Using Social Media to Create a Global Community of Sustainability-Engaged Students

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Allan Feldman is a professor of science education at the University of South Florida. For the past 20 years his research has focused on science teacher learning and action research. His current research focuses the ways in which people learn to engage in science and engineering practices in apprenticeship situations. He has been PI and co-PI of NSF projects, many of which have been in collaboration with colleagues in the sciences and engineering. These include environmental studies of acid mine drainage, arsenic in the environment, algal biofuels, and water and wastewater treatment. He is currently working with an interdisciplinary team of engineers, scientists and anthropologists on water, waste and energy in developing countries. He taught middle and high school science and math for 17 years before obtaining his doctorate at Stanford University.

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Dr. James R. Mihelcic is a Professor of Civil and Environmental Engineering and State of Florida 21st Century World Class Scholar at the University of South Florida (Tampa). Dr. Mihelcic directs over $7 million of research projects including an EPA National Research Center for "Reinventing Aging Infrastructure for Nutrient Management" and an NSF PIRE project titled Context Sensitive Implementation of Synergistic Water-Energy Systems (see http://usf-reclaim.org/). He also directs the Peace Corps Master's International Program in Civil & Environmental Engineering which allows students to combine their graduate studies with service and research in the Peace Corps as water/sanitation engineers (http://cee.eng.usf.edu/peacecorps). His teaching and research interests are centered around engineering and sustainability, specifically understanding how global stressors such as climate, land use, and urbanization influence water resources, water quality, water reuse & resource recovery, and selection and provision of water supply and sanitation infrastructure. He is also an international expert in provision of water, sanitation, and hygiene in developed and developing world communities. Dr. Mihelcic is a member of the Environmental Protection Agency's Chartered and Environmental Engineering Science Advisory Boards. He is past president of the Association of Environmental Engineering and Science Professors (AEESP), a Board Certified Environmental Engineering Member, and Board Trustee with the American Academy of Environmental Engineers & Scientists (AAEES). He is lead author for 3 textbooks: Fundamentals of Environmental Engineering (John Wiley & Sons, 1999) (translated into Spanish); Field Guide in Environmental Engineering for Development Workers: Water, Sanitation, Indoor Air (ASCE Press, 2009); and, Environmental Engineering: Fundamentals, Sustainability, Design (John Wiley & Sons, 2010) (2nd Edition to appear in January, 2014) (translated into Spanish & Portuguese). He (and his students) have also received several university and national education and research awards, including some from the Association of Environmental Engineering and Science Professors (AEESP) and American Society for Engineering Education (ASEE).

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INTRODUCTION

Programs that enable engineering students to study outside of the United States have been effectively integrated with engineering education (1). These programs are exposing students to global concepts of sustainability (2). They are also helping students develop core competencies in engineering, while simultaneously building higher cognitive levels in some skills and in attitudes and identity outcomes (3). However, not every student can travel outside of the country. Social networking sites, such as Twitter and YouTube, have not only been embraced by students from younger generations, but they are also being used to communicate science and to enhance discussions of global importance (4). Social networking sites are also being used to engage stakeholders from around the world. For example, social media has been central to the United Nation's Post-2015 campaign (5), which seeks global feedback on proposed development goals. Social networking is also rapidly crossing cultural, geographical, and generational barriers. As of 2013, the fastest growing demographic on Twitter is the 55-64 year age bracket (6). YouTube reaches more U.S. adults between the age of 18 and 34 than any cable network (7). Both Twitter and YouTube have also been recently suggested as an appropriate means to engage international students on U.S. campuses in programs that emphasize global citizenship (8).

In 2013, the University of South Florida (USF) and the University of the Virgin Islands (UVI) launched the "Reclaim" initiative as a way to create a community that connects researchers from different disciplines around the world who are dedicated to the recovery of resources from waste. Reclaim utilizes a website with a blog (usf-reclaim.org), a YouTube channel, and a Twitter account to create this global community and to disseminate research findings and educational materials. Students from both institutions enrolled in a one-credit seminar course designed to operate entirely through the use of these social networking platforms. Students created and shared videos and articles that were discussed during weekly Twitter chats using a specific hashtag. The overall purpose of the course was to inform students about the history, discourse, and professional practice of sustainability across different disciplines, to allow them the opportunity to explore how social media can be used to disseminate research and educational materials, and to develop skillsets needed to become globally competent in science and engineering. A particular focus was placed on the sustainability of coupled engineered-environmental-social systems.

The objectives of this study are to document how the YouTube channel is being used, measure the participation in weekly Twitter chats, analyze the content of individual tweets, and describe the nature of participant diversity in the conversation strings that emerged during chats. This study seeks to provide a preliminary answer to the broader question: *can Twitter and YouTube be used to create a global community of students that are engaged in learning about the meaning of sustainability across multiple disciplines?*

METHODS

Each week, one or two students produced a 10 – 20 minute video to upload to YouTube, and selected reading materials (or other relevant videos) about a topic or a case study related to interdisciplinary solutions to key global challenges in context-sensitive situations. The weekly topics were selected by the course professor and related to the themes of a National Science Foundation (NSF) grant under NSF's Partnership for International Research and Education (PIRE) program. These students also developed five to six discussion questions related to the materials (which were posted on the blog several days in advance), and hosted an hour-long "Twitter chat" each week about the topic covered in the video, the readings, or the case study. During this hour, the student hosts (moderators) posed the discussion questions and other participants were invited to provide their own responses to these discussion questions, using a designated hashtag (Figure 1). In addition to students and faculty from the two universities, participants from the broader global community were also invited to participate in the Twitter discussions.

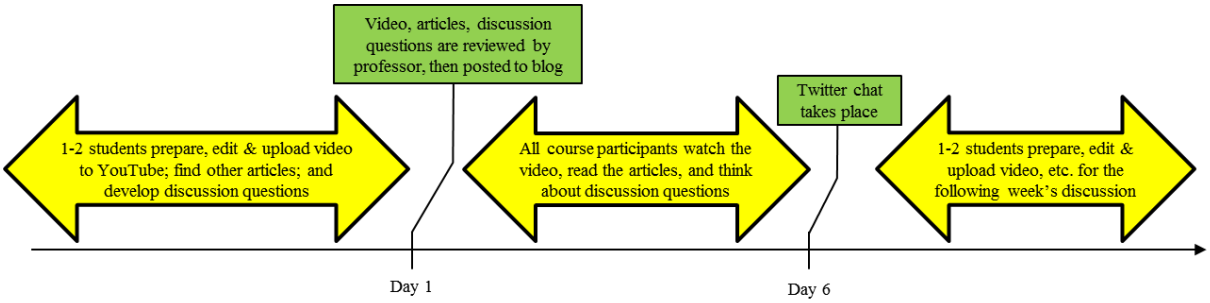

Figure 1. Outline of seminar activities and requirements

YouTube videos and Twitter tweets are in the public sphere and as such are available to anyone who wants to use them for research purposes. Students enrolled in the seminar had the option to set up a Twitter account with an anonymous user name for the purposes of the course, or to opt out of the Twitter chats altogether and complete an alternate assignment for credit. Course participants were also provided with consent forms for their videos and tweets to be used for the purpose of this study. Data was collected to measure the participants' involvement and interaction with the website, the YouTube Channel and the Twitter chats. The data collection procedures have been approved by the Institutional Review Board of the University of South Florida. Weekly participation of students enrolled in the course was consistently above 90% and nearly one-fourth of the tweets during the Twitter chats were submitted by participants that were not enrolled in the course for credit.

YouTube Analytics was used to track the total number of views and the duration of views of the videos posted. For Twitter chats, all tweets containing the specified hashtag were downloaded weekly using Twitter Archiving Google Spreadsheet (TAGS) Version 5.1 (9). Tweets were not analyzed during the first three weeks of the course, as participants were still adjusting to the format of the course and the use of the technology. The participation in the Twitter chats from the following weeks was analyzed, consisting of eight Twitter chats that took place between February 7th and April 11th with a total of 2,985 tweets. Tweets that were entered in reply to another tweet were traced back to the original tweet that started the "conversation," and organized into groups using the vlookup function in Microsoft Excel. The interaction between

students and professors and the interaction between participants from different geographic locations and from different disciplines was measured within each conversation group.

Each tweet from a sample of the Twitter chats was coded as a question, a claim (without a premise), an argument (claim with a reason), an informative statement, or an unintelligible statement. If a tweet appeared to agree or disagree with a claim made in a previous tweet, this information was also recorded. Questions were coded on a Likert scale of 1 to 6, in accordance with Bloom's taxonomy of educational objectives, with B1 representing "Knowledge" and B6 representing "Evaluation" (10). Multiple coders were used to analyze the content of the tweets in this study. The coders included two graduate engineering students, one science education graduate student, and one science education professor. In order to guarantee the stability of responses, the intercoder agreement strategy was used (11). The team of coders developed the codes and individually coded each of the tweets. The group met each week to compare the codes assigned to each tweet and arrive at an intercoder agreement.

RESULTS AND DISCUSSION

Participant Interaction with YouTube Channel

Analysis of YouTube analytics data shows that 20% of the total views and 22% of the total minutes watched are from participants outside of the continental United States (Figure 2). These data may suggest that participants from outside the continental United States (in particular, those located in the Virgin Islands where one of the participating NSF PIRE university partners is located) may be viewing the videos for a longer period on average than participants from Florida, where the other university is located (Figure 3). Based upon the total number of views for each video, the location of the viewers, and the manner by which viewers were accessing the link to the videos, it appears that students were indeed watching the videos, but not necessarily for the entire duration. The lengths of the videos ranged from 10 minutes to nearly 20 minutes, and there was a weak negative correlation between the length of the video and the percentage viewed (Pearson product moment correlation coefficient = -0.32).

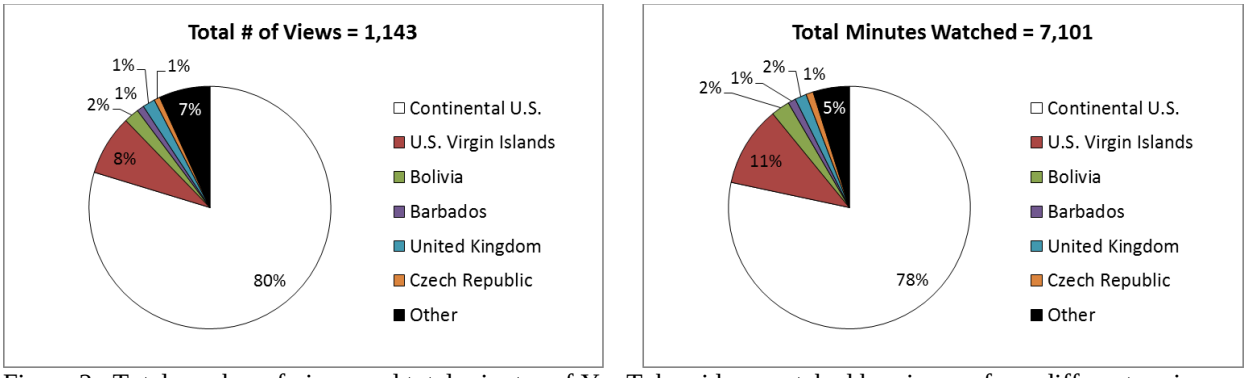

Figure 2. Total number of views and total minutes of YouTube videos watched by viewers from different regions

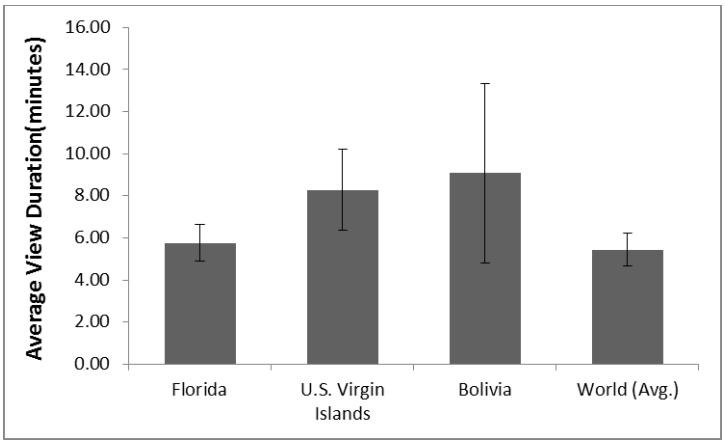

Figure 3. Average view duration in minutes of the YouTube videos by viewers from different regions (the error bars represent the 95% confidence intervals, assuming a normal distribution)

This apparent difference in the pattern of video viewing between course participants from the U.S. Virgin Islands and from Florida appeared to diminish gradually as the course progressed; the trend also appears to have reversed in April 2014 (Figure 4). The YouTube videos uploaded between January and March were produced by students from USF, while the video from the first week in April was produced by students from the UVI. Students may have a greater interest in watching videos produced by students from a region other than their own, since the material may be new to them. Another possible explanation is that the data may be skewed by students who watch the same video multiple times, but only watch small portions of it on the second or the third time or at a later date (e.g. to review portions of the video that they wish to watch again).

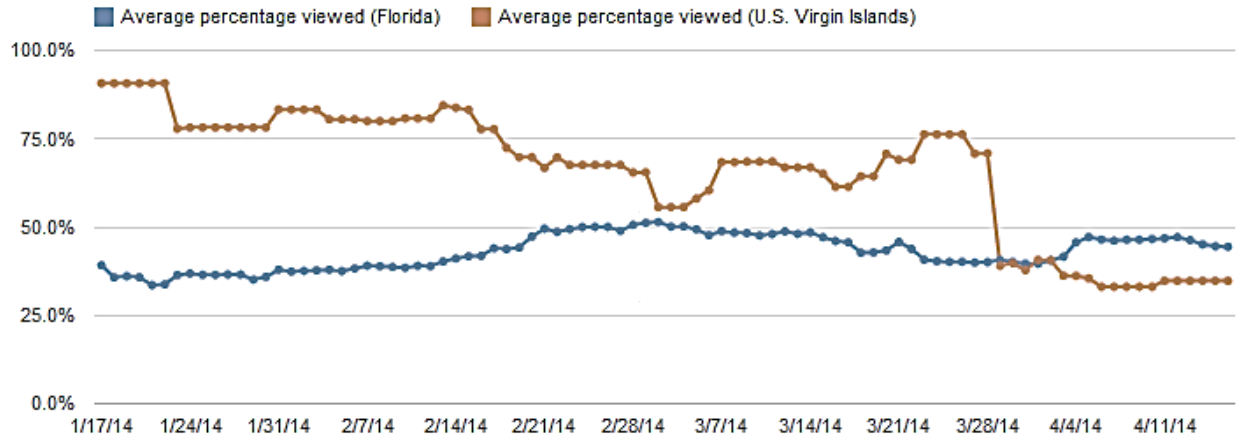

Figure 4. Percentage of YouTube videos viewed (30 day average) by viewers from Florida and from the U.S. Virgin Islands (regions where the two participating universities are located)

Participation in Twitter Chats

Most students enrolled in the course for credit had used Twitter infrequently before the course and none of them had used it in this way. The Twitter chats have had participation from more than 70 different users representing engineering, anthropology, education, philosophy, marine science, biochemistry, and microbiology backgrounds, from 10 different universities in six different countries, though the international participants contributed less than 5% of all tweets (Figure 5). The Twitter chats were largely dominated by graduate students and by participants

with engineering backgrounds. The median number of Twitter chat participants from anthropology, engineering, and marine science backgrounds was 4, 20, and 7, respectively. The median number of Twitter chat participants from the Tampa Bay area and from St. Thomas, VI was 27 and 5, respectively.

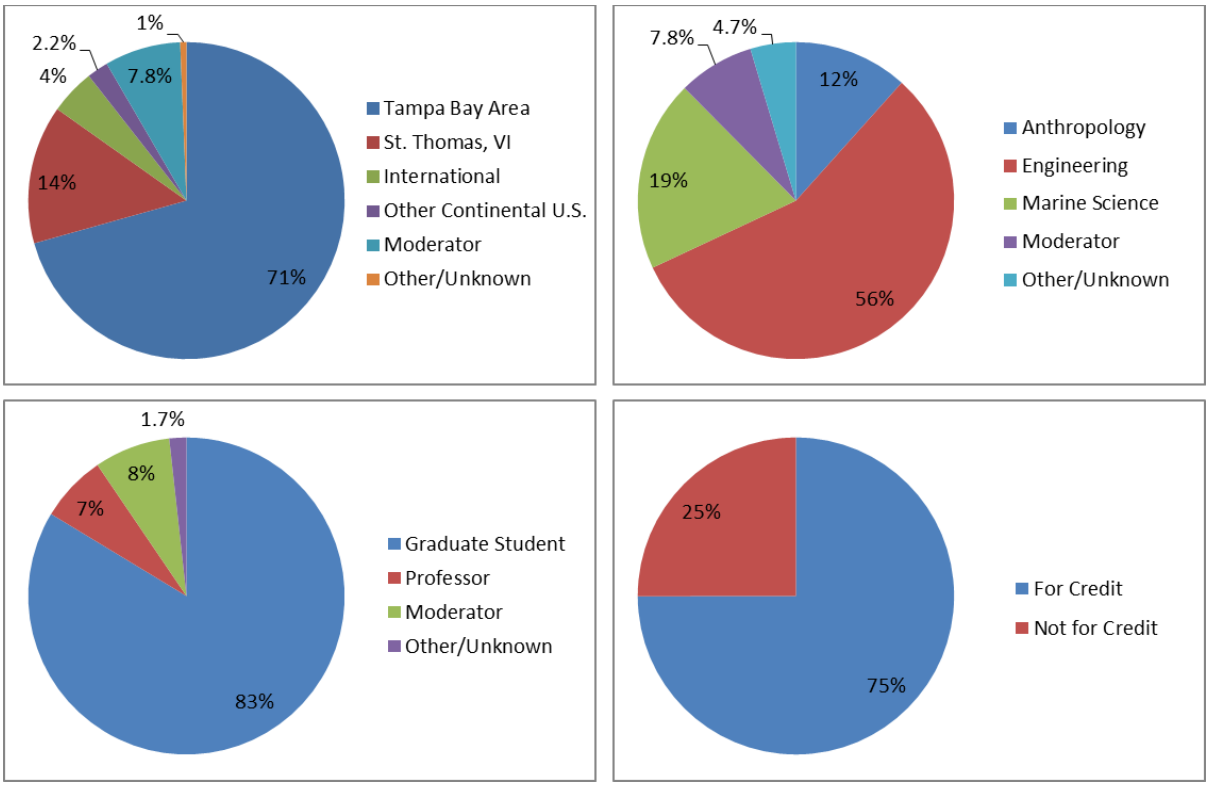

Figure 5. The total number of tweets contributed in the Twitter chats by location (upper left), discipline (upper right), position (lower left), and whether or not the participant was taking the course for credit (lower right).

Analysis of Conversation Groups

New conversational strands emerged during the Twitter chats as participants asked questions that either challenged a claim made by others in a tweet or requested a clarification of points. While multiple conversational strands occur simultaneously in the Twitter discussions, participants maintain conversations for up to nine (back and forth) turns over a 15 minute interval. Conversation groups (defined as a collection of more than two tweets that replied directly to other tweets and which could all be traced back to a single common tweet) contained up to 33 tweets from up to 19 different participants. Most of the conversation groups included participation from students in more than one geographical location and from more than one discipline (Figure 6). The percentage of tweets tied to a conversation (in contrast to "free-floating" tweets) was higher for anthropology students than it was for students from other disciplines (Table 1).

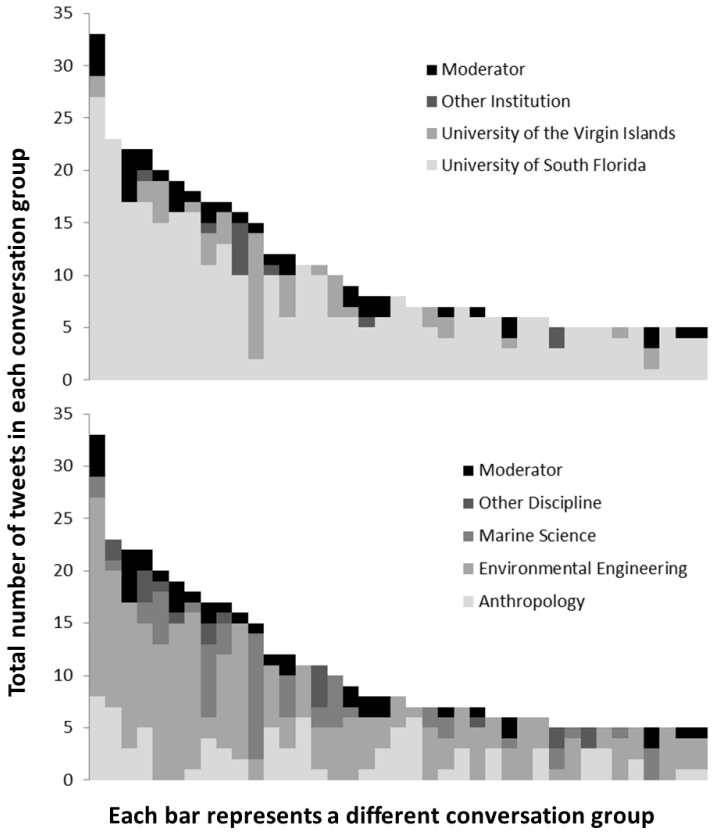

Figure 6. Distribution of participants from different regions (above) and disciplines (below) in conversation groups

Table 1. Percentage of tweets that were part of a conversation group, by discipline

Discipline	Tweets that were part of a Conversation Group	Total Number of Tweets	Percentage of Tweets that were part of a Conversation Group
Moderator	100	232	43%
Anthropology	208	348	60%
Engineering	683	1,673	41%
Marine Science	175	583	30%
Other Discipline	38	110	35%

Content Analysis of Tweets

Of a sample of 350 individual tweets from the Twitter chats, approximately one-fifth were structured as reasoned claims, while nearly one-third were structured as claims with no premise. Nearly 20% of tweets consisted of a question or a clarifying question, and in approximately 10% of tweets, participants were either agreeing or disagreeing with a comment made by another participant. Participants supported their claims with a reference to reading material, the YouTube video, or some other external source in <5% of the tweets analyzed, and <1% of tweets consisted of an argument framed as a syllogism. In general, discussion questions that were rated lower on the Bloom's taxonomy scale appeared to yield responses that were structured as claims with no premise.

There may be several reasons for the large number of tweets consisting of unreasoned claims. While the character limitation of individual tweets (140 characters) requires tweets to be concise, it may also limit students from supporting their claims with reasons, references, or examples from the readings or videos. Students may also be making claims that are not based on a particular reason or premise (for example, if they did not read the material or watch the entire video). Another limitation may be the pace of the Twitter chats, which averaged 347 tweets per week (approximately one tweet every ten seconds). It may be challenging or even impossible for participants to read every tweet and keep up with the many different conversational strands that occur simultaneously.

Despite these limitations of the Twitter platform, the Twitter chats may be providing an opportunity for students from different regions and different disciplines to develop a greater sense of community and an understanding for each others' values about sustainability as it relates to engineered, environmental, and social systems. On several occasions during the semester, students have had the opportunity during the Twitter chats to interact with members of the general public, representatives from industry, or authors of the papers being critiqued. The post-course surveys may provide more insight into the advantages and disadvantages of using Twitter and YouTube, however this information was not yet available at the time of publication.

CONCLUSIONS

The overall goal of this research is to determine if Twitter and YouTube can be used to create a global community of students that are engaged in learning about the meaning of sustainability across multiple disciplines. In this paper, we are reporting on the usage patterns of Twitter and YouTube, and to a limited extent, the nature of the content of the tweets. It appears that the use of these web applications is allowing for global participation. However, it is not yet clear whether the types of exchanges and their content signify in any way the development of a "global community of scholars". While our preliminary analysis describes the extent of interdisciplinary and cross-regional participation in Twitter chat "conversations", it does not allow us to say anything substantive about how this participation and the use of Twitter and YouTube may affect the ways in which the students learn about the meaning of sustainability across disciplines. Our next steps will be to continue the analysis of existing data to uncover global connections and the ways in which the students develop an understanding of the nature of sustainability. The former will be done by careful analysis of the untangled conversational strands of the Twitter conversations. The latter will require additional content analysis of the tweets, both within and outside of the conversational strands. Post-course surveys will also be administered to each student enrolled in the course.

ACKNOWLEDGEMENTS

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