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Building a Student-Generated Instructional Video Library for Thermodynamics

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Abstract

Current college students are accustomed to documenting and sharing their experiences through text, photo, and video, thanks to the ready availability of all of these through personal portable devices. The democratization of video production and access has led to the possibility to both teach and learn with video as never before. This work seeks to capitalize on student expectations and the current technological environment to bring the benefits of both teaching and learning with video into core technical undergraduate engineering courses. Specifically, in this work, we ask student teams to create short, targeted, easy to understand videos about concepts in thermodynamics, and then invite them to watch the faculty-vetted library of videos developed by their peers at their own and two collaborating institutions. We are studying changes in students' conceptual learning as a result of participation in this program, and are building a repository of accurate, engaging, videos for thermodynamics learning that will ultimately be shared with other instructors and the public.

Introduction

Technology has rapidly changed the landscape of how people communicate over the past two decades. The ubiquity of the smartphone, which provides users the ability to email, text, access the web, take pictures, and record video, has generated a relatively low barrier for the general public to participate and exchange content in these digital media. Current students, and the cohorts that follow, have immersed themselves using this technology, regularly generating their own material for peers or the general public. Educators have the challenge of finding ways to capitalize on this phenomenon to improve student learning.

The digital age has expanded the educator's toolkit beyond the chalkboard (Wheeler – 2001). However, in order for these technologies to be effective, they must be systematically implemented in a student-centric manner, and not be a mechanism of simply delivering content. In one example, students who generated and shared podcasts to the rest of the class showed an improvement in conceptual understanding (Lee – 2007). In another example, students who were tasked to create a digital story using MS Photo Story increased their understanding of curricular content (Sadik – 2008).

Video is a medium that would be a robust choice for use in education (Copley – 2007). Low equipment cost, relative ease of production, and high communication value makes it a strong candidate for implementation. Early adoption used a top-down approach where lectures were simply captured into video format and then disseminated to students (Chandra – 2007). A more effective approach was used by Kearney and Schuck, who have published a body of work describing students that generated digital videos to learn in real-world contexts (Kearney and Schuck – 2004, 2006). They assert that digital video is particularly useful in allowing students to learn within their own particular knowledgebase and framework.

This work examines the changes in conceptual learning as a function of students watching peer-generated videos in an undergraduate thermodynamics course. The content produced in this work will be shared in an online repository that may be accessed by other instructors and the general public.

Methods

This work is component of a broader study between three institutions that seeks to evaluate the effect of video *generation* and *viewing* on student understanding of several thermodynamics concepts: 1) Entropy and the Second Law, 2) Reversibility, 3) Steady State vs Equilibrium, 4) Internal Energy vs Enthalpy, and 5) Reaction Rate vs Reaction Equilibrium (Abulencia – 2012). The focus of this paper is to examine the effect of students *viewing* peer-generated videos (21 total) of the aforementioned topics. The viewing assignment coincided with the time that particular topic was being taught in lecture. The Thermodynamics Concept Inventory developed by Vigeant and colleagues was used to assess conceptual learning and was administered at the beginning and end of the semester (Prince – 2009, Vigeant 2009, Vigeant 2011). The Concept Inventory is established to be a reliable measure of conceptual understanding in thermodynamics using the Kuder-Richardson Formula 20 (KR20 = 0.80).

Results and Discussion

There were a total of 68 students from the three institutions that participated in this year's study. Comparing the collective post-test scores between the group watching the videos and those who did not (control) reveal no significant difference between the two (Table 1).

Table 1 – Mean Post-Test Scores of Students Who Watched Peer-Generated Videos vs Control

Group	Mean Score	n	Standard Deviation
Control	23.72	58	4.37
Watched Peer-Generated Videos	22.97	68	4.83

This result rejects our original hypothesis that students watching peer-generated videos will increase their conceptual understanding in thermodynamics. Perhaps a different outcome may result by factoring the GPAs of the different classes (i.e. each group was represented by a different year). Maybe some other level of interaction in addition to simply watching the video is necessary to be effective (Zhang – 2006). However, it leads to other questions such as, "Is video an effective media to enhance conceptual knowledge?", or "Is straightforward technical content more effective than using metaphors when teaching concepts?" These questions can be assessed in future studies. Regardless, this project aims to answer one more hypothesis (i.e. examining the effect of video *generation and viewing*) this current academic year.

Despite this result, another outcome we wish to accomplish is the generation of a repository of these videos for instructors, students, and the general public. Thermodynamics is offered as a core class in other disciplines and in other courses where concepts may be embedded (e.g. General Chemistry and Physics). The authors are currently in the process of generating a website where anyone would be able to contribute their own video, and posted after a review for content. The goal is to acquire different perspectives on a particular topic such that users with different backgrounds and frameworks can find one that particularly appeals to them.

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