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A Preliminary Summative Assessment of the HigherEd 2.0 Program–Using Social Media in Engineering Education

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Educational Social Media Use and its Relationship to Student Performance in Engineering Education

Abstract
The HigherEd 2.0 (HED2.0) program initiated in 2006, and the research team developed and evaluated pedagogical techniques for integrating social media (what we used to call web 2.0) tools into engineering education. Inspired by the 2006/2007 rapid adoption of podcasting for entertainment, news, and other non-academic purposes, the HED2.0 program sought: (i) to integrate various social media tools into the fabric of engineering undergraduate classrooms, (ii) to evaluate the program using mixed methods and targeting various specific outcomes, and (iii) to develop best practices for deployment of social media tools in support of student learning. The HED2.0 program has focused on the use of blogs, video technologies (including podcasts), and student-generated content as powerful and productive pedagogical tools.

This paper reports on a preliminary summative assessment of the program, its outcomes, its successes, and its challenges. Throughout the program, a mixed-methods evaluation approach was used, and it focused on a variety of factual factors (usage data, download statistics), survey response data from students, faculty and student interviews, and student gradebook data. While the full summative assessment of the program is beyond the scope of this conference paper, this preliminary presentation focuses on several specific aspects of the program. First we consider student response to the idea of using social media for teaching and learning, and in particular we examine student attitudes about, and usage of, the social media resources across multiple years of the program. What we learn is that student response to the program follows a somewhat predictable diffusion of innovations framework, and we present data from student surveys, factual usage data, and interviews with students. Second, we examine the relationships between student usage and engagement with HED 2.0 technologies and their performance on specific assessments in the course, including homeworks, quizzes, and exams. We characterize several model student profiles based upon the apparent impact of technology usage on their academic performance. Finally, we examine the role of incentives in shaping student use of the social media resources. Based upon different approaches to incentivizing usage, ranging from no incentives to some measure of course credit, we can conclude that students generally require an initial motivation to engage with what is (for most students) an entirely new framework for learning. However, after students gain experience with the HED2.0 techniques, they require far fewer incentives to continue their engagement with the social media tools.

1. Introduction

Use of Internet-based (and by generalization, *web-based*) social media such as social web sites, discussion groups, wikis, blogs, micro-blogs, photo and video sharing web sites are quite pervasive in society today. Their use is not only commonplace across all ages and social strata, but also globally in various cultures. They have even played roles in major global events, such as in revolutions and grand social changes. Governments, companies, schools, politicians, actors, and regular everyday people all engage in the use of social media for a variety of purposes, including advertising, promoting a message, mutual communication, and just to have a presence in cyberspace.

The use of web-based technology by schools is varied. Aside from having a school web site that serves as the school's point of presence on the Internet, schools have made many of their processes and information web-based. This includes things such as the school directory, library searches, school calendar, and even human resource management functions. In higher education, many schools conduct student course evaluations as web-based online surveys, use web-based student information management systems, and manage student registration and enrollment via web-based systems. Many courses make use of a course web site from which students can obtain the syllabus, assignments, resources, and track their course progress.

Schools, however, are historically slow at adopting technological innovations. This is certainly the case, as schools have adopted web-based technology after it has matured in wider general use. This delay is warranted, however, as it is necessary for schools to assess and predict the impact of technology on education. Given the mission of educating students, schools must also find uses for new technology that promote education, considering the unique requirements of the educational environment. These considerations apply at all levels of granularity: at the level of a University as a whole, an individual school or college, at the department and program level, an individual course, an individual instructor, and perhaps even at the level of a specific class.

As a natural progression of the proliferation of web-based technology into schools, we expect the use of social media by schools in support of their educational mission. Indeed, this is already happening. It is necessary, then, to assess and evaluate the use of social media technology. What is its impact on education? Whom does it serve? How is it used? How might it be leveraged to improve education? These are just a few questions that we might ask as we implement social media in support of education.

2. Review of Relevant Literature

We begin by defining our use of the term "social media" in this context. Originally emerging under the heading "web 2.0", social media today comprises an ecosystem marked by powerful authoring tools and ubiquitous user-generated content. Today's social media landscape includes a wide range of file types (audio, video, text) shared in a multitude of ways (YouTube, Vine, Facebook, Twitter), pushed to personal devices (especially mobile devices), often using location-based services. In the current study, we focus on two specific slivers of this broader ecosystem: (i) blogging for educational purposes, and (ii) use of video resources to support learning. We do not consider the full spectrum of social media tools, nor do we focus on the most current (for instance, twitter). The origins of this study were shaped by the most rapidly-maturing technologies of the late 2000's, as well as those that appeared to offer the highest relative advantage compared to other technologies (see the diffusion of innovations discussion below). These rapidly-maturing technologies are blogging and video, and both lend themselves to substantial user-generated content.

The scholarship on blogging as an educational tool continues to emerge. Much recent work has focused on the use of blogs for reflective, self-expressive, peer critique, or highly-individualized authoring, and in many cases each student in a class has their own blog site. In a meta-analysis of the literature, Sim and Hew[11] identified only a few studies that did not focus on the reflective and/or peer critique elements of blogging. But the preponderance of the literature they reviewed suggests that students (albeit via mostly self-report mechanisms) believe blogs to be useful for academic purposes, for connecting with their peers in a social sense, and for socially constructing knowledge via peer review and feedback. This conclusion about blogs is generally supported in the more recent work of Hew and Cheung[4], who conclude that blogs generally have a positive impact on learning, especially when used within a "constructionist" pedagogy. The review by Tess[14] echoes what is stated in several other works about blog research: the experimental design is somewhat lacking and more rigorous studies are in order. The work reported here cultivates a community-based blog in which all students are encouraged to participate, and the blog is specifically constructed to not be a reflective space. Instead, the blog serves a variety of largely utilitarian functions, and the comment threads are the public spaces in which students can ask and answer questions, exchange ideas, and otherwise share knowledge about course concepts. As such, the use of blogs in this engineering education context is fairly distinct from much of the literature on blogging which, in general, focuses more on the reflective aspect of blog use.

In addition to this background on blogging and web 2.0 tools, there are three additional literature threads that bear upon this research and lend a theoretical framework to its analysis. The first of these literature threads address the dynamics of learning content using technology, while the other two address somewhat broader issues of how technology is adopted and what unintended negative effects it might bring.

The first thread is the worked-example effect. Widely reported by Sweller and colleagues[12,13], the worked-example effect basically posits that students learning (i.e., schema acquisition) can be effectively supported and accelerated by watching experts solve problems. The particular brand of worked-examples in this research is the video solution (described in detail later) which allows students to possess, play/re-play, and share recorded versions of expertly-constructed solutions on their computer or portable device. The essence of the worked-example effect is that expert problem solving processes—the details, the decisions, and the things that experts (by virtue of being experts) know to be true—are presented to novice learners in a clear and concise way. The worked-example effect corresponds strongly to the CLT, because the videos must be both constructed by the expert and used by the novice in ways that optimize cognitive load on the learner.

The second thread involves the rate of technology adoption, and a very useful way to consider this question is the diffusion of innovations framework[9]. Diffusion of innovations contends that there are five metrics on which users decide whether or not to adopt a particular technology, and these five metrics are: (i) the *relative advantage* of this technology versus other available technologies, (ii) *compatibility* of the technology with the values of the user and community, (iii) the perceived *complexity* of the technology, (iv) ability of the user to easily *try* the technology to determine its usefulness, and (v) the user's ability to observe the *impact* of the technology on the user or community. This framework will help us understand the rate of technology adoption within the learning community presented here, and also shed light on the differential rates of adoption among different achievers in the class.

The third thread in the literature provides some clues about why some users of the technology do not achieve a very good outcome in the class. The illusion of explanatory depth (IOED)[10] addresses the idea that people in general are not very good at estimating their own mastery of a particular concept *a priori* of an external assessment of their mastery. Our hypothesis is that some students, after receiving training in problem solving techniques via in-class activities and the use of the video solutions, believe that they have a higher level of mastery that they actually do. It is not until an external assessment (say, a quiz or exam) that they realize their true level of mastery was much lower than they thought.

3. Background for the Study

The overall study consists of observations and survey responses for more than 6 semesters in three different engineering mechanics classes. In all, hundreds of students participated in the study. The specific results presented here relate to a course in Dynamics at a large public mid-Atlantic university, with all data collected during Spring 2012.

4. Classroom Pedagogy

The Spring 2012 Dynamics course had a final enrollment of 120 students, mostly drawn from mechanical and aerospace engineering and almost entirely composed of undergraduate sophomore students. This three-credit class meets three times per week, 50 minutes per meeting, and each meeting contains minimal "lecturing" on new concepts and ideas and a larger block of collaborative problem solving and other active learning strategies. As such, this is considered to be an active classroom in which students are invited to collaborate with their peers. All students are encouraged to collaborate in class during the active learning exercises, as well as out of class. The out of class collaboration is encouraged to take multiple forms, including face-to-face study groups and online collaboration via the course blog.

5. Participants and Data Sources

Of the 120 students enrolled in the course, 83 elected to participate in the study and were consented for this purpose. Each participant was invited to complete three surveys throughout the semester (pre-, mid-, and post-), and these paper-based surveys were administered in class. The pre-survey in particular considered some demographic data, test scores (i.e., SAT), questions about comfort with technology, and other baseline questions. Notably, as addressed later in the paper, we did not collect any information about student personality type, such as Big Five indicators. As such, because not all students attended all class meetings, not all participants completed all three surveys. The data presented here is derived almost exclusively from the post-survey, and therefore data analysis by demographic and other factors is not presented here. In addition to the surveys, students were invited to participate in the public discussion on the course blog, so the digital record of their engagement on the blog is also collected. All their grades for all graded material in the course are used to correlate participant survey responses to academic performance.

6. Treatment

Throughout the class, students were exposed to the full range of technology interventions deployed by the instructor. The class used a course blog that took the place of a more traditional CMS, and was designed to be the single portal through which students would obtain homework assignments, ask and answer each other's questions, access video solutions and other instructional supports, etc. Students could access "video solutions", which are essentially narrated solutions to textbook problems in dynamics authored by the instructor of the course. These videos come in two types: those offered by the textbook publisher as part of adopting the textbook (and these also happen to be authored by the instructor of this course), and those authored by the instructor as part of the normal execution of the course. In all, students had access to about 100 dynamics video solutions. These videos do not contain a talking head, and are instead screen captures of handwritten tablet input synchronized with the author's narration on his thought process during the solution. Students could also download "lecture videos", which are identical to the video solutions in format (i.e., no talking head), but are recordings of lecture content such as motivations, conceptual issues, and derivations, instead of problem solutions. Students were *required* to access the blog to obtain their homework assignments, but they were *not required* to use any of the technology interventions such as video solutions or lecture videos. As part of their course grade (3% of their overall class grade), students were *required* to ask and answer questions using the comment features on the course blog to encourage dialog, sharing, and collaborative learning. The course grading consisted of the usual collection of homework assignments, quizzes, and exams, plus the 3% "blog points" mentioned above.

All the technology is fully explained in class, with repeated reminders about the available technology resources and how to use them appropriately. Basic IT support (e.g., how to sign in to the blog) is available to students, and the technology content such as video solutions and lecture videos has been constructed using best practices in multimedia production[6,7] in order to ensure their effectiveness and minimize the difficulty of use. The videos are distributed in a ubiquitous file format (Quicktime) and are compressed using modern video processing standards (H. 264) to optimize file size (about 1 MB/minute).

7. Methods

Course performance was measured by combining weighted quiz and exam grades into a composite score. The resulting composite score was divided into grade bands (90% <= A <= 100%, 80% <= B < 90%, 70% <= C < 80%, F < 70%). Due to low sample sizes (from low response rates per survey item), this study takes a more qualitative approach to analyzing the survey responses. Survey response data were grouped by grade band. Frequencies of categorical response data from the surveys were totaled for each band. Standardized frequencies (proportion of code frequency for a grade band) of responses were compared between bands.

8. Results

Many different dimensions were analyzed from the survey responses. The subset of metrics presented below in Tables 1-6 focuses on several issues: (i) student attitudes about collaboration (in-person and online), (ii) student attitudes about technology in general and for purposes of learning, (iii) students metacognitive ideas about their preferred learning strategies, (iv) student ideas about the perceived usefulness of some of the technology interventions, (v) student blog activity, and (vi) student usage of video solutions. Proportions displayed in these tables are proportions of those students that gave a response to the survey item in question. Students who gave no response are not included in the results summary and analysis for that item.

Table 1
Survey Responses: Collaboration

Item and Responses	P_A	N_A	P_B	N_B	P_C	N_C	P_F	N_F
Collaboration is a priority								

N	0.53	8	0.37	10	0.59	13	0.80	4
Y	0.47	7	0.63	17	0.41	9	0.20	1
Collaboration is beneficial for learning								
N	0.33	5	0.11	3	0.14	3	0.20	1
Y	0.67	10	0.89	24	0.86	19	0.80	4
Collaboration is beneficial for my grade								
N	0.33	5	0.22	6	0.18	4	0.20	1
Y	0.67	10	0.78	21	0.82	18	0.80	4
Collaboration helps understand concepts								
not at all	0.13	2	0.00	0	0.00	0	0.00	0
a little	0.13	2	0.11	3	0.19	4	0.40	2
Somewhat	0.33	5	0.52	14	0.48	10	0.40	2
Definitely	0.40	6	0.37	10	0.33	7	0.20	1

Note. P_A = proportion of A-student respondents; N_A = number of A-student respondents; other columns are similarly labeled.

Table 1 displays the survey results regarding collaboration. Students across all grade bands appear to have believed that collaboration was beneficial. However the F students in this sample appear to be quite different than the other students in that they did not make collaboration a priority, and had a lower opinion of collaboration's contribution to understanding concepts.

Table 2

Survey Responses: Attitudes About the Technology

Item and Responses	P_A	N_A	P_B	N_B	P_C	N_C	P_F	N_F
Trust the blog content								
not at all	0.07	1	0.04	1	0.09	2	0.00	0
a little	0.07	1	0.00	0	0.23	5	0.20	1
Somewhat	0.67	10	0.52	14	0.18	4	0.60	3
Definitely	0.20	3	0.44	12	0.50	11	0.20	1
Homework threads are useful								
not at all	0.13	2	0.00	0	0.09	2	0.20	1
a little	0.20	3	0.15	4	0.36	8	0.20	1
Somewhat	0.47	7	0.56	15	0.27	6	0.40	2
Definitely	0.20	3	0.30	8	0.27	6	0.20	1

Note. P_A = proportion of A-student respondents; N_A = number of A-student respondents; other columns are similarly labeled.

Table 2 displays the survey results for attitudes about technology. The "do you trust the blog content" item was specifically asking about the student-generated questions/comments/ideas on the blog, and students from all grade bands appeared to trust the blog content. They also generally felt that the homework threads were useful.

Table 3
Survey Responses: Learning Strategies

Item and Responses	P_A	N_A	P_B	N_B	P_C	N_C	P_F	N_F
How do you best learn (check all)								
do it myself	0.93	14	0.88	23	0.91	20	0.80	4
Lecture	0.20	3	0.31	8	0.23	5	0.00	0
Reading	0.27	4	0.35	9	0.18	4	0.60	3
Watching	0.40	6	0.58	15	0.64	14	0.60	3
working w/ others	0.53	8	0.65	17	0.45	10	0.20	1
Other	0.00	0	0.04	1	0.00	0	0.00	0
Best learning strategy (check one)								
do it myself	0.80	12	0.65	17	0.59	13	0.80	4
Lecture	0.00	0	0.04	1	0.00	0	0.00	0
Reading	0.00	0	0.00	0	0.05	1	0.00	0
Watching	0.07	1	0.12	3	0.23	5	0.20	1
working w/ others	0.13	2	0.19	5	0.14	3	0.00	0
Other	0.00	0	0.00	0	0.00	0	0.00	0

Note. P_A = proportion of A-student respondents; N_A = number of A-student respondents; other columns are similarly labeled.

Table 3 displays the survey results regarding different learning strategies that students believe are the most effective. Students across all bands predominantly believed that the best way to learn something is for someone to do it for themselves. Watching someone else (perhaps in a video) also scored highly for students of all bands. Working with others is reported as an effective strategy by the A, B, and C students, whereas the F students preferred reading.

Table 4
Survey Responses: Technology Usefulness

Item and Responses	P_A	N_A	P_B	N_B	P_C	N_C	P_F	N_F
Access to the technology helped in the course								
N	0.40	6	0.22	6	0.55	12	0.60	3
Y	0.60	9	0.78	21	0.45	10	0.40	2
Technology was useful to the way you learn								
N	0.80	12	0.96	25	0.59	13	0.60	3
Y	0.20	3	0.04	1	0.41	9	0.40	2
The technology was essential to your learning								

N	0.80	12	0.59	16	0.55	12	0.80	4
Y	0.20	3	0.41	11	0.45	10	0.20	1
What would you access w/out points (check all that apply)								
none	0.20	3	0.04	1	0.27	6	0.00	0
blog/HW	0.40	6	0.73	19	0.45	10	0.80	4
demos	0.07	1	0.31	8	0.18	4	0.40	2
post to blog	0.20	3	0.19	5	0.05	1	0.00	0
lecture recordings	0.27	4	0.46	12	0.41	9	0.40	2
video solutions	0.60	9	0.85	22	0.55	12	0.80	4
other	0.00	0	0.00	0	0.05	1	0.00	0

Note. P_A = proportion of A-student respondents; N_A = number of A-student respondents; other columns are similarly labeled.

Table 4 displays the results regarding the perceived usefulness of the social media technology used in the course. The item "what would you access without the points" probes the question of whether students would use the technology without incentives, and specifically targets the "points" (i.e., the 3% of their overall course grade) associated with asking and answering questions using the commenting features of the blog. Upper band students (A and B) appear to have felt that the technology helped them in the course, yet reported that the technology was not useful to the ways that they learn. The lower performing students (C and F) appear to be split. The A and F students reported that the technology was not essential to their learning, but the B and C students were split on this item. When asked which technologies they would access even if there were no points for the course associated with accessing them, students most frequently selected the video solutions, homework blog, and lecture recordings.

Table 5
Survey Responses: Blog Activity

Item and Responses	P_A	N_A	P_B	N_B	P_C	N_C	P_F	N_F
When you accessed the blog, what did you do? (check all)								
Demos	0.07	1	0.11	3	0.09	2	0.00	0
lecture recordings	0.20	3	0.26	7	0.27	6	0.00	0
video solutions	0.60	9	0.63	17	0.45	10	0.40	2
answer questions	0.20	3	0.30	8	0.27	6	0.00	0
check answers	0.20	3	0.11	3	0.23	5	0.00	0
exam review	0.40	6	0.41	11	0.64	14	0.60	3
get homework	0.87	13	1.00	27	1.00	22	1.00	5
post comments	0.20	3	0.44	12	0.36	8	0.00	0
post questions	0.13	2	0.26	7	0.14	3	0.00	0
read comments	0.47	7	0.74	20	0.55	12	0.80	4
other	0.00	0	0.04	1	0.00	0	0.00	0
You didn't post because (check all)								

couldn't answer questions	0.00	0	0.00	0	0.16	3	0.20	1
did post frequently	0.20	3	0.08	2	0.05	1	0.00	0
didn't access blog	0.13	2	0.00	0	0.00	0	0.00	0
didn't want to share	0.00	0	0.04	1	0.05	1	0.00	0
don't know what to post	0.27	4	0.40	10	0.58	11	0.80	4
nothing to contribute	0.53	8	0.80	20	0.84	16	0.80	4
stopped after got points	0.40	6	0.20	5	0.26	5	0.00	0
tech problems	0.00	0	0.12	3	0.05	1	0.00	0
other	0.00	0	0.28	7	0.11	2	0.00	0

Note. P_A = proportion of A-student respondents; N_A = number of A-student respondents; other columns are similarly labeled.

Table 5 displays the responses regarding blog activity. The most frequently reported reason for accessing the blog for students of all grade bands was to get the homework assignment. Other frequently reported activities include accessing video solutions, reading comments, and reviewing for the exams. Posting comments was also reported as an activity, primarily for B and C students. When asked why they didn't post to the blog, students most frequently responded that they had nothing to contribute or didn't know what to post. The proportion of students reporting that they did not know what to post appears to have been inversely related to grade band. A students were also the most frequent to report that they stopped posting after they had received the points (3% of their overall course grade) associated with posting questions and answers to the blog.

Table 6

Survey Responses: Video Activity

Item and Responses	P_A	N_A	P_B	N_B	P_C	N_C	P_F	N_F
Blog videos watched								
0	0.21	3	0.27	7	0.41	9	0.40	2
1-5	0.50	7	0.31	8	0.18	4	0.40	2
6-10	0.21	3	0.19	5	0.23	5	0.00	0
11-15	0.07	1	0.23	6	0.18	4	0.20	1
15+	0.00	0	0.00	0	0.00	0	0.00	0
Publisher's videos watched								
0	0.21	3	0.27	7	0.50	11	0.00	0
1-6	0.43	6	0.38	10	0.23	5	0.40	2
7-12	0.21	3	0.19	5	0.09	2	0.00	0
12-20	0.14	2	0.12	3	0.05	1	0.60	3
20+	0.00	0	0.04	1	0.14	3	0.00	0

Note. P_A = proportion of A-student respondents; N_A = number of A-student respondents; other columns are similarly labeled.

Table 6 displays the results of reported video watching activity. Of note in these data are that no students reported watching more than 15 blog videos, however students do report watching large numbers of videos from the textbook publisher. A larger proportion of the F students reported watching 12-20 of the publisher's videos than the proportions of the other grade bands. The most frequently reported number of blog videos reported watched by A and B students is 1-5, whereas the C students most frequently report watching no blog videos. A similar pattern is seen in the watching of the textbook publisher's videos: A and B students most frequently report watching 1-6 videos, whereas the C students most frequently report watching no videos. All of the F students in the sample reported watching at least one of the publisher's videos, with them split between 1-6 and 12-20 videos.

9. Analysis

The survey data grouped by grade band appear to describe some student characteristics associated with higher versus lower performance. Higher performing students appeared to have made collaboration a priority and were more inclined to work with others. They made use of the video solutions. They felt that the educational social media technologies were helpful in the course but not essential to their learning. Lower performing students appeared to have been more inclined to work alone, and to read the book. They accessed the blog for exam review, and tended to watch more of the textbook publisher's videos than the blog videos. There appears to be a higher reliance on the publisher's videos for the lower performers than for the higher performers.

The data suggest that the middle-band (B and C) students were the most active users of the blog, both producing and reading comments. The A and F students appear to have been more interested in reading comments rather than in producing them. This, coupled with the results that indicate that the most frequently reported reasons for not posting were that students had nothing to add to the discussion, and that lower performing students were more likely (empirically) to report not knowing what to add, suggests that the blog primarily served the middle-band students. Reading comments on the blog dominates posting comments or questions on the blog, which suggests that students were primarily consumers of information rather than producers.

10. Discussion

Academic Engagement and (Technology-Based) Collaboration

The responses of the F students in this study are particularly interesting. The picture that emerges is one of the low performing student that is socially disengaged online (at least in the context of the course), and moreover probably employs poorer study techniques (work alone rather than collaborate, read the book rather than practice problems) as compared to higher-achieving students. The low performing student prefers working alone, and tries to learn by reading the book and watching videos. Contrast this against the higher performing students who prefer to work with others and are more active online. The results from this study suggest that asocial individuals sometimes excel (making up part of the A students) but also fail. We might formulate a hypothesis about these apparently similar disengagements resulting in different academic outcomes using the disengagement framework of Brint and Cantwell[1]. "F" students appear to have what Brint and Cantwell call "behavioral disengagement", because they do not display the study habits of effective students. They often study alone, they take a passive approach to learning (i.e., reading the book or watching videos rather than working problems), and they reported having low time on task. "A" students may fall into the category of "interactional disengagement", because they do not have the high-quality academic interactions with peers or their instructors. Some of them nonetheless achieve strong academic outcomes, and they may of course be fully engaged in the other aspects of university life including intramural sports, clubs, or organizations. But it appears that for some of the A students, academic interactions are not a required component of their academic success.

We hypothesize a connection between students' personalities and their general engagement with their peers, especially by social media. There is an emerging body of literature on the relationship between personality traits (as captured by the Big Five) and social media usage. Correa et al. contend[2] that three of the traits—extraversion, emotional stability/neuroticism, and openness to experience—are useful in understanding an individual's social media usage. Previously, Guadagno et al. also found[3] that higher levels of neuroticism correlate with more blogging, apparently because blogging helps combat their feelings of loneliness. Pierce[8] shares this finding, and posits that students high in neuroticism may also appreciate the asynchronous conversations that take place with social media (because they have time to ponder a response, as opposed to the give and take of a real-time, face-to-face conversation).

These studies might implicate personality as a mediating factor in some of the observations made here. Big Five factors have been correlated to academic success as measured by GPA[15], and conscientiousness in particular has the strongest impact. We might speculate that the A students in the current study had a high degree of conscientiousness and therefore performed well in the course; moreover their confidence in their own abilities might limit their neuroticism (and hence their blogging). The mid-range students might be more neurotic about improving their grade, and therefore use the blog constructively as a collaboration platform in an attempt to take full advantage of the knowledge of their peers. The F students are a more opaque group, because while some literature suggests failing students have higher levels of neuroticism, the observation here is that they blog less. We might tentatively hypothesize that it is not the neuroticism that drives their lack of engagement on the blog, but rather the broader behavioral disengagement descried above that explains their blogging habits. We emphasize, however, that this description of the Big Five is highly speculative at this point, since we have no independent personality data collected as part of this research. However, these ideas clearly suggest a potentially productive avenue for future research.

The Worked-Example Effect and IOED

The social media technology in this study was used by students differently depending upon their study habits and corresponding performance levels. The blog appears to have been more useful for the middle-band (B and C) students, as exhibited by their activity and trust in it. The videos are used by all, but the higher performers actually report watching more videos than the lower performers. The lowest performers appear to rely on the textbook publisher's videos more than the other groups. We believe the F students are falling into the trap of the illusion of explanatory depth, in that they are comfortable watching the solution unfold in front of them and manage to convince themselves that they could produce the same level of performance when assessed. They fail to appreciate all the subtlety of the solutions and confuse their understanding of what they have just seen for an ability to actually do it. This behavior has all the hallmarks of IOED and represents a potentially important--and negative, for some students—consequence of the worked-example effect.

The data suggest that the worked-example effect is valuable for many students, and the video solutions in particular are the technology components of the course that students rate most highly. They like the video solutions, and they believe they are useful. The broader literature on worked examples makes clear that in some circumstances worked examples can be very beneficial for schema acquisition. However, this study suggests that poorer students may not benefit from and may in facts be damaged by the worked examples presented in the video solutions. Engineering problem solving is akin to Rozenblit and Keil's IOED categories[10] of "devices" and "natural phenomena" in the sense that insight, judgment, and synthesis of different pieces of information all contribute to a successful engineering problem solution. Self-ratings of knowledge about such things are known to be highly inflated in general, and it appears that F students succumb to a belief in those self-ratings (for instance, as they are preparing for an exam) rather than challenging those self-ratings. As a result of their (faulty) self-rating, they spend less time on task and do not continue perfecting their problem solving skills, a sentiment proposed recently in chemistry education[5]. They have therefore given themselves an illusion of problem-solving prowess rather than actual ability. We can speculate that better students either have a more accurate self-rating of their knowledge (unlikely) or are simply engaged in the habits of successful learners and continuously challenge themselves to achieve higher levels of mastery in engineering problem solving (more likely).

Technology Adoption and Diffusion of Innovations

All of the technology interventions have been constructed through continuous iteration to address three of the five diffusion of innovation metrics explicitly; they are easy to access, easy to use/try, and fully compatibly with the learning environment. The remaining metrics are the academically important ones: relative advantage and impact. The relative advantage of using the video resources and blog content is measured against the competing solutions: reading the book, or collaborating with peers. The F students generally judge the videos to have high relative advantage compared to collaboration with peers, but low relative advantage compared to reading the book. Their use of the videos, while frequent, does not seem to have a significant impact on their academic success, perhaps for the IOED reasons cited above. It appears that the technology adoption within the F student might be reasonably high, but it also appears that their use of the technology does not have the intended/desired effect. Could it be that they are not using the technology as it was intended?

The A students tell a somewhat different story. It appears that A students perceive little relative advantage to using the technology versus collaborating with peers or other learning strategies. We can argue that this is what makes A students, A students. They do not necessarily need more instructional support in order to be academically successful, and we suspect that A students use the videos in very targeted ways. For instance, if an A student is struggling with one particular concept or technique, we expect the student to access a specific video for the purpose of clarifying that specific issue. They may not need or want to broadly use the videos in a routine way, but they are strong enough students with good enough study habits to effectively use the technology resources presented to them. In this micro-sense, the impact of the technology might be high because it helped the student answer a specific question. But in a broader sense, it seems that the A students rate the impact of the technology to be fairly low. This is why they rate the technology to be useful, but not essential.

11. Conclusion

This study examined the use of educational social media in a Mechanical Engineering course. The social media technology consisted of a course web site that provided a homework blog, video solutions, lecture recordings, links, and other resources. Students were encouraged to use the technology during the course, and were provided some incentives (points) to use the technology. We were interested in how students of different performance levels (grade bands, A-F) used the technology.

The students were asked about their attitudes, perceptions, and use of the technology through a survey administered at the end of the course. Survey responses were grouped by students' performance levels and analyzed. Patterns and themes in the responses were identified and used to develop characteristics that described how students of different performance levels used the technology.

We found that the students used the technology in different ways; however students' level of social interaction and participation appeared to be an important factor in their performance. Lower-performing students indicated that they were less inclined to work with others, whereas higher performing students were more inclined to work with others. This tendency of social engagement appeared to be reflected in the use of the social media technology (primarily the course homework blog, a vehicle for course discussions) in the course. Asocial tendencies appeared related to both the highest and the lowest performers. Those that were the most active on the blog were the middle-band (B and C) students. The results suggested that making more of an effort to get students socially engaged in the course may help the lowest performers. The educational social media technology could be leveraged as part of the process of getting students to be more socially participatory in the course, intentionally tapping into self-expression tendencies that students may have outside of the course.

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References

1. Brint, S. and A. M. Cantwell, "Portrait of the disengaged", *Research and Occasional Paper Series of the Center for Studies in Higher Education (UC Berkeley)*, **CSHE.9.12**, 2012. Available from http://cshe.berkeley.edu, accessed December 2013.
2. Correa, T., Hinsley, A. W., and Gil de Zuniga, H., "Who Interacts on the Web? The Intersection of Users' Personality and Social Media Use", *Computers in Human Behavior*, **26**:247-253, 2010.
3. Guadagno, R. E., Okdie, B. M., and Eno, C. A., "Who Blogs? Personality Predictors of Blogging", *Computers in Human Behavior*, **24**:1993-2004, 2008.

4. Hew, K. F. and Cheung, W. S.,"Use of Web 2.0 Technologies in K-12 and Higher Education: The Search for Evidence-Based Practice", *Educational Research Review*, **9**:47-64, 2013.
5. Mathabathe, K. C. and M. Potgieter, "Metacognitive monitoring and learning gain in foundation chemistry", *Chemistry Education Research and Practice*, 2014 (advance article, accessed January 2014).
6. Mayer, R. E., Multimedia Learning (2e), Cambridge University Press: New York, 2009.
7. Mayer, R. E. and R. Moreno, "Nine ways to reduce cognitive load in multimedia learning", *Educational Psychologist*, **38**(1): 43-52, 2003.
8. Pierce, T., "Social Anxiety and Technology: Face-to-Face Communication Versus Technological Communication Among Teens", *Computers in Human Behavior*, **25**:1367-1372, 2009.
9. Rogers, E. M., Diffusion of Innovations (5e), Free Press: New York, 2003.
10. Rozenblit, L. and F. Keil, "The misunderstood limits of folk science: an illusion of explanatory depth", *Cognitive Science*, **26**:521-562, 2002.
11. Sim, J.W. S and Hew, K. F., "The Use of Weblogs in Higher Education Settings: A Review of Empirical Research", *Educational Research Review*, **5**:151-163, 2010.
12. Sweller, J., "The worked-example effect and human cognition", *Learning and Instruction*, **16**(2):165-169, 2006.
13. Sweller, J., "Cognitive load during problem solving: effects on learning", *Cognitive Science*, **12**(2):257-285, 1988.
14. Tess, P. A., "The Role of Social Media in Higher Education Classes (Real and Virtual)—A Literature Review", *Computers in Human Behavior*, **29**:A60-A68, 2013.
15. Trapmann, S., Hell, B., Hirn, J.-O. W., and Schuler, H., "Meta-Analysis of the Relationship Between the Big Five and Academic Success at University", *Journal of Psychology*, **215**(2):132-151, 2007.