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Putting twitter to the test: Assessing outcomes for student collaboration, engagement and success

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Abstract

Herein, we present data from two studies of Twitter usage in different postsecondary courses with the goal of analyzing the relationships surrounding student engagement and collaboration as they intersect learning outcomes. Study 1 was conducted with 125 students taking a first-year seminar course, half of who were required to use Twitter while the other half used Ning. Study 2 was conducted with 135 students taking a large lecture general education course where Twitter participation was voluntary. Faculty in Study 1 engaged with students on Twitter in activities based on an *a priori* theoretical model, while faculty in Study 2 only engaged students sporadically on the platform. Qualitative analyses of tweets and quantitative outcomes show that faculty participation on the platform, integration of Twitter into the course based on a theoretically driven pedagogical model and requiring students to use Twitter are essential components of improved outcomes.

Introduction

Twitter, a microblogging and social networking platform that allows users to post 140-character updates, has revolutionized the social media landscape. In the 5 years since its introduction, Twitter has garnered over 200 million users who send an estimated 155 million messages ("tweets") per day (Twopblog, 2011). While Facebook has been the most popular social networking site for college students, educators have been more willing to use Twitter as part of their college courses possibly because Twitter is primarily a microblogging platform and therefore more amenable to ongoing public dialogue (Antenos-Conforti, 2009; Ebner, Lienhardt, Rohs & Meyer, 2010; Grosseck & Holotescu, 2009; Junco, Heiberger & Loken, 2011; Schroeder, Minocha & Schneider, 2010; Smith & Caruso, 2010). Indeed, a study of nearly 1400 faculty members found that 56% of faculty who were Twitter users used Twitter as a learning tool in the classroom (Faculty Focus, 2010). Another study of 1920 university faculty members found that even though more faculty were Facebook users, an equal percentage used Facebook and Twitter in their courses (Moran, Seaman & Tinti-Kane, 2011).

Twitter as an educational intervention

Little research exists examining the efficacy of Twitter as a classroom learning tool. Mirvis, Sales and Hackett (2006) found that the efficacy of new educational interventions, especially those

Practitioner notes

What is already known about this topic

- Student use of social media is integrally related to how students engage the world.
- Little research exists on how social media use is linked to college student engagement in relation to academic outcomes.
- One study using a controlled design demonstrated a relationship between Twitter use and student engagement.

What this paper adds

- An empirical comparison of two ways in which Twitter was differently integrated into college courses.
- The utilization of quantitative and qualitative data to assess real-world academic outcomes related to Twitter use.
- Evidence-based best practices for using Twitter in educationally relevant and productive ways.

Implications for practice and/or policy

- If integrating Twitter in their courses, faculty should require and structure its use along educationally relevant criteria.
- To achieve the most effective results, faculty should have a theoretically driven pedagogical basis for incorporating Twitter.
- Faculty should actively engage with students on the platform to obtain maximum benefit.

involving technologies, are contingent upon a variety of factors including context, choice of technology, methods for implementation and how the particular platforms intersect with students' technology acumen/familiarity. Additionally, Johnson (2011) examined the effect that different types of Twitter posts had on instructor credibility, while Junco *et al* (2011) examined the effect of educational uses of Twitter on student engagement and grades.

Student engagement

The construct of student engagement is defined as the time and effort students invest in educational activities that are empirically linked to desired college outcomes (Kuh, 2009) and encompasses various factors, including investment in the academic experience of college, interactions with faculty, involvement in cocurricular activities and interaction with peers (Kuh, 2009; Pascarella & Terenzini, 2005). Besides a study by Gunawardena *et al* (2009), which found that student engagement and learning was enhanced by web 2.0 collaboration, few studies explore the specific ways in which online collaboration is linked to engagement. However, a number of studies have examined the links between the use of web 2.0 technologies like Twitter, collaboration and student engagement.

Twitter, collaboration and student engagement

While little research exists examining Twitter, a few studies have discovered correlations between Facebook use and student engagement (see Heiberger & Harper, 2008; HERI, 2007; Junco, 2012a). The Heiberger and Harper (2008) and HERI (2007) studies found positive correlations between social networking website use and single-item measures of college student engagement. Conversely, the Junco (2012a) study found that while time spent using Facebook was positively

related to time spent in cocurricular activities, it was negatively related to scores on a scale designed to measure student engagement. Additionally, four studies have examined the relationship between Facebook use and student learning; however, the results have been mixed with two studies showing no relationship and two showing a negative relationship (Junco, 2012b; Kirschner & Karpinski, 2010; Kolek & Saunders, 2008; Pasek, More & Hargittai, 2009).

Only the study by Junco *et al* (2011) used a controlled design to evaluate the effects of Twitter use on student engagement, based on Chickering and Gamson's (1987) seven principles for good practice in undergraduate education: (1) student/faculty contact; (2) cooperation among students; (3) active learning; (4) prompt feedback; (5) emphasizing time on task; (6) communicating high expectations; and (7) respecting diversity. The findings from that study were noteworthy: students in the Twitter group had significantly increased engagement and higher overall semester grade point averages (GPAs) than the control group. Junco *et al* (2011) conclude that Twitter can be repurposed for educationally relevant activities that have impacts on real-world academic outcomes, namely student engagement (offline) and grades.

Research questions

RQ1: How does explicit encouragement of Twitter usage (through course design) impact the relationship between student engagement and grades?

RQ2: Are there differences in collaboration between a class that requires Twitter use and one that does not?

RQ3: What are the effective elements of integrating Twitter into college courses?

Study 1: Examining the effects of requiring students to use Twitter in educationally relevant ways

In this study, we required students taking a first-year seminar course to use Twitter in the ways that we indicated.

Method

Sample

We used a controlled experimental design to test the causal relationship between Twitter use and both student engagement and grades. Four sections of a one-credit first-year seminar course for pre-health professional majors were randomly assigned to the experimental group and three to the control group. The experimental group used Twitter as part of the class, while the control group used Ning, a service that allows users to create their own social networking site. None of the students had used Twitter before participating in this study. Students were asked to participate in the study by taking a pre- and posttest (the survey containing the engagement instrument). Although participation was voluntary, participants could enter to win drawings of cash deposits to their university card accounts throughout the semester.

Of the 132 students in the seven sections, 118 completed the study by taking both the pretest and the posttest for an overall 89% participation rate in both groups. The final sample sizes were 65 students in the experimental group and 53 in the control group. The final sample was 92% Caucasian, 5% Latino and 3% Native American. Sixty-two percent of the final sample were female and 38% were male. The mean age of the sample was 18.2 with a standard deviation of 0.445. The age of the participants ranged from 17 to 20, although over 98% were between 18 and 19 years old. Thirty-two percent of the sample had at least one parent with a bachelor's degree.

Procedure

During the second week of the semester, sections received an hour-long training on how to use either Twitter or Ning, supplemented by question-and-answer periods over the next few class meetings. Right after the training sessions, both the experimental and control groups were sent

links to an online survey that included the 19-item engagement scale as well as demographic items and items inquiring about a student's technology use. The survey was hosted on SurveyMonkey.com. The posttest instrument was sent during the last week of the study.

The Twitter and Ning accounts were administered by two of the researchers, and activity on both platforms happened exclusively outside of scheduled class time. Both Twitter and Ning were used for the educationally relevant activities delineated in Junco *et al* (2011) that were developed based on Chickering and Gamson's (1987) seven principles for good practice in undergraduate education:

1. Continuity for class discussions: Since the first-year seminar met only once a week for an hour, Twitter and Ning were used to continue conversations begun in class. For instance, students were asked to discuss the role of altruism in the helping professions.
2. Giving students a low-stress way to ask questions: Oftentimes, first-year and/or introverted students are less comfortable asking questions in class. The dynamics of Twitter and Ning allow students to feel more comfortable asking questions given the psychological barriers inherent in online communication (Kruger, Epley, Parker, & Ng, 2005).
3. Book discussion: All first-year students read the same book as part of their first-year reading program. The book *Mountains Beyond Mountains* (Kidder, 2004) focuses on Dr Paul Farmer's medical relief work in Haiti and was used to stimulate discussion about altruism and the helping professions.
4. Class reminders: Since students all took a similar sequence of courses, we were able to remind them of due dates for assignments and dates for exams in multiple classes.
5. Campus event reminders: At the beginning of the semester, we used SocialOomph to schedule tweet reminders for the entire semester. These reminders included campus events, speakers, concerts and volunteer opportunities.
6. Providing academic and personal support: We regularly posted information about academic enrichment opportunities on campus (for instance, the location and hours for the tutoring center), both periodically and in response to student requests for help. Additionally, we provided encouragement and support when students reported things such as feeling "stressed out" or being worried about exams.
7. Helping students connect with each other and with instructors: The "cohort effect" or the intentional creation of learning communities is an important concept in ensuring student persistence (Keup, 2005–2006). Additionally, student/faculty interaction is a National Survey of Student Engagement (NSSE) factor related to student success (Kuh, 2002).
8. Organizing service-learning projects: As part of this course, students needed to participate in a service learning volunteer opportunity. Students used Twitter or Ning to coordinate volunteer times with each other.
9. Organizing study groups: With only a little encouragement from the authors via the Twitter feed, students organized study groups for two of their more difficult courses, Chemistry and Biology.
10. Optional assignments: Students had the option of completing two assignments via Twitter or Ning. The two assignments were:
    a. Attend an upper-class student panel and post two questions they had for panelists.
    b. Post reactions to their shadowing experience (where they shadowed a healthcare professional in the community for a day).
11. Required assignments: Students in all sections had four required assignments during the final 4 weeks of the semester. They were:

a. Students were required to post two statements and two replies to other students, discussing how reading *Mountains Beyond Mountains* has changed their ideas about people who are less fortunate than they are.
b. Students were asked to watch a video of the Hurst family's medical volunteer work at the Pine Ridge Indian Reservation, read an online article about the Hursts, read the article *100 People: A world portrait*, and discuss their reactions by posting two statements and two responses to other students' reactions.
c. Students were asked to react to the statement that what Paul Farmer was doing in *Mountains Beyond Mountains* was only a band-aid for the problem by posting two statements and posting two responses to other students' posts.
d. Students were asked to discuss their service project in the context of their future career. They were also asked to compare and contrast their experience to that of Paul Farmer and to use examples from their assigned readings.

Instrument and measures

The NSSE is an established instrument that was developed to measure engagement in educationally relevant activities and the desired outcomes of college (Kuh, 2009; Pascarella & Terenzini, 2005). Data from the NSSE exhibit acceptable psychometric properties (see Kuh, 2002), and items focusing on good practices in undergraduate education consistently predict development during the first year of college, based on multiple objective measures (Pascarella, Seifert & Blaich, 2009).

We developed an engagement instrument that uses 19 items from the NSSE (Appendix). These items were selected because of their focus on academic and cocurricular engagement. We kept the original coding of Likert scales from the NSSE; therefore, engagement scale items 1–14 were coded using a 4-point Likert scale from "Never" (1) to "Very often" (4). Questions 15–17 were presented as a 7-point Likert scale coded with responses 1 or 2 as "1," 3 or 4 as "2," 5 or 6 as "3," and 7 as "4." Responses for question 18 were coded from "Very little" (1) to "Very much" (4). Lastly, responses for question 19 were coded 1 for "Poor" through 4 for "Excellent." An aggregate engagement score was created using the sum of the individual items. The minimum score possible on the instrument was 19 and the maximum was 76.

Students gave the researchers permission to access their academic records to obtain semester GPAs as well as high school GPAs, to examine the differences in grades between the experimental and control groups. Grades were measured on a 4.0 scale ranging from 0 for "F" to 4.0 for "A." In this scale, the lowest grade possible was 0–0.99 (an "F"), the next highest was 1.00–1.99 (a "D"), the next highest was 2.00–2.99 (a "C"), the next highest was 3.00–3.99 (a "B") and the highest grade possible was 4.0 (an "A").

Engagement instrument reliability and validity

Reliability analyses found that the data from both administrations of the survey were internally consistent. Cronbach's α for the pretest administration was 0.75, and for the posttest administration, it was 0.81. The engagement instrument's internal consistency was similar to the α of 0.85 reported by Hytten (2010) and the α of 0.82 reported by Kuh, Cruce, Shoup, Kinzie and Gonyea (2008) using a different 19-item scale from the NSSE. Also, our instrument's reliability was similar to the α of 0.85 obtained by examining data on the 22 college activity items (Kuh, 2002). Lastly, the internal consistency estimates for these administrations were similar to the 0.80 found by Junco (2012a) using the same 19 items and a large sample.

Evidence was collected to support the construct validity of the 19-item engagement scale by correlating the total score on the scale to the number of minutes students reported spending in cocurricular activities on campus in a typical week. Because, theoretically, students who are more

engaged in general spend more time on cocurricular activities, one way to show evidence of construct validity of the engagement instrument would be if the scores on the engagement instrument correlated somewhat (ie, shared some of the variance) with the amount of time students spent in cocurricular activities. Indeed, there was a weak yet significant correlation between scores on the engagement instrument and average minutes per week students reported spending in cocurricular activities (Pearson's $r = 0.26$, $p < 0.01$ at the pretest, and Pearson's $r = 0.33$, $p < 0.001$ at the posttest). Still, the correlation coefficients were modest, indicating that our instrument measures more than just cocurricular engagement. This is congruent with similar analyses conducted by Junco (2012a).

Statistics and qualitative analyses

To assess differences in engagement and grades, we used mixed-effects analysis of variance (ANOVA) models with class sections nested within treatment groups. In order to assess changes between the pre- and posttest measurement of engagement, we used difference scores as the dependent variable, calculated by subtracting the total pretest score on the engagement instrument from the total posttest score. We used PASW (SPSS) Statistics Version 17.0 for all analyses.

To evaluate how students interacted on Twitter, we used Leximancer software to extract the themes in the corpus of tweets that was collected over the entire semester. Leximancer uses algorithms that automatically analyze semantic and relational information in natural language databases and creates top-level themes. Furthermore, Leximancer visualizes relationships between major themes in a dataset by producing concept maps and assigning strength values (as percentages) to each theme. Leximancer output shows the major themes, the concepts used to make up those themes and how they are related.

Results

Results from the mixed-effects ANOVA model revealed that the Twitter group ($M = 5.12$, $SD = 6.69$) had significantly higher difference scores than the control group ($M = 2.29$, $SD = 7.67$) with $F(1, 4.9) = 12.12$, $p < 0.05$. We also conducted a mixed-effects ANOVA model with pretest engagement scores as the dependent variable and found no preexisting differences in engagement between the Twitter group ($M = 35.49$, $SD = 6.84$) and the control group ($M = 38.17$, $SD = 7.78$; $F(1, 4.9) = 2.80$, $p = 0.16$). Therefore, the Twitter group's engagement score increased significantly more than the control group's over the course of the semester and this difference cannot be explained by preexisting engagement differences.

To examine the effect of Twitter use on student grades, we also used a mixed-effects ANOVA model with sections nested within the treatment group. The dependent variable was overall first semester GPA. The semester GPAs of the Twitter group ($M = 2.79$, $SD = 0.85$) were significantly higher than those of the control group ($M = 2.28$, $SD = 1.08$) with $F(1, 4.9) = 8.01$, $p < 0.05$. We also conducted a mixed-effects ANOVA model with high school GPA as the dependent variable and found no preexisting differences between the Twitter group ($M = 3.56$, $SD = 0.48$) and the control group ($M = 3.43$, $SD = 0.45$; $F(1, 4.9) = 1.24$, $p = 0.32$). Like engagement score, the Twitter group had higher overall semester GPAs than the control group, and this difference cannot be explained by preexisting academic ability. Therefore, the Twitter intervention promoted both student engagement and academic achievement.

Figure 1 shows the average number of tweets students sent each week of the semester. Figure 2 shows the themes extracted from the corpus of tweets with the Leximancer analyses. Students in this study used Twitter primarily for cognitive matters; however, there were frequent conversations about affective matters (ie, being stressed about upcoming exams). The most prevalent themes in the tweet data were, in order of strength:

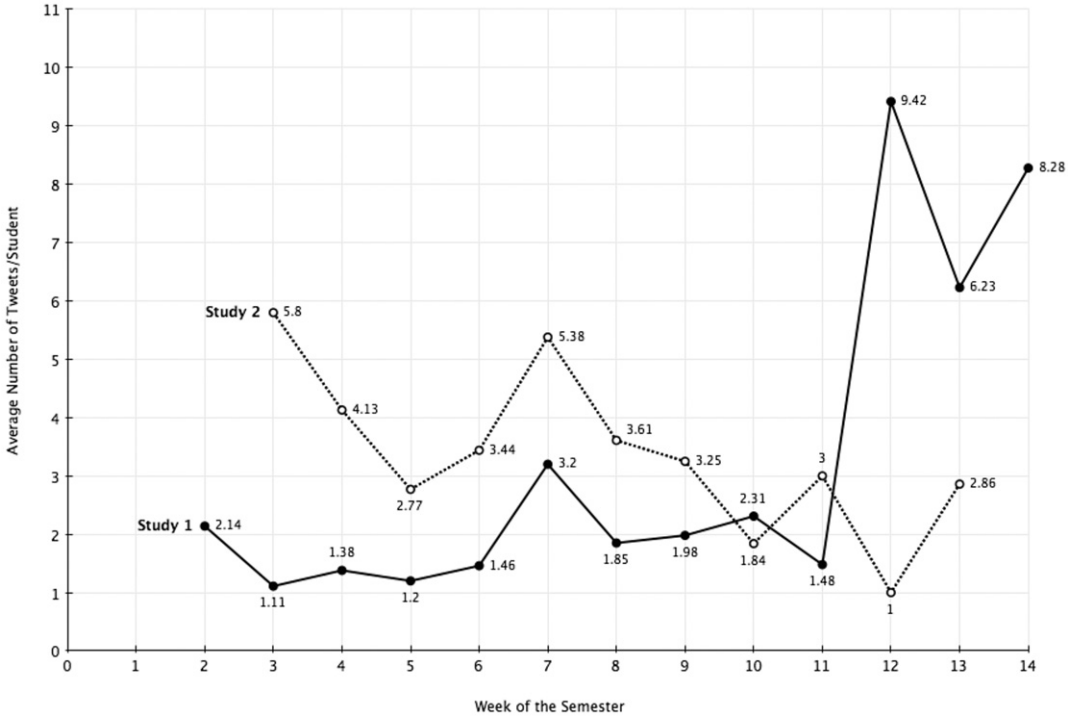

Figure 1: Average number of tweets sent per student in each study over the course of the semester

1. *Farmer*: These were tweets where students examined issues raised by their discussion of a common reading, *Mountains Beyond Mountains* (Kidder, 2004). This book describes Dr Paul Farmer's medical relief work in Haiti and was chosen to help students entering the helping professions reflect on altruism. An example of a tweet from this theme was: "How does Dr Farmer continue his work without feeling overwhelmed?"
2. *People*: Another theme that was an intended focus of this course was how students will help others in their chosen professions. An example tweet was: "@User so in essence, if we can experience that selflessness to help other countries, we will further our own drive to help people here."
3. *Others*: This theme was closely related to the *People* theme in that students discussed their responsibility to others and their community. An example was "@User makes me realize how much more I care about myself than others, makes me feel selfish."

Study 2: Examining the effects of allowing students the option of using Twitter to collaborate through methods of their choice

In Study 2, we allowed students to choose whether they wanted to use Twitter to collaborate on course content, did not impose a framework of use and engaged with them intermittently on the platform.

Method

Sample

One section of a large lecture general education communications course on media and democracy participated in this study. Students were given the option to utilize Twitter for the class. Unlike Study 1 where participants in the control group used Ning, students opting not to use

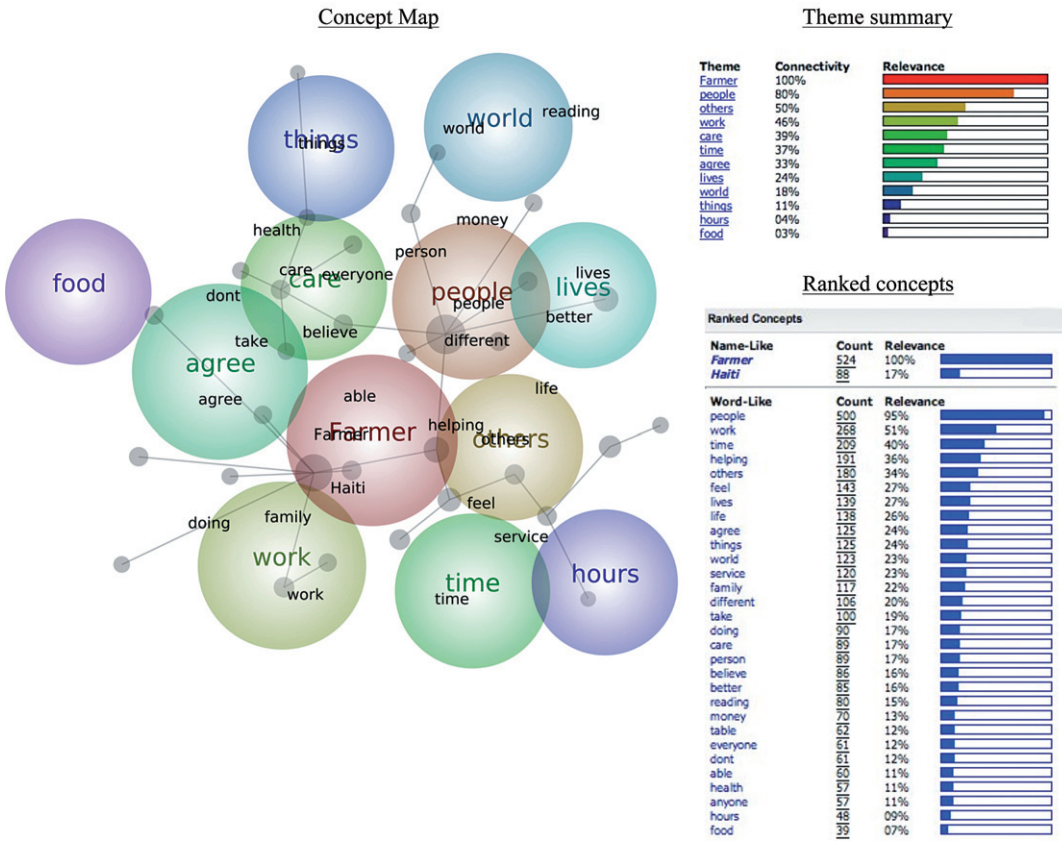

Figure 2: Leximancer concept map of themes, theme summary and list of ranked concepts from the Twitter corpus of Study #1. The circles and their labels in the concept map represent the higher-level themes based on the concepts in the dataset. The concepts are represented by the darker-colored words in the circles. The themes are heat-mapped to indicate importance (ie, the most important theme appears in red, and the next most important in orange, etc). The theme summary shows a list of all themes as well as their importance ranked by connectivity and relevance. The ranked concept list shows the name of each concept, the number of times it was found in the corpus of tweets and its relevance in the dataset

Twitter in Study 2 had no other formal alternative medium for virtual participation. No incentives were offered. At the start of the class, 61% of students said they were familiar with Twitter, 43% said they had explored or used Twitter before and 4% said they had used it as part of a previous class. These numbers are congruent with and representative of Twitter's growth since Study 1 was conducted.

Of the 179 students in the class, 135 completed the study by taking both the pretest and the posttest for an overall 75% participation rate. Throughout the course of this study, 66 of the participants used Twitter as part of the class, while 69 did not. The sample was 79% Caucasian, 4% African American, 10% Latino, 11% Asian and 1% Native American. Forty-seven percent of the sample was female and 53% male. The mean age of the sample was 19.7 with a standard deviation of 1.6. The age of the participants ranged from 18 to 28, although over 97% were between 18 and 22 years old. Thirty-seven percent of the sample had at least one parent with a bachelor's degree. Because this course was open to students at all levels, there was variability in class rank. Specifically, 30% were first-year students, 24% were sophomores, 29% were juniors and 17% were seniors.

Procedure

During the third week of the semester, students were formally introduced across two 75-minute class sessions to the technologies we were employing in the course (Twitter and Google documents), the reasons behind their implementation and the expectations the instructor had for student participation (in the case of Twitter, voluntary contributions). The Twitter feed was projected in class on the lecture hall screen once a week during full-class discussion of a topic, although instructors made little explicit reference to the Twitter feed during discussions. No specific directions or limitations were given regarding what the students should post, meaning the open-forum nature of Twitter was fully embraced, including how they engaged one another in this medium. Attempts were made (at least one class period per week) to fold commentary from the feed back into the classroom discussions. While the instructors found it both stimulating and an important addition to what is traditionally a unidirectional format in the large lecture hall, the results were nonetheless mixed, most often depending on the quality of commentary posted to the feed by the students.

Instrument and measures

For this study, we used the same 19-item scale based on the NSSE used in Study 1, included the same additional questions in the online survey and were granted permissions to access academic records as in Study 1.

Engagement instrument reliability and validity

Reliability analyses found that the data from both administrations of the survey were internally consistent. Cronbach's α for the pretest administration was 0.83, and 0.81 for the posttest administration. This is congruent with the results from Study 1 as well as with data reported by Hytten (2010), Kuh *et al* (2008) and Kuh (2002). Like in Study 1, we found that scores on the engagement instrument both at the pretest and posttest correlated significantly with the hours per week students reported spending in cocurricular activities (Pearson's $r = 0.28$, $p < 0.001$ at the pretest, and Pearson's $r = 0.23$, $p < 0.01$ at the posttest). These correlations showed the same pattern as in Study 1, suggesting that the instrument is an omnibus measure of both academic and cocurricular engagement.

Statistics and qualitative analyses

To assess differences in engagement and course grades, we used one-way ANOVAs. In order to assess changes between the pre- and posttest measurement of engagement, we used difference scores calculated by subtracting the pretest from posttest score as the dependent variable. To evaluate how students interacted on Twitter, we used Leximancer software to code the corpus of tweets collected over the entire semester.

Results

To examine the effect of Twitter use on student engagement, we used a one-way ANOVA model with whether students used Twitter as the independent variable. The dependent variable was the difference score between the posttest administration of the engagement instrument and the pretest administration. There was no difference between Twitter users ($M = 0.80$, $SD = 6.22$) and nonusers ($M = 0.43$, $SD = 6.52$) on engagement difference scores with $F(1, 133) = 0.11$, $p = 0.74$. We also conducted a one-way ANOVA with pretest engagement scores as the dependent variable and found that there were no preexisting differences in engagement between Twitter users ($M = 45.53$, $SD = 7.28$) and nonusers ($M = 47.06$, $SD = 8.84$; $F(1, 133) = 1.2$, $p = 0.28$).

To examine the effect of Twitter use on student grades, we also used a one-way ANOVA model with whether students used Twitter as the independent variable. The dependent variable was final course grade. Like with the analysis of engagement scores, there was no difference between

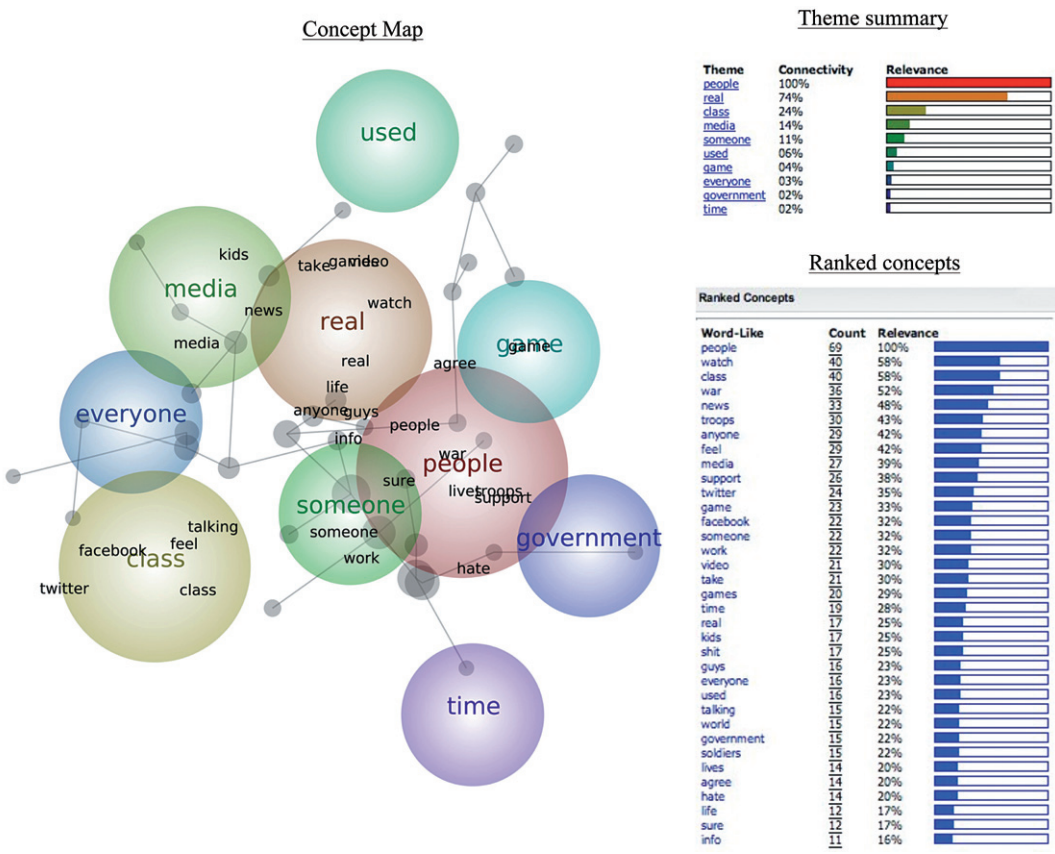

Figure 3: Leximancer concept map of themes, theme summary and list of ranked concepts from the Twitter corpus of Study #2. The circles and their labels in the concept map represent the higher-level themes based on the concepts in the dataset. The concepts are represented by the darker-colored words in the circles. The themes are heat-mapped to indicate importance (ie, the most important theme appears in red, and the next most important in orange, etc). The theme summary shows a list of all themes as well as their importance ranked by connectivity and relevance. The ranked concept list shows the name of each concept, the number of times it was found in the corpus of tweets and its relevance in the dataset

Twitter users ($M = 94.27$, $SD = 3.83$) and nonusers ($M = 92.79$, $SD = 7.77$) on course grade $F(1, 133) = 1.95$, $p = 0.17$. We also conducted a one-way ANOVA with high school GPA as the dependent variable in order to assess for preexisting academic ability differences. There were no differences between Twitter users ($M = 3.62$, $SD = 0.49$) and nonusers ($M = 3.57$, $SD = 0.46$; $F(1, 121) = 0.36$, $p = 0.56$).

Figure 1 shows the average number of tweets students sent each week of the semester. Students in Study 1 began tweeting at week 2 and tweeted through week 14, while students in Study 2 began at week 3 and tweeted through week 13. While students in Study 1 tweeted over a longer period, students in Study 2 sent a slightly higher number of tweets each week with the exception of weeks 12–14 when students in Study 1 were completing required assignments via Twitter. Figure 3 shows the themes extracted from the corpus of tweets for Study 2. Students in this study used Twitter almost exclusively for cognitive matters. The three most prevalent themes in the tweet data were, in order of strength:

1. *People*: The *People* theme was also one of the top three themes in Study 2; however, students tweeted about *people* differently than in Study 1. An example tweet illustrates the difference: "I don't think most young people realize that non-presidential elections are important as well." In this corpus of tweets, the word *People* was used as a synonym for society or different subsections of society (as illustrated by the example tweet). It was clear that these tweets were less critically reflective and focused than the *People* theme in Study 1; however, the *People* theme in this study was congruent with the focus of the course—modern society.
2. *Real:* In this study, students spent a good amount of time talking about connections between media and "real" life. For instance, one student tweeted: "Does anyone think that violence in video games can lead to violence in real life?" This theme was also congruent with a central theme of the course—exploring the relationship (or lack thereof) between media consumption and personal, psychological, and societal effects.
3. *Class:* Students tweeted about two things related to the *Class* theme: (1) Commentary about the class as evidenced in this tweet: "favorite class of the semester," and (2) arranging meetings with groups such as "community 14 want to meet up after class?" Interestingly, this theme was not related to the issue of social class, a theme that was discussed in a number of the offline class sessions.

General discussion

RQ1: How does explicit encouragement of Twitter usage (through course design) impact the relationship between student engagement and grades?

When students are required to use Twitter for a course and faculty engage with them regularly on the platform, there is an increase in student engagement and grades that was not seen when students were allowed to choose whether or not to use Twitter and when faculty rarely interacted with them on the platform. Study 1 established particular parameters for collaboration that implicitly facilitated and motivated students in ways that were not reproduced in Study 2, producing positive outcomes related to student learning. Whether these outcomes are linked to student motivations regarding grades is not clear. What is clear is that the different results between Study 1 and 2 cannot be explained by preexisting differences in engagement and academic ability in the groups that were required to use Twitter (Study 1) and who chose to use Twitter (in Study 2). This finding is of particular interest as, at least in these two samples, preexisting differences in engagement and academic ability cannot explain either Twitter adoption or positive outcomes derived through Twitter use.

RQ2: Are there differences in collaboration between a class that requires Twitter use and one that does not?

While qualitative analyses of tweets show that students in both studies discussed and collaborated on course content, such collaboration was not directly related to improved outcomes in Study 2. While only two of the educationally relevant activities in Study 1 specifically called for collaboration (organizing service learning projects and study groups), the amount of collaboration went beyond these activities. In Study 2, the collaboration among students was incidental as there were no requirements to do so. This finding provides evidence to support the idea that *how* instructors use Twitter (for example, to engage with students by answering questions, encouraging discussions and providing support) is an important factor in engagement and achievement gains seen with the intervention in Study 1. Specifically, faculty who are more engaged on the platform with their students will see greater gains in academic outcomes.

Junco *et al* (2011) suggested that future research take steps to evaluate the proportion of the variance that is due to the technology and the proportion due to the instructor in outcomes—we have done so here and found evidence, albeit limited, that both how Twitter is integrated into a

college course and how faculty interact with students on Twitter are important elements in such a design. This could be attributable to many factors including course requirements (students feel more compelled to participate in the forum in relation to achieving higher grades, the instructor's presence, etc), discursive novelty (students are able to engage with one another—not least of which, the instructor—in compelling ways), self-disclosure (perceived learning is linked to the perspectives one contributes), and, perhaps most important, a reconfigured sense of empowerment in relation to shaping the course design and meaningful outcomes.

Our data suggest that there may also be pedagogical affordances to Twitter as compared to Ning and other technologies. For instance, Twitter lends itself to a more engaging and continuous conversation than Ning, and this factor alone could have drawn students in the Twitter group in Study 1 to be more engaged. Ning updates resembled static posts such as those found on learning management system discussion boards and they received few student responses, while Twitter updates garnered multiple responses. Further research will want to evaluate the dynamics of each platform and include additional control groups to evaluate the pedagogical potential of each, separate from how they are used.

RQ3: What are the effective elements of integrating Twitter into college courses?

The data from these studies show three effective elements of integrating Twitter into college courses that can be considered best practices:

1. Requiring students to use Twitter as part of the course is important in affecting academic outcomes. Students in Study 2 who were not required to use Twitter did not see the engagement and academic benefits experienced by students in Study 1.
2. Twitter should be integrated into the course in educationally relevant ways. For Study 1, we used a theoretical framework (Chickering & Gamson's (1987) seven principles for good practice in undergraduate education) that guided Twitter integration. We did not use this framework for Study 2 instead allowing students to use Twitter in emergent and natural ways. Therefore, having a theoretical reason to use Twitter and implementing that reason into the course pedagogy will maximize the benefits achieved.
3. Faculty engagement on the platform is essential in order to impact student outcomes. In Study 1, faculty were actively engaging students on Twitter, while in Study 2, faculty maintained a more *laissez-faire* attitude. Interestingly, the students who used Twitter in Study 2 showed a trend toward higher grades that may have been significant with a larger sample size. Future research should examine if there are additional benefits received by students who are not required to use Twitter and whose faculty do not engage with them on the platform.

Limitations

The findings of both studies need to be expanded and replicated with larger samples, more diverse student populations and a variety of courses. Using a single model of student engagement is an additional limitation of these studies. Specifically, the Astin (1984) model is but one way to think about student engagement, and the NSSE is but one way to measure it (see Finn, 1993). A potential confounding factor for future research may be differences in adoption rates. In these studies conducted in two different classrooms at two separate times, we saw none of the students in the earlier study report prior Twitter use, while 43% in the later study reported either prior use or exploration. These differences may be because more students will adopt Twitter as time passes, differences in institutional cultures or both.

A further limitation relates to the challenges of framing/assessing collaborative learning outcomes. For example, while Kuh (2009) delineates engagement as occurring in class and out of class, the parameters of Twitter's virtual space clearly challenge such distinctions and any easy definition for understanding the educational praxis occurring across these delineations. Lastly,

providing incentives for students in Study 1 may have increased their motivation to be engaged as compared to students in Study 2. Conversely, the extent of one's investment in the activity related to Twitter might also have motivated positive feedback mechanisms extending beyond the instrumentality of using the platform simply to successfully achieve expected grading outcomes. Future studies should incorporate into their design structural considerations to offset the potential reproduction of the Hawthorne effect (McCarney *et al* 2007).

Conclusion

The incorporation of new technologies into the contemporary classroom remains an important and compelling development with regard to producing more effective learning strategies and outcomes. This study demonstrates that the design of teaching strategies and practices related to virtual engagement and collaboration is instrumental to achieving positive educational outcomes. It also underscores the need for contemporary students to improve their capacity to initiate self-directed, collaborative practices as a means to more effectively take ownership of their learning.

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Appendix

Engagement Instrument

In your experiences at _____ University during the current school year, how often have you done each of the following?

Very often, Often, Sometimes, Never

1. Asked questions in class or contributed to class discussions.
2. Participated in a community-based project (e.g., service learning) as part of a regular course.
3. Discussed grades or assignments with an instructor.
4. Talked about career plans with a faculty member or advisor.
5. Discussed ideas from your readings or classes with faculty members outside of class.
6. Worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc).
7. Discussed ideas from your readings or classes with others outside of class (students, family members, co-workers, etc).
8. Had serious conversations with students of a different race or ethnicity than your own.

9. Had serious conversations with students who are very different from you in terms of their religious beliefs, political opinions, or personal values.

During the current school year, about how often have you done each of the following?

Very often, Often, Sometimes, Never

10. Attended an art exhibit, play, dance, music, theater, or other performance.
11. Exercised or participated in physical fitness activities.
12. Participated in activities to enhance your spirituality (worship, meditation, prayer, etc).
13. Tried to better understand someone else's views by imagining how an issue looks from his or her perspective.
14. Have you done or plan to do community service or volunteer work before you graduate from _____ University?

Done, Plan to do, Do not plan to do, Have not decided

Mark the response that best represents the quality of your relationships with people at _____ University.

15. Relationships with other students.

Unfriendly, Unsupportive, Sense of Alienation ..... Friendly, Supportive, Sense of Belonging

16. Relationships with faculty members

Unavailable, Unhelpful, Unsympathetic ..... Available, Helpful, Sympathetic

17. Relationships with administrative personnel and offices

Unhelpful, Inconsiderate, Rigid ..... Helpful, Considerate, Flexible

18. To what extent does _____ University emphasize attending campus events and activities (special speakers, cultural performances, athletic events, etc)

Very much, Quite a bit, Some, Very Little

19. How would you evaluate your entire educational experience at _____ University?

Excellent, Good, Fair, Poor

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