Work in Progress: Model Design to Measure the Efficacy of Students Learning Preferences—Does Media Matter?

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Abstract

With the advance of online Learning Management Systems (LMS) it is easier than ever to provide students content providing multiple types of media. Many contend that this generation of students prefers video to text. This paper proposes a study that will examine if first year engineering students learn more about given case studies using the recommended textbook or the video prepared by the text publisher. Students are required to learn about the wonders of the industrial world in their first year engineering course. Students are tasked to learn about the wonders from the recommended text. Sometimes students choose to use to learn about the wonders from the video that is being available from the publisher of the book. In this study, it is planned to assess how much the students learn depending on their choice of media as well as study style and time on task. The students' performance in the reflective assessment item will be combined with the survey results to determine if there are any significant effects on student learning. The results of this study are not yet known. It could be that students learn better with the video vs. the text or vice-versa. It may be that the most influential aspect is how long the student spent studying or if the student reviewed notes before taking the assessment. Regardless of the specific outcome of the results, the overall conclusions will be useful in helping future first year engineering course students be successful in this particular assignment and in the course over all. This Work In Progress paper is presented with the intention of receiving feedback on the study and survey design.

Keywords

Using video in engineering education • Video aided learning • Text aided learning

Introduction

Many contend that the current generation of University students has a new set of preferred ways of learning, that the generation of Millennials prefers to learn with technology [1, 2]. However, we do not yet have a good understanding if introductory engineering students share the same preferences and beliefs about learning with technology. In addition, we do not yet have a good understanding if students are able to effectively use technology to meet stated learning outcomes. In the specific exercise, students will be given cases to study from engineering achievements that ensued during the Industrial Revolution. The cases are available

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both in text and video format. Students have the freedom to select the preferred format to study the cases.

It is understood that if the students learn the case studies well, they should be able to exhibit their learning about engineering and the profession in general and be able to:

- Demonstrate evidence of developing professional capacity to communicate, work, and learn.
- Articulate an appreciation of the complex nature of engineering activities including ill-defined situations and problems involving uncertainty, imprecise information, and conflicting technical and non-technical factors.
- Describe, apply and justify risk assessment and workplace health and safety in engineering activities.
- Discuss the socio-technical role of the professional engineer.
- Articulate an appreciation of the uncertain nature of engineering design [3].

This paper presents the design of an engineering education experiment that will explore the beliefs, preferences, actions and efficacy of those actions, when introduction to engineering students have a choice of technology to use to reach stated learning outcomes.

Background

Learning Preferences

Researchers have attempted to characterize engineering students' learning preferences. Carver [4] attempted to enhancing student learning for different learning styles through hypermedia courseware. The author tried two approaches; students were provided a number of tools to prepare for lessons in one approach. The author found that the value of a particular multimedia tool to a student varied widely based on an assessment of the multimedia and hypertext documents. An adaptive hypermedia interface was suggested which, in authors view, is the most effective for students learning.

Mohler [5] reported that educators are examining different ways to implement publisher generated materials or custom, self-developed digital utilities into their curriculum and suggested educators to continue to integrate digital tools into their classrooms which provide active learning opportunities to the students. The author also suggested educators to undertake research to determine the effective level of interactive multimedia for students to understand the engineering concepts and identify the technologies that may have most successful impact on student learning.

Ambikairaja et al. [6] conducted a survey over a three year period to better understand the learning approaches and behaviours of year 3, 4 and 5 engineering students. They found that students over the 3 years were less interested in attending lecture 100 % of the time (48–30 %) while they became more interested in attending tutorial sessions 75 % or greater (75–85 %). They also observed students preferences were moving toward more learning via self-study (30–48 %). A small proportion used the textbook as a study aid (10 %). Most students relied on past exams (35 %), lecture notes (30 %) and worked examples (25 %).

Beliefs

An interesting finding from Ambikairaja et al. [6] was that, in the first year of the survey, 70 % students believed they learn the more from lectures than working by themselves, but this value fell to 53 % by the third year of the survey. Student critiques of lectures included: hard to understand, difficult teaching techniques, or boring presentations. The students tended to spend less than the recommended 20 h a week on study outside of class, with 30 % of the students stating they study less than 5 h a week. The authors noted a correlation between non-attendance and students with part-time work.

Learning Preference and Efficacy

Belski [7] provided third year electronic engineering students a choice between static (text and pictures) and dynamic recordings (video and audio) of problem solutions. Students statistically significantly preferred the dynamic worked examples over the static examples and they also performed statistically significantly better on the final exam. Only three of the 30 students preferred the static questions. Wandel [8, 9] also found that students preferred dynamic worked examples. These examples of using videos to present solved problems demonstrated the concept of reducing cognitive load by having students review solved problems first before trying to solve problems on their own [10].

Calm et al. [11] reported the effectiveness of video in online maths courses where they provided video tutorials along with other educational resources. The results were presented in terms of student satisfaction and their academic outcome. The authors reported that students satisfaction in the course increased by 20 % in the first semester of 2011–2012 when they introduced videos resources compared to 2010–2011 when the same resources were not available to the students. Moreover, the authors reported sustained upward trend of the percentage of the students finally passed the course.

How Students Use Technology

Jonassen and Reeves [12] and Burns and Ungerleider [13] reported that the effects of technologies on learning are variable and inconclusive.

Taylor [14] performed an experimental study on the use of captioned video with the beginning students of Spanish and reported that the first year students found the captioned distracting and had difficulties to attend the information with captioned video compared to non-captioned video. However, 3rd and 4th year students scored better than the first year students in the captioned video.

Lowerison et al. [15] suggested that there is need to perform controlled studies of technology integration and the methods of technology integration to realise its impact on students perceptions of learning.

In Belski's [7] work, with third year electronic engineering students Belski found students used the dynamic solutions right before summative assessment opportunities.

Purpose of the Study

With the advance of online Learning Management Systems (LMS), it is easier than ever to provide students content using multiple types of media. Currently, CQUniversity engineering programs use a mix of video and text based learning material. Types of learning material used in a typical ABC University engineering course include:

- Study Notes, lecture slides (text).
- Full 1–2 h lectures (video).
- Short videos addressing a specific course content (video).
- Step by step problem solving (videos and text).
- Textbook (hard copy).
- Additional online material (text/video).

With the availability of wide variety of material, students may feel overwhelmed by the amount of information they have to go through during a course. Also the educators need to spend a considerable time preparing different types of material using different technologies for the course. Furthermore, some content may be made redundant by other content. For example it may not be necessary to view the tutorial answers after watching problem solving videos. Hence it is important to understand what learning material best serves the student's learning requirements.

We intend to address four major research questions in this study.

1. Preference: In what format do first year engineering students prefer their learning content (text or video or a combination)?
   (a) If a student prefers video, what type of video does the student prefer (short, long, problem solving)?
2. Beliefs: Do first year engineering students believe they learn better with video or text?
3. Learning Preference and Efficacy: Do first year students actually learn better with video or text? Is there a certain type of video they prefer (e.g. long, short, problem solving)? Is their preference statistically correlated with their performance? Do students learn better when they spend more time on task—regardless of media choice? Do students learn better when they take notes or when they review their notes?
4. How Do Students Use Technology Do students use more video than text (as measured in number of downloads)? How do students use videos—do they review them before an assessment or do they rewind and watch particular parts?

Answers to these questions will allow the academics to more effectively and efficiently prepare course material. Furthermore the teaching staff would be able to provide student guidelines as to how to best use different course material (e.g. "Students in the past have learned the most when they watch the video first, take notes, and then attempt a set of questions).

Study Method

The data collection for the study will occur in two subsequent offerings of the Engineering Skills course, a common first year course for all CQUniversity engineering students. In the course, students are required to study case studies on the seven wonders of the industrial world. Both video and text material are available that provide the necessary learning content.

Engineering Skills is part of CQUniversity [3] two unique degree pathways in engineering – one with a Co-op experience (the dual award program Bachelor of Engineering (Co-operative Education)/Diploma of Professional Practice (Engineering) [16] and one with Distance Education option, but no Co-op option (Bachelor of Engineering). Both of the degree options integrate Project Based Learning (PBL) in all years of the degree program [17]. Approximately 32 % of the CQUniversity enrolled engineering students take their courses as part of the distance education program.

The engineering skills course, which is offered in the first year of the CQUniversity engineering degree program, has been developed to satisfy the pedagogical requirements of the Engineers Australia and the University's graduate attributes. The course requires students to develop and/or enhance technical and professional knowledge, skills and attributes required for team work, self and team management along with other core learning outcome of the courses. The course offers a number of learning approaches including text

and video based courseware, face to face lecture and/or via multimedia streaming technologies, tele-tutorials, online video conferencing, residential school etc. Students are to participate in a number of learning activities and reflections including reflective journals, team based and individual activities, case studies, laboratory experiments, instructional design, and hands on activities [18]. The courses are offered across four regional campuses and by distance mode with academic support in each of the campuses to ensure equitable learning opportunities for students.

In the proposed experiment, students will be able to choose their preferred mode to learn about the six case studies. Students will either use the video prepared by the publisher, or the recommended textbook or both. About 210 students take this course each year across the 4 campuses and in the distance mode. Hence over 400 students are expected to participate in the study over the 2 years.

Before students are given the case study assignment, students will be given a survey that will query them about their learning preferences. Table 1 provides a sample of the types of questions that will be part of the preference instrument.

Students will then be given one of the case study assignments where they can choose to use the course text, the video provided with the course text or both to learn the required content. Students also have the freedom to source additional resources if they prefer to do so.

The students will then be assessed on how much they learned. In the specific exercise, students will be given a case to study from engineering achievements that ensued during the Industrial Revolution. Students are required to prepare a reflective paper highlighting their capacity and propensity for teamwork, individual work, communication, use of information well (research, investigate etc.), socio-technical role of engineers, account for the uncertain nature of design, use of engineering language effectively etc. Students will also conduct a self-assessment on their learning from the learning resource. Students will also be given a post-survey where they will report on how they used the video or text and increase/decrease self-reported performance and overall performance. Table 2 and 3 below provides an outline of the proposed survey instrument.

Lastly, students usage data will be collected from the learning management system. Student uses of video and text content will be measured against their preferences and intentions.

Data Analysis

1. Preferences
   The data from the pre-assignment survey will be summarized to determine student preferences. These data will be separated into categories of face to face students, regional campus students and distance students.
2. Beliefs
   The data from the pre-assignment survey will be summarized to determine student beliefs about their ability to learn with different types of media. In addition, statistical analyses will be completed to determine if there is any correlation between the student beliefs about their ability to learn with different media types and the student's score on the assessment item.
3. Learning Preference and Efficacy
   Statistical analyses will be completed to determine if there is any correlation between the student preference for video or text and the students score on the assessment item.
4. How Students Use Technology
   The data from the post-assignment survey will be summarized to determine student reported use of technology. The data from the learning management system will be summarized and analyzed to determine if there are any reportable trends. Lastly, statistical analyses will be completed to determine if there is any correlation between the student self-reported use of the media and the measured student use of the media. Also, statistical analyses will be performed to determine if there is a correlation between student performance and measured use of the media on the learning management system.

Table 1 Anticipated number of students in each cohort

Campus	Number of expected participants
On-campus Rockhampton	80
On-campus Gladstone	25
On-campus Mackay	30
On-campus Bundaberg	25
Distance	50

Anticipated Outcomes

The results of this study are not yet known. It could be that students learn better with the video vs. the text or vice-versa. However, it may be that the most influential aspect is how long the student spent studying or if the student reviewed notes before taking the assessment. Regardless of the specific outcome of the results, the overall conclusions will be useful in helping future first year engineering course students be successful in this particular assignment and in the course over all. It will also assist to understand how the type of media selected by students assist them to shape perceived their ideas of engineering and arouse their desire to learn the basic skills required in athe professional life.

Table 2 Draft set of questions for pre-assignment preferences survey

• From the available resources (textbook or textbook provided video), which type of study resource do you prefer to use for this case study?
• Do you intend to use other type of resource later on? (for example extra web based resources, textbook if you decided to use video initially)
• What factors influenced your choice of resources? Check all that apply (estimated time to view/read the resource, personal preference, ease of sourcing the material, ease of use, content covered by the resource, efficacy of the resource)
• How confident are you (from 1 to 5 in Likert scale, where 1 is not confident at all and 5 for extremely confident) that your choice of resource is the best type of resource for your study?
• How confident are you (from 1 to 5 in Likert scale, where 1 is not confident at all and 5 for extremely confident) that you will not need any other type of resources to complete the study?

Table 3 Draft set of questions for study survey

• Which media did you choose for the reflective assessment? (video, text, both)
• What factors influenced your choice of resources? Check all that apply (estimated time to view/read the resource, personal preference, ease of sourcing the material, ease of use, content covered by the resource, efficacy of the resource)
• Did you read the text or watch the video more than once?
• Did you take notes while reading the text or watching the video?
• How long did you study for the reflective assessment?
• If you took notes, did you review your notes before the reflective assessment?
• How satisfied are you (from 1 to 5 in Likert scale, 1 for not satisfied at all and 5 for extremely satisfied) about your choice of resource?
• Would you select the same type of material for a similar assessment next time? Why?
• How confident are you that you (from 1 to 5 in Likert scale, 1 for not confident at all and 5 for extremely confident) have learned well from the selected type of learning resource?

Study Limitations

In this study, we will not focus heavily on broad learning patterns of students. Hence, it is not impossible that we may not see any particular correlation between the material used and the students' grades. In our study, we propose to let students choose their preferred media. If the results from this study are inconclusive, the authors plan to design a study where students will be randomly allocated a particular type of material and later surveyed and assessed in a similar manner.

Concluding Remarks

The results of this proposed study will provide information to help course designers provide the best type of media to support students to learn as effectively.

In addition, the results of this proposed study should provide information to help future first year engineering students make more informed choices on how to study more effectively. The study results will be useful in helping future first year engineering course students be successful in this particular assignment and in the course over all. The results of the study can be fed forward to students so they can learn the practices that made most students successful in the assignment.

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