Designing video teaching for postgraduate engineering education

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ABSTRACT: Video teaching plays an important role in engineering education, and the design of teaching by video is significant to the process of educating postgraduate students. The aim of this article is to explore the existing forms of video teaching and their applications to postgraduate engineering education. Described first in this article are the requirements of postgraduate engineering education, and the reasons why video teaching should be applied to the courses. Then, the forms of video teaching are outlined. Here, the authors argue there are three forms of video teaching that can be designed for postgraduate students of engineering education; these forms include video cases (studies), video examples of subject detail and video interpretation. The features and application conditions of each form are explored, as well as how the three forms are applied. The intention of this article is to throw some light on the applications of video teaching to postgraduate engineering education.

INTRODUCTION

Postgraduate engineering education involves studying for engineering degrees or other qualifications, for which a Bachelor's degree is generally a prerequisite, and is normally considered to be part of tertiary or higher education [1]. Video teaching is widely applied to postgraduate engineering education, since videos can effectively communicate complex information to students and, if used creatively, can become a powerful expressive tool. In postgraduate engineering education, using audio-visual materials, such as videos, has become an important means of improving teaching quality. The design of video teaching plays a vital role in developing material for teaching engineering courses, and is, therefore, worthy of great attention.

Many scholars emphasise the importance of video teaching in postgraduate engineering education, e.g. Kong et al find that video is widely used in teaching and it is hoped will result in greater equality of opportunity for the students to learn about information search methods and electronic resources [2].

Subbarao studied the opportunities and difficult choices of India's higher engineering education and finds that the Indian National Knowledge Network (NKN) and YouTube can revolutionise the spread of quality education and improve the pedagogy of engineering education [3]. Balslev et al compare text and video cases in a potential postgraduate problem-based learning environment and find that video is more effective than text in assisting the transmission and retention of information [4]. As well, Chu finds interactive multimedia teaching can provide a multisensory learning environment, promote a more active form of learning, offer more individualised and independent learning, and provide simulations of complex scientific social processes that are impossible to demonstrate in classroom situations [5]. However, designing video teaching for postgraduate engineering education is seldom attempted. This article aims to contribute to rectifying this situation.

The rest of this article is organised into the following sections: the applicability of video teaching to postgraduate engineering education, the design of three forms of video teaching for postgraduate engineering education, applications of video teaching and conclusions.

APPLICABILITY OF VIDEO TEACHING TO POSTGRADUATE ENGINEERING EDUCATION

Requirements of Postgraduate Engineering Education

Graduate engineering education aims to develop specialist innovative and research knowledge relevant to real-life problem-solving, and to develop strong interactions with industry. Learning interests originate from two sources: active learning interests and passive learning interests. Active learning interest results from exploring the novelty and

uniqueness of things. Passive learning interest results from the demands for solving problems. The major difference between them is that the former is spontaneous, while the latter is caused by the pressure of the external environment.

Engineering postgraduates obviously experience both kinds of learning. However, passive learning appears more common, which is mainly reflected by the fact that many engineering postgraduates are actually not so much interested in their major, but rather to get their Master's degree and, hence, a good job. Therefore, postgraduate engineering education, which aims to strengthen basic knowledge and guide students to explore academic frontiers must engage the learning interests of postgraduates, which relates to many factors including the classroom atmosphere, course content and the teaching skills [6].

Postgraduate courses, compared with the undergraduate courses, are advanced, investigative and dynamic. Postgraduate learning should transition from *reciting* and *understanding* in undergraduate learning to *investigative* learning. However, investigative learning requires an active rather than passive classroom atmosphere, as well as stimulating teaching; hence, requiring appropriate teaching methods be designed and developed. Postgraduate students' psychological characteristics should also be considered when choosing teaching methods. Postgraduates pursue excellence, which calls for teaching methods to guide this pursuit by cultivating analysis and independent problem-solving [6].

Advantages of Video Teaching in Postgraduate Engineering Education

Video teaching has advantages, which traditional teaching methods do not have, e.g. video can provide novel perspectives and is very expressive, with rich informational content [7]. Videos can set the mood of a course, and deeply impress students. For example, since most students are interested in cars, the video of a new car design and production inspires their enthusiasm for learning the theory of the design and manufacturing of automobiles. Therefore, in postgraduate education, video can be used to develop more interactive teaching.

Video captures the motion of objects in time and space that reflect the dynamics of concrete images. Video teaching can transform the inflexible planar texts into lifelike, colourful images, and transform the static into the dynamic, the difficult into the easy, and the abstract into the concrete. Video teaching can illustrate scientific laws in engineering and can guide students to appreciating the beauty of science, which will inspire their desire to pursue and explore scientific truths.

Video is a good medium at exhibiting unusual details of unfamiliar things, especially content that is difficult to express through words. In addition, video content of teaching material enables students to analyse, understand and learn. For example, videos of classical courses have images of the actual objects, increasing the sense of reality, which further promotes learning.

In conclusion, video teaching not only can be used to relay teaching content, but also can change traditional teaching and learning methods by creating a vivid learning atmosphere, which mobilises students' learning interests. Video teaching, therefore, opens up a whole range of new learning possibilities to suit a range of different learning styles. Thus, video teaching can be an important means of improving the teaching of postgraduate students.

FORMS OF VIDEO TEACHING FOR POSTGRADUATE ENGINEERING EDUCATION

Video teaching for postgraduate engineering education can be categorised as: video case studies, video examples and video interpretation.

Video Case Studies

A video case displays the case study in a landscape that includes actors. It can capture teaching behaviours, providing an observation platform and transforming learning to improve students' study.

A video case is the combination of case teaching and multimedia teaching. Teachers use multimedia courseware to present material. Teachers provide guidance to students on discussion of the material in an interactive learning environment, which differs from the situation in which students are passive. According to behaviourism and constructivism, knowledge derives not only from outside stimulation, but also from the interaction between the internal psychological state and external stimulation [8].

The discussion of video cases can make knowledge durable; and the active participation improves learning. Through the thinking collision, as well as the interactive discussion between teachers and students, students gradually can clear their minds of solving-problems and acquire correct answers to achieve benefits, both in theory and in practice.

Video cases should not be simply transformed from written materials. Because the emphasis of postgraduate engineering education is on helping postgraduate students to cultivate their learning capabilities, video cases should not only guide students on analysing and solving problems, but also help them to develop the ability of discovering

problems where they lie. Thus, a video case should generally include two parts: the main body of the case and the relevant materials. The main body of the case is the basic information, which includes the subjects, processes and results; the relevant materials include the background and the contrast information, as well as other, related cases or theories, methods and research (see Figure 1).

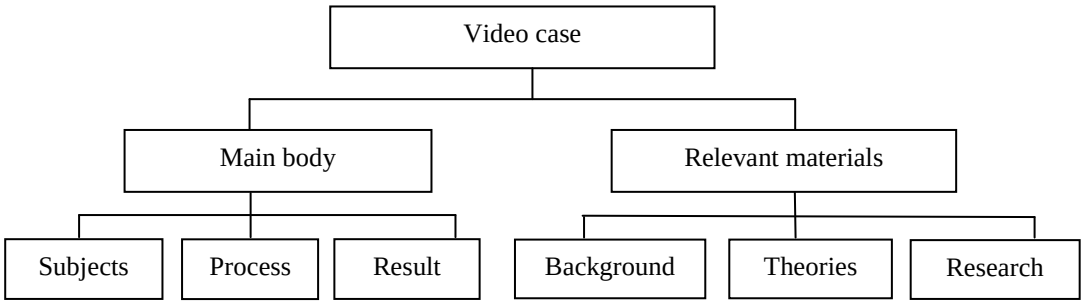

Figure 1: The structure of a video case.

In applying video cases, teachers firstly should let students extract the essence of the cases, which is the key to cultivating their capacity for identifying any problems. The relevant materials can provide students with extensive knowledge, which means they are effective as content for developing students' minds.

The choice of appropriate video cases is an important step when applying such means in teaching. The sources of video cases are rich and diverse. These can be segments of films and TV programmes or even specially produced videos. However, a specially produced video for a particular course may not prove to be very popular; it appears that a useful and important choice can be had in selecting cases from movies and television programmes. This requires, then, that teachers must be good at discovering content in videos that are related to the relevant courses and that can stretch students' minds.

Video Examples

A video example is the example of choice in material, which aims to increase students' comprehension through videos or images with audio tracks. Its major functions have two aspects. One is to make knowledge easier for students to understand and accept, and the other is to liven up the atmosphere in the classroom. In the teaching process, giving examples is the most often-used teaching method. However, traditional example illustration, often given through oral means or by chalk and blackboard, is a single media activity. The video example provides multimedia forms that integrate sounds, pictures and sample story to vividly illustrate content to students. This makes knowledge easier to be accepted and mastered.

Moreover, a video sample can be wonderfully expressive and, when combined with an agreeable sound track, can fully mobilise students' senses of vision, hearing and touch. It also has the power to boost students' engrossment in the teaching process, as well as to help them develop better concentration. This clearly is beneficial in stimulating students' interests in study and learning.

However, there is a point reached where the video example cannot be applied too liberally or it may lose its effectiveness. More importantly, teachers should be specific in their choice of material for the video example: the best pictures and vivid content are those that best exemplify the course material. If teachers choose a simple video lacking representability, students' restlessness may lead to boredom, resulting in the exactly opposite effect of the teacher's intention. When using video examples, timing must be taken into account.

When the content itself is attractive and easily understood, there is no need to use a video to illustrate it; making video examples can be a costly exercise. Only when the content is technically difficult to understand and monotonous should a video example be considered as a way to strengthen students' understanding and to maintain their attention.

Video Interpretation

Video interpretation mainly refers to teaching course content through the use of existing teaching videos, such as videos of nationally excellent courses, say, or videos made especially for certain courses. The principle behind teachers choosing a particular type of video interpretation is that this element of choice can make the way students acquire new knowledge that much easier for them.

The advantage that teachers have when communicating with students in class is that it is interactive and didactic (instructional), but lacks other types of vivid presentation. Video interpretation, for example, has the advantage, whereby media technologies can show the combination of text, sounds, pictures and images, and this is beneficial for postgraduate students in acquiring knowledge quickly, while improving their ability to solve problems.

Two well-known psychological experiments made by Treicher have confirmed that humans mostly obtain information from vision (see Figure 2) [9]. The media technologies used in video teaching clearly make use of visibility, as well as audibility. Thus, information obtained from various sensory stimulation must be more than that only obtained from listening.

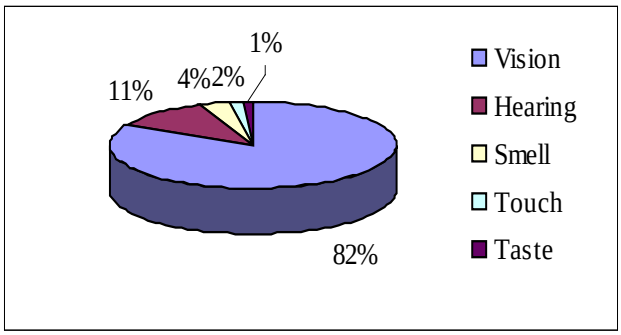

Figure 2: Sources for obtaining information.

As well, Treicher confirmed that people generally can remember more of what they say than what they read, hear or see (see Table 1) [9]. Video interpretation can be heard and seen and, then, expressed through discussion and communication, which is much better than traditional teaching for knowledge acquisition and maintenance.

Table 1: Percent of remembered content through various means.

Ways of obtaining information	Read	Hear	See	Hear and see	Say
Percent of the remembered (%)	10.0%	20.0%	30%	50%	70%

Effort must be made to match text, pictures and sounds in video materials to the course content. Ensure that the video interpretation does not take too long a time to deliver. On the one hand, from a psychological perspective, a single type of teaching method loses its attraction after a certain period of time.

Thus, video teaching should be interspersed with explanations from the teacher. On the other hand, video interpretation is vivid, but it lacks interaction with students in real time, and this may make students adopt a passive position. To solve this problem, teachers should allow students enough time for discussions in, or after, the screening of the video interpretation.

APPLICATION EFFECTS OF VIDEO TEACHING IN POSTGRADUATE ENGINEERING EDUCATION

The three forms of video teaching or applications, are applied during engineering courses. The effects of these in postgraduate engineering education are described below.

Applying a Video Case

In teaching the course, Operation of High-tech Enterprise, the authors chose a television programme called *The Big Development in A Small Country* to explain the importance of technology. The programme describes the development of Holland, from which students can explore the seven key technologies that played important roles in its dominance in the world at that time. Moreover, through the exploration, students can understand that technologies have many forms in the scientific sense, which include not only the *hard* aspect, but the *soft* aspect, too.

The authors have used this video case for three years and find it is effective in guiding students to think about the functions of technology, and to comprehend deeply what technology is, and technological innovation. In the examination, the authors found that when students answered questions on problems related to technology innovation, those who had received this type of video case teaching method gave answers with wider and deeper information. What is more, scores the students obtained were increased on average by 30%, compared with those who did not receive video case teaching.

Applying a Video Example

In order to explain aerospace technology strategy, the authors chose three ways of doing so: 1) listing significant events and explaining by oral description; 2) demonstrating related pictures in Flash, with textual description; and 3) using the related segments of space history videos. It was found that students have quite different reactions to the three ways (see Table 2). From Table 2, it can be seen that the video example has the best effect, but compared with oral explanation and Flash, it costs more time to prepare.

Table 2: Effects from three ways of teaching.

Classes	Ways	Effects
Class 1	Oral explanation	Students showed little interest. The content seemed boring to students due to having to cover a large number of years and the professional terms used. Materials aimed at strengthening understanding did not take effect.
Class 2	Flash with textual description	Students found it easy to concentrate their attention on the material. The unfamiliar technological knowledge was understood through the use of pictures.
Class 3	Video example	Students were absorbed by the three minutes' video about the rocket launch, missile flight, atomic explosion and satellite operation in space. After watching the video, students held a discussion of more than 10 minutes and acquired clear cognition of the development of the space technology. This made the explanation of the technological strategy flow smoothly.

Video Interpretation

The authors tried video interpretation in teaching engineering innovation, some parts of which the students found were strongly technical and lacked vividness. Hence, the authors chose a number of videos from the MBA programmes at a European Business School to teach these parts in class. The videos give lots of examples, accompanied by striking music and witty animation besides text. Students were able to learn the concepts of innovation, motivation and the steps of innovative management, in a relaxed atmosphere. The authors believe the trial was quite successful, which shows that, compared to unattractive content, video interpretation rates was better than traditional teaching.

CONCLUSIONS

In this article, the authors discuss the applicability of video teaching in postgraduate engineering education based on the requirements of postgraduate engineering education. They also have designed three forms of video teaching for postgraduate engineering education; these are video case, video example and video interpretation. Then, they applied the three forms within their teaching of engineering courses, and the results show that video case, video example and video interpretation are all more effective than is traditional teaching.

The authors also argue that a video case is more applicable to cultivating students' capacity to explore solutions; a video example can be used to enrich the teaching methods and liven up the atmosphere; and that video interpretation is a good way of providing explanation for difficult or technical content. In conclusion, it was found that effective design and application of video teaching can appeal to postgraduate students' psychology and inspire postgraduate students' learning interests, as well as improve the quality of postgraduate engineering education. Video teaching can meet the requirements of postgraduate engineering education very well. However, video teaching may need to be used in moderation due to its relatively high cost.

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