



The Relationship between Class Size and Active Twitter Participation in the Engineering Classroom

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Introduction

The use of Twitter (<http://www.twitter.com>), a micro-blogging platform, in the higher education classroom has expanded in recent years as educators come to realize the benefits of social media use as a tool for faculty-student communication or for inter-student communication¹. While the literature on the use of Twitter in the classroom is emerging, recent studies have found the platform functional for promoting concise expression of ideas, critical reading and writing skills, stronger student-teacher relationships, self-learning in an informal environment, and accountability among other benefits². Further benefits have been found in relation to asking students to communicate the content of a given course to a broader, general-public audience^{3,4}. However, at the same time it can be a challenge to promote active participation in this sort of activity due to students' apprehension about putting themselves out there and being wrong. Similar apprehensions at the instructor level have limited the use of Twitter as a classroom resource⁵. Further, using Twitter in the classroom has potential disadvantages such as distracting content, overly constraining character limitations, and privacy concerns⁶. One hypothesis is that student apprehensions can be overcome by engaging a larger cohort of participants thus creating a sense of anonymity through presence within a large population. Further, the use of a larger participant pool increases the odds of it containing students who drive the online classroom discussion through their active participation. It is expected that the presence of such individuals lowers the barrier to entry for the rest of the students. This effect may be tampered by the limitations on student engagement in classes with large enrollments that have been observed in the literature.⁷

These questions were explored over a multi-semester study of student participation in directed Twitter discussions within an engineering mechanics classroom. First, a small cohort of students was used and later the same study was conducted with a large cohort of students. Comparisons will be made between these two cohorts on the basis of active engagement in the assigned tasks, course performance, and student perception of the tasks.

The tasks that students were asked to complete as part of the study involved required weekly postings to Twitter relevant to the topics of discussion in the course that week. With these tasks, it was intended for the student to look beyond their standard homework and relate to the course material in a new way, independent of their textbook or course notes. Similar work by others has demonstrated success in getting students to make the connection between the classroom and the "real world"⁸.

The deliverables for these tasks consisted of either a photograph or video, along with a written

description, of an object or event that demonstrates the concepts relevant to the week's course material. The students were also asked to comment on their peer's postings, thus spurring further discussion. Examples of students' work are presented along with discussion of lessons learned through this study. Evaluation of student learning outcomes will be discussed and comparisons will be made between the small cohort and large cohort groups.

Methods

The Twitter based tasks were explored over multiple semesters in an introductory course taken by engineering students. As this course is generally taken early in a student's undergraduate program, they often experience difficulty grasping the concepts presented and connecting them with real world experiences. To help promote a deeper understanding of these concepts, students were tasked with making regular posts to the microblogging service, Twitter, such that they might connect better with the course curriculum. The specific directions provided are given in Textbox 1. Two cohorts of students were studied; a small cohort, which consisted of a class size of 16 students and a large cohort, which had a class size of 46. Due to changes in the course offerings at the author's institution, the small cohort students were registered in a course covering both the topics of Statics and Dynamics. The large cohort students were registered in a course focused only on the topic of Dynamics.

Create one original Twitter post per week (photo/video + text) giving an example of something that demonstrates the concepts discussed in that week's classes. Also submit at least two comments in response to the posts of your classmates.

Textbox 1: Assignment instructions as provided to the students.

As discussed, Twitter was utilized as a means to both collect and promote discussions around student submissions. When posting to Twitter, students were asked to include a hashtag (#engmech) with each of their posts (tweets) to provide a means of quickly sorting and organizing relevant posts. Students were asked to produce one original submission on an approximately per week schedule corresponding with the submission deadlines for their normal homework assignments. Each original submission was expected to include a photograph or video and a brief descriptive statement that demonstrated the concepts discussed in that week's lectures. Students were also asked to submit at least two comments on the posts of their classmates. The instructor used limited direct participation in the ongoing Twitter discussion during the first few weeks of the semester in an attempt to spur student participation. After those initial weeks, the instructor posted more sparingly as needed. The majority of instructor participation was centered around course announcements or responses to student questions.

To facilitate archiving of student Twitter posts related to the class, all posts containing the #engmech hashtag were collected and analyzed using the Twitter Archiving Google Spreadsheet (TAGS)⁹. This tool allowed for automated collection of all tweets tagged appropriately along with the corresponding time stamp and performed high level analysis of the connections (mentions) between tweets.

Students in both cohorts were given pre- and post-assessments using the Concept Assessment Tool for Statics (CATS)¹⁰ for the small cohort and the Dynamics Concept Inventory (DCI)¹¹ for the large cohort. While it is not ideal that two different assessments had to be used, they provide some insight into the learning gains achieved within a given semester. Each of these concept inventories (CI) attempt to quantify achievement of learning outcomes in statics or dynamics, respectively. In addition to the CATS/DCI, performance on course examinations for each group was recorded as a group mean and standard deviation. While different for each cohort, the course examinations were written such that the difficulty of each was comparable.

In addition to the quantitative assessment performed using the concept inventories. Students were also given a qualitative self-efficacy survey¹² to assess student engagement outcomes that are difficult to capture. The questions included on this survey are shown below. The multiple-choice responses were constructed such that greater efficacy corresponds with descending order.

1. How would you rate your ability to identify statics and dynamics principles in your surroundings?
 - (a) I am not sure how the statics and dynamics principles discussed in this class relate to real life.
 - (b) I can understand the application of statics and dynamics to a real life example when shown an example.
 - (c) I can identify the statics and dynamics principles discussed in this class when I see them.
 - (d) I can analyze the statics and dynamics principles relevant to a situation that I observe.
2. How prepared are you to discuss engineering mechanics with others?
 - (a) I do not think that I could carry on a conversation about engineering mechanics with others.
 - (b) I could describe simple engineering mechanics ideas with someone but not in detail.
 - (c) I could discuss engineering mechanics in a thoughtful manner even on topics that are new to me.
 - (d) I seek out conversations about engineering mechanics because I want more people to understand how the world around them works.
3. How do you see yourself fitting within the greater engineering community?
 - (a) I am not sure how I fit into the greater engineering community.
 - (b) I see myself as an engineer who maintains a separation between my engineering job and personal life.
 - (c) I see myself as an engineer who actively promotes greater engineering knowledge in the world.
 - (d) I see myself as an engineer who does outreach in my community and encourages others to do the same.

4. During the semester how much have you discussed the course material outside of class?
 - (a) I have talked about it with my classmates when completing assignments.
 - (b) I have talked about it with my classmates when completing assignments and in other situations.
 - (c) I have talked about it with classmates and with faculty other than the course instructor.
 - (d) I have talked about it with friends and/or family in addition to classmates and/or faculty.
5. How would you describe your participation in the class Twitter discussions?
 - (a) I didn't participate in these discussions.
 - (b) I participated weekly but below the minimum required level (1 original post and 2 comments).
 - (c) I participated at the minimum required level (1 original post and 2 comments).
 - (d) I participated actively (above the minimum required level) and contributed thoughtful comments on the posts of my peers.
6. How would you rate the Twitter discussions used in this course?
 - (a) I feel that the Twitter discussions did not help me relate to the course material.
 - (b) I feel that the Twitter discussions were somewhat helpful but could have been better.
 - (c) I feel that the Twitter discussions helped me extend my knowledge of the course material.
 - (d) I feel that the Twitter discussions influenced my view of the world in an engineering context.

Results

For the small cohort, a total of 232 tweets were collected in the archive over ten assigned posting periods. Of this, approximately 114 (49%) of them were replies. For the large cohort, a total of 880 tweets were collected of which 516 (59%) were replies. The reply rate for the large cohort is comparable with what has been seen before¹³. A comparison of the number of posts for each cohort is shown in Table 1. It can be seen that on a per-student basis, the participation rate was not significantly higher and was actually lower than what has been seen previously with a cohort size of 36¹³. A plot of the the tweet volume versus time for each cohort is shown in Fig. 1. The peaks in the data correspond approximately with the submission deadlines for each of the ten assigned time periods.

Table 1: Participation metrics from both cohorts.

Cohort	# Tweets	Tweets/student	Tweets/student/assignment
Small cohort (N=16)	232	14.5	1.45
Large cohort (N=46)	880	19.1	1.91

If this data is further broken down to isolate the top 20% and the bottom 20% from each cohort, as shown in Table 2, we see that the bottom 20% of students in terms of participation was roughly equal for the small and large cohorts. However, for the top 20%, the students in the large cohort participated at a higher rate than the same selection from the small cohort. Where the small cohort students participated at the baseline required level, the large cohort students participated above the required level of three tweets per assignment on average.

Table 2: Participation metrics for top and bottom participants from both cohorts.

Cohort	# Tweets	Tweets/student	Tweets/student/assignment
Small cohort, bottom 20% (N=3)	15	5	0.50
Small cohort, top 20% (N=3)	87	29	2.90
Large cohort, bottom 20% (N=9)	40	4.4	0.44
Large cohort, top 20% (N=9)	360	40	4.00

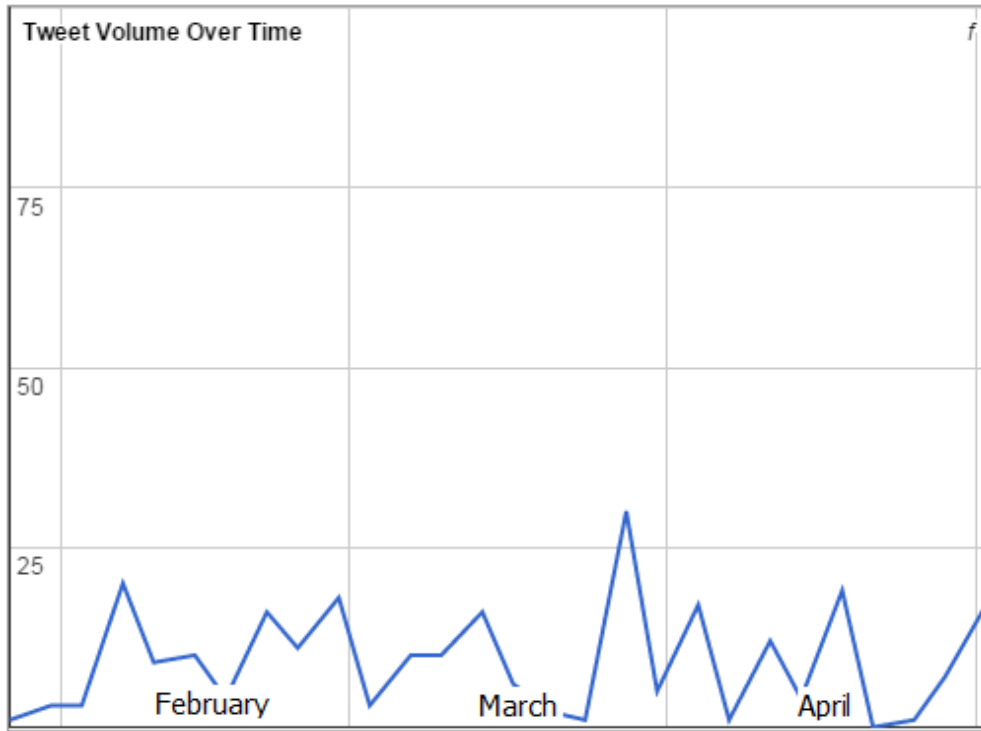
Consistent with what was previously reported, student posts via Twitter were typically *simple* in nature due to the limitations of the platform¹³. Posts primarily consisted of links to existing online content, photos of items relevant to the course content as shown in Fig. 2, or original videos demonstrating dynamics¹⁴. Comparing student submissions from both the small cohort and the large cohort suggests that each is approximately equivalent in quality and detail¹⁵.

Assessment

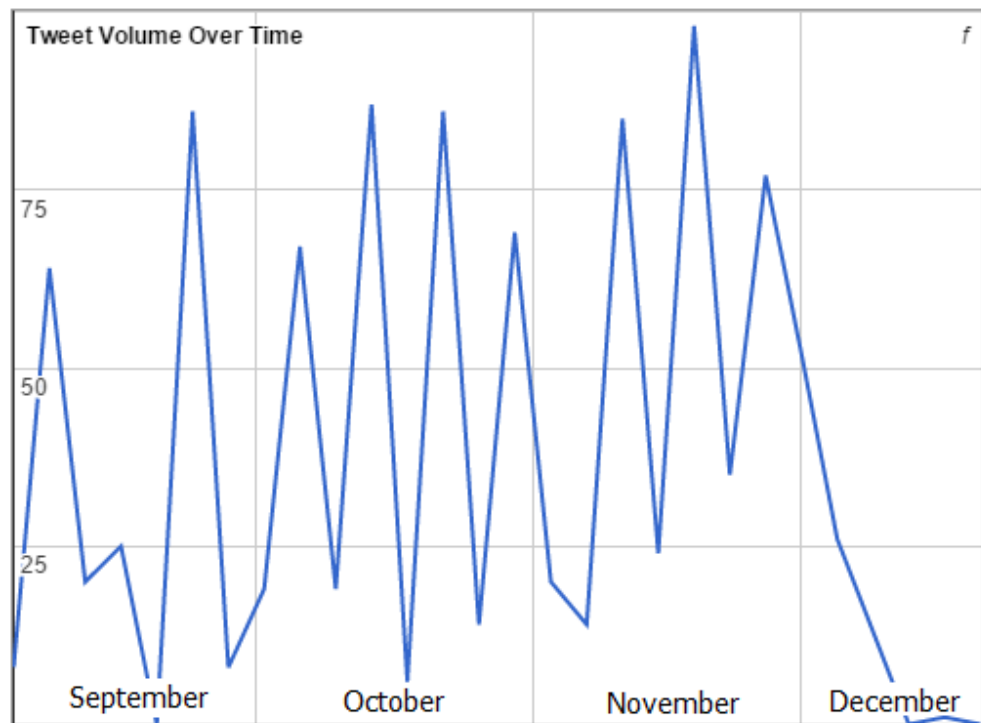
Quantitative data was collected from both the small and large cohorts. The results gathered from the initial assessment, performance on course exams, and post-assessment is presented in Table 3. Data is presented as average cohort performance for each cohort along with standard deviation for each average score. The results show that students in each cohort performed at a similar level for the initial assessment and for Exam 2. For Exams 1 and 3 and the post-assessment, the small cohort performed at a higher level than the large cohort. However, the variations in performance between each group were not statistically significant based on the standard deviation.

Table 3: Quantitative performance assessment for both cohorts.

Cohort	Pre-CI	Exam 1	Exam 2	Exam 3	Post-CI
Small cohort (N=16)	23.6 ± 9.0	85.7 ± 8.4	68.1 ± 15.1	74.9 ± 12.2	36.2 ± 14.3
Large cohort (N=46)	22.2 ± 8.3	74.0 ± 11.6	69.0 ± 11.2	60.4 ± 15.3	28.8 ± 10.3

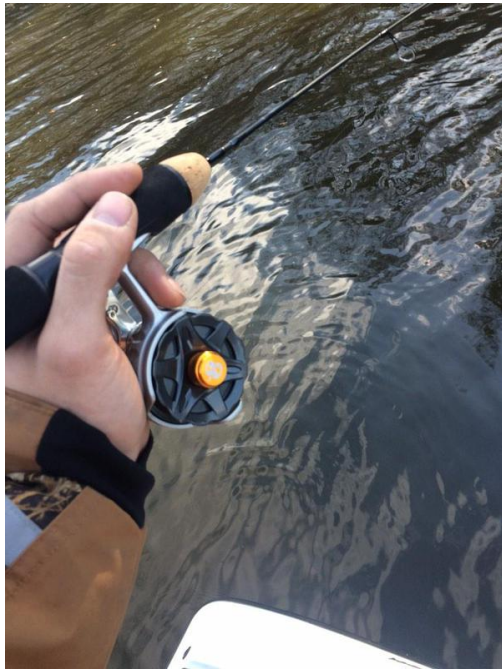


(a)



(b)

Figure 1: Volume of tweets over time for (a) the small cohort and (b) the large cohort.



(a)



(b)



(c)

Figure 2: Examples of student posts including (a) a fishing reel¹⁶, (b) bicycle suspension¹⁷, and (c) a rotational molding machine¹⁸.

Using the concept inventories, students within the small cohort (N=16) and large cohort (N=46) groups were evaluated at the beginning and end of each semester. The results for each cohort are plotted in Fig. 3. The solid line in each plot represents the plot locations where pre- and post-CI score were equivalent for a given student. Data points above the line indicate an improved score with greater distance from the line correlating to greater improvement of score. As can be seen, there is little measurable difference between the cohorts. Further, for both groups there was little variation in gains between lower performing students and higher performing students as indicated by the relative uniformity of score increases across the range of pre-CI scores. Interestingly, looking at the concept inventory scores for the top and bottom 20% of students measured by participation as presented in Table 2, the top 20% students for each cohort showed greater improvement when compared with the bottom 20%. For the small cohort, the percentage improvements in CI scores were 64.9% and 72.9% for the bottom and top 20%, respectively. For the large cohort, the percentage improvements in CI scores were 9.1% and 47.3% for the bottom and top 20%, respectively. Thus the small cohort displayed greater performance gains overall regardless of participation level, while the gains for the large cohort showed greater difference on the basis of participation level.

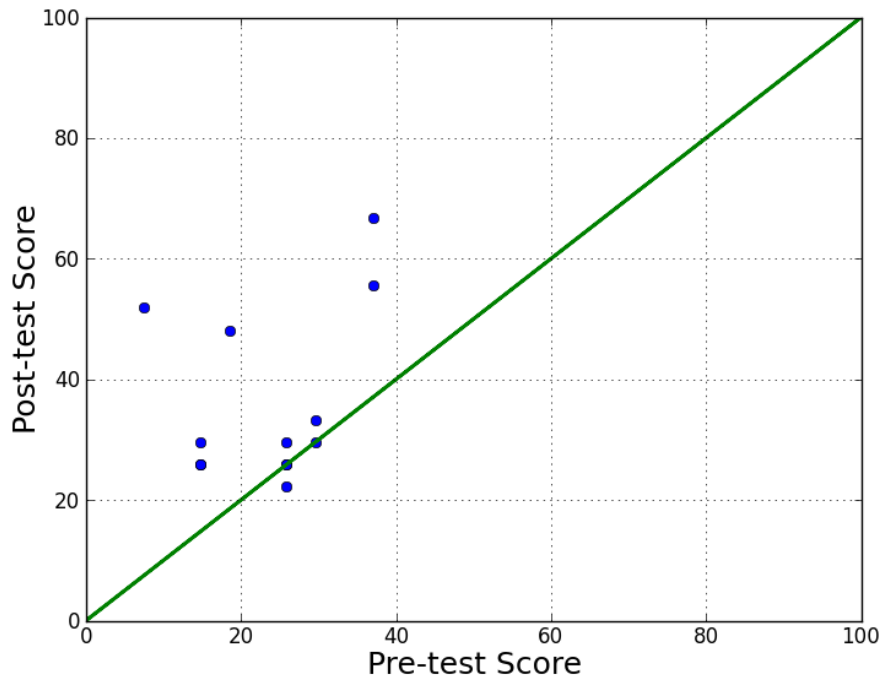
Results from the qualitative self-efficacy survey were collected and are shown in Table 4. The answers for each survey questions were coded such that (a) → 1, (b) → 2, (c) → 3, and (d) → 4. As such, the survey responses could be averaged as shown in the table. Each answer is in the inclusive range [1,4] with a score of 4 corresponding to greater efficacy. The results show that the self-reported efficacy for each question was comparable for each of the six questions with the small cohort having higher efficacy on five of the six questions.

Table 4: Results from the qualitative self-efficacy survey.

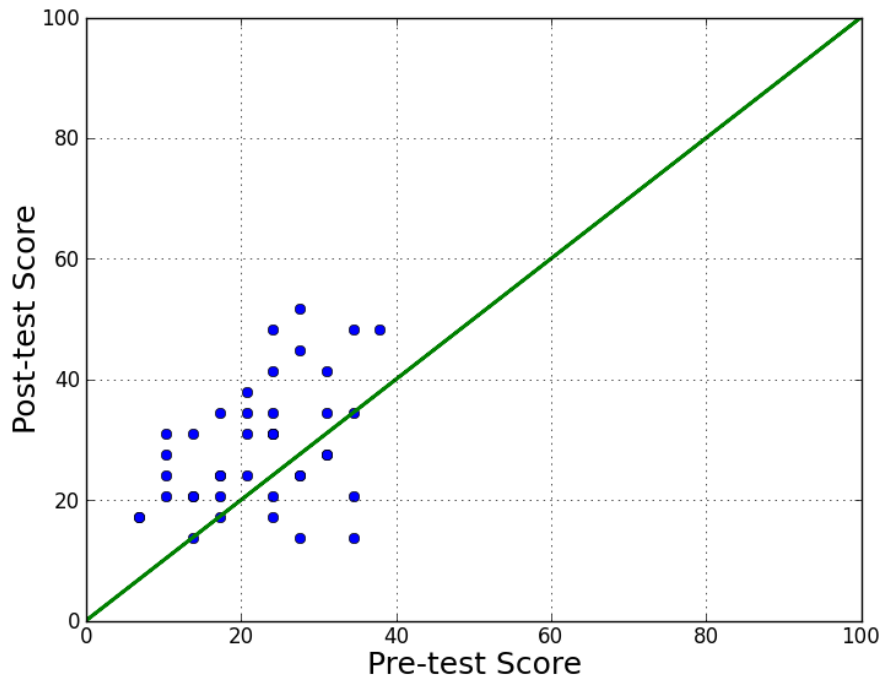
Question	Small cohort	Large cohort
(1) How would you rate your ability to identify statics and dynamics principles in your surroundings?	2.93 ± 0.68	2.75 ± 0.87
(2) How prepared are you to discuss engineering mechanics with others?	2.63 ± 0.72	2.36 ± 0.67
(3) How do you see yourself fitting within the greater engineering community?	2.70 ± 0.84	2.28 ± 0.83
(4) During the semester how much have you discussed the course material outside of class?	2.97 ± 1.17	2.26 ± 0.99
(5) How would you describe your participation in the class Twitter discussions?	2.57 ± 0.78	2.68 ± 0.85
(6) How would you rate the Twitter discussions used in this course?	2.03 ± 0.67	1.95 ± 0.83

Discussion

The hypothesis of this study was that a larger cohort of students would lead to greater class participation by cultivating a feeling of anonymity and by increasing the likelihood of the class



(a)



(b)

Figure 3: Pre- and post-CI results for both (a) the small cohort and (b) the large cohort. The solid line in each plot represents the plot locations where pre- and post-CI score were equivalent for a given student. Data points above the line indicate an improved score with greater distance from the line correlating to greater improvement of score.

having an active participant who would drive class participation. However, this hypothesis proved to be false. While the participation measured as tweets per student per assignment was slightly higher for the large cohort, it was still lower than was measured in previous studies. Student outcomes measured using concept inventories and course examinations found little difference between the cohorts with the exception of greater achievement correlated with higher participation for the large cohort relative to the small cohort. Finally, qualitative efficacy survey results showed that the small cohort had slightly better self-reported efficacy compared with the large cohort. In terms of achieving greater student engagement in such an activity, it has been the experience of the author that greater activity is driven largely by have a small number of students who push class participation. However, it would seem that this is not achieved just by virtue of a large class size and does not overcome the limitations of lower student engagement in larger classes as previously observed⁷. Therefore, some other incentive must be found to promote active participation.

Informally, students have communicated that they had difficulty remembering to complete the required Twitter postings and could often not think of anything to post. Further consideration is needed to determine how to address these issues. The author plans to continue use of this type of activity while finding ways to promote greater participation. For example, opening the assignment to a greater variety of social media platforms such as Facebook or similar may lower the barrier to entry for the students. Additionally, making use of a teaching assistant or past student to model active participation may encourage more students in the course to follow their example. These techniques remain to be explored through further study.

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