 3.7 being obtained out of 4, and last year, with an average mark of 3.71. The online lecture was also used last year, but with Microsoft Anna as the female voice. (Old question papers with model answers are available to students. However, the model answer to this question only listed the boiling regimes, not disclosing the actual question setup on Blackboard). In the test following the current online lecture, a very similar average mark of 3.75 was obtained by the students. This seems to be an indication that having a lecture online has no measurable effect on the learning of students, a result which has been found to be the case generally for online education [3], [10]. This result could possibly have been expected in this work as it was strived to emulate an on-campus lecture.

3.3 Student Performance for a Question based on an Audio File

In the third test, another question was posed as follows: "Type about two sentences to describe the average heat transfer coefficient due to radiation on Blackboard". The audio file was obtained using the following text and the TTSAPP:

"WARC513b You will need to calculate the average radiation heat traaansfer coefficient, h, bar, rad. Note that, if the formula for heat traaansfer coefficient due to radiation is plugged into Newton's law of cooling, it becomes the Stephen Boltzmann law."

WARC513b is the identifying number of the audio file. The triple a spelling in "traaansfer" results in the word "transfer" sounding more South African.

The formula which was displayed on Blackboard was:

$$\overline{h}_{rad} = \frac{\varepsilon\sigma\left(T_S^4 - T_{sat}^4\right)}{T_S - T_{sat}} \tag{1}$$

13% of the students recalled that the Stephen Boltzmann's law would result. It is presumed that most would have recalled this had they listened to and understood the audio, or if they read it in the notes section of the slide and understood in that say. This 13% cannot be compared to anything, but it does not seem to be an unreasonably low percentage of students remembering a relatively obscure fact.

3.4 Thoughts of the Students Regarding the Online Lecture

21 students chose to give this feedback. Some feedback was that the online lecture was good, with many finding the rewinding aspect appealing and applauding the clarity of the slides:

"if we can have more of such lectures since one is able to pause and play back for better understanding."

"I thought the online lecture highlighted important points very well"

The fact that students appreciated the rewinding aspect of online lectures was also found in the literature [9]. The author is pleased that many students found that the slides were clear; this is not surprising as an iterative process was followed to get the audio sentences as clear and succinct as possible.

One comment was that online lectures would be useful if a lecture could not be attended and the student was absent due to unforeseen circumstances. Five students just expressed a positive response to the lecture, but did not specify why, for example:

"we should have these kind(s) of sessions often."

Sometimes students expressed more than one opinion, which could be positive and negative:

"Overall the video is good but I didn't find the background voice interesting."

In fact, many students complained about the mechanical quality of the voice, and hopefully newer versions will be developed in the future by Microsoft. Two comments were about the effort required (concentration and time rewinding for note-taking). The author was in two minds whether the increased effort was a bad or a good thing! One student made a valid point that the lecturer was not there to answer questions. However, this function could have been performed by the attending peer tutors. Alternatively, there is e-mail or consulting hours.

7 comments were received that students would have liked to see examples of calculations. This is a valid issue; however, the examples were not present in the traditional lecture either and so this was not presumed to reflect negatively on the online lecture. In future, it may make sense to break the lecture up into smaller sections, and have the students do problems in between, perhaps after dealing with an example. One student also suggested that both traditional and online lectures could be presented. The summary of student comments is given in Fig. 3, where it can be seen that about 2/3 of the comments were positive.

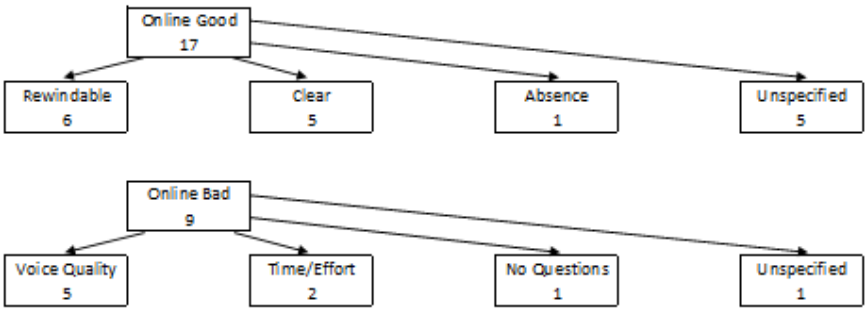

Fig. 3. Student Feedback for Online Lecture.

4 Conclusions

It has been demonstrated that online videos can be set up using PowerPoint and a TTSAPP. Keeping a record of the text in the notes section of the PowerPoint slides, facilitates the making of changes to the text, so that the audio can be redone using the TTSAPP. This avoids having to record a whole lecture again as could well be the case for a simple recording of a lecturer's voice. These notes can also be read by students to aid the learning process. Students can click on the loudspeaker icons to play the audio for a concept in that area of a slide.

Overall, students were positive about the prospect of having online lectures for the subject on offer. 80% of participating students rated the online lecture as good as or better than a traditional lecture, and 2/3 of the comments collected were positive. The rewindability and clarity of the online lecture featured high on the list, but it remains crucial to improve the voice quality of the TTSAPP. There is an indication that struggling students may benefit more from an online lecture due to the support this provides them. There is an initial indication that the learning of students for the subject is not negatively affected by presenting it online; however more extensive testing, perhaps by putting all the lectures of a subject online, will be required to allow assessment of the whole subject and comparison with previous years.

Perhaps after that could one start thinking of rolling out of the online lectures across the country. This could also open the window for collaboration on the content of the lectures while lowering of cost for higher quality online offerings, as suggested in the literature [3], and also the reduction of individual academics' lecturing workload.

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