

# TEXT MESSAGING AS A TOOL FOR ENGAGING CHEMICAL ENGINEERING STUDENTS

S. PATRICK WALTON, DAINA BRIEDIS, STEPHEN D. LINDEMAN, AMANDA P. MALEFYT, AND JON STICKLEN  
*Michigan State University • East Lansing, MI*

**M**illennial/net generation students are more interconnected than any prior generation, often connecting through means not commonly used by the faculty. From a variety of social network sites to the pervasive use of mobile devices, these digital natives are fully comfortable interacting with people that, in some cases, they have never even met in person. Current modes of communication among instructors, however, still typically default to, in some order of preference, face-to-face meetings, e-mail, and phone calls. As such, there may be a disconnect in the ways students would prefer to interact with their instructors and the ways generally available to them. It would seem, then, that to maximize student engagement, retention, and support, instructors should, if possible and practical, interact with their students via means that students prefer.

A classic report established the “Seven Principles for Good Practice in Undergraduate Education.”<sup>[1]</sup> Among these principles, student-instructor interactions are explicitly listed as critical to maximizing student learning. Recent data, however, reveal that student-faculty contact outside of class occurs on average only once per month, with 9% of students not meeting with their instructors outside of class even once during an entire semester.<sup>[2]</sup> This lack of engagement with their instructors, combined with a reduced personal investment in their studies—today’s full-time students spend 13 fewer hours on coursework than students in past generations (27 vs. 40)<sup>[2,3]</sup>—has impaired student learning to the point that

one-third of students make no gains in critical thinking during four years of undergraduate education.<sup>[2]</sup> Although the faculty cannot make students choose to work harder, faculty members can encourage contact by continuing to evolve in

**S. Patrick Walton** is an associate professor in the Department of Chemical Engineering and Materials Science at Michigan State University. He received his bachelor’s and doctoral degrees at Georgia Tech and MIT, respectively. His research interests, in addition to education, are nucleic acid biotechnology and biomolecular engineering.

**Daina Briedis** is a faculty member in the Department of Chemical Engineering and Materials Science at Michigan State University. She has been involved in several areas of education research including student retention, curriculum redesign, and the use of technology in the classroom. She is active nationally and internationally in engineering accreditation and is a Fellow of ABET and of AIChE.

**Stephen Lindeman** is a junior at Michigan State University. He is majoring in chemical engineering with plans to pursue a concentration in biomedical engineering.

**Amanda P. Malefyt** is currently a graduate student in the Department of Chemical Engineering and Materials Science and a member of the Future Academic Scholars in Teaching (FAST) Fellowship program at Michigan State University. She received her bachelor’s degree from Trine (formerly Tri-State) University. Her research interests include engineering education and nucleic acid therapeutics.

**Jon Sticklen** is the director of the Center for Engineering Education Research at Michigan State University. He is also director of Applied Engineering Sciences, an undergraduate bachelor of science degree program in the MSU College of Engineering that focuses both on engineering and business. He also is an associate professor in the Department of Computer Science and Engineering. Over the last decade, he has pursued engineering education research focused on early engineering with an emphasis on hybrid course design and problem-based learning.

how they engage students both in and out of class. Applying new technologies is often a focus of new strategies/interventions in this regard.<sup>[4-7]</sup>

Among the technologies that should be considered is text messaging. Roughly 2.5 trillion text messages were sent worldwide in 2008.<sup>[8]</sup> A recent Pew Research Center project determined that 75% of 12- to 17-year-olds own a cell phone and use texting as their primary mode of communication with friends, texting at nearly twice the frequency of face-to-face interactions.<sup>[9]</sup> The frequency with which these students text also increases as they age, with older students (ages 14-17) sending roughly 60 messages per day and younger students (ages 12-13) sending 20. Interestingly, while text messaging was found to be the preferred means of peer communication, teens reported using voice calls preferentially to reach their parents. This suggests that these students recognize that different modes of communication can be useful for communicating with different social groups or for different purposes. Moreover, it may suggest that the manner by which students choose to communicate is indicative of the type of relationship they have or would like to have with the other party.

In this work, we sought to determine if students would want to use text messaging for professional communication about chemical engineering course content and if doing so would increase their engagement with the course. The genesis of the project was the observation that attendance at office hours seemed to have decreased dramatically in the last few years, an observation that was supported by anecdotal evidence from colleagues. Over the same time period, text messaging had become essentially universal among students.<sup>[9]</sup> It prompted the question of whether students' ubiquitous use of this form of communication, which is inherently distinct from face-to-face meetings in synchronicity, portability, and relative anonymity, was in some measure responsible for the decline in office-hours visits. Thus, could enabling texting for class communication re-establish the more traditional, and potentially more valuable, routes of communication?

## METHODS AND APPROACH

We focused this study on text messaging as it is more accessible and less formal than e-mail and presumably less intimidating than phone calls and face-to-face contact. It was important, however, to consider the practicality of using texting for an instructor who may not text for personal or professional communication (as was the case here). To address this issue and avoid privacy concerns, the texting contact number provided to the students was a free phone number provided through Google Voice.<sup>[10]</sup> Use of Google Voice allowed the instructor and TA to receive and respond to texts from their computers as if the texts were e-mails. In this way, the instructor (unlike the TA, who does text regularly) did not have to learn how to text or use his personal phone and number.

## *It was important to consider the practicality of using texting for an instructor who may not text for personal or professional communication (as was the case here).*

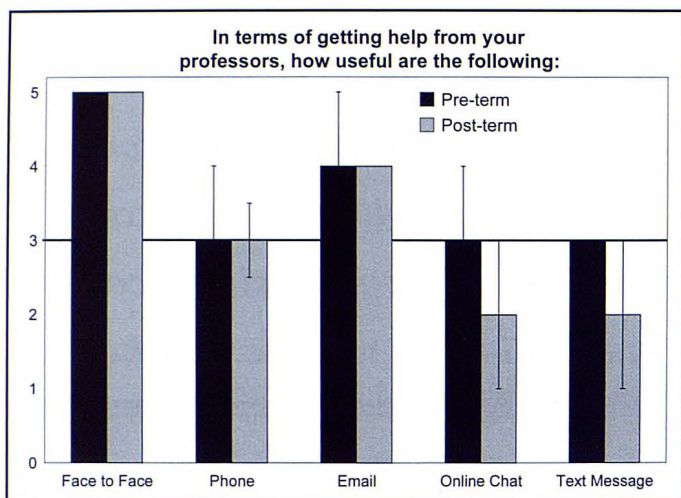
---

Our study primarily sought to test two hypotheses: i) that students would prefer to interact with their course instructor via text messaging, as compared to interactions by other means such as e-mail, phone calls, and office hours; and ii) that students who text message their instructor would also be more likely to interact using other means. The rationale of the second hypothesis was that if a student were willing to make initial contact with the instructor via a "comfortable" method (*i.e.*, text messaging), then perhaps the student would be more likely to engage further with the instructor through means with which the student may have initially been less comfortable (*i.e.*, a face-to-face meeting during office hours).

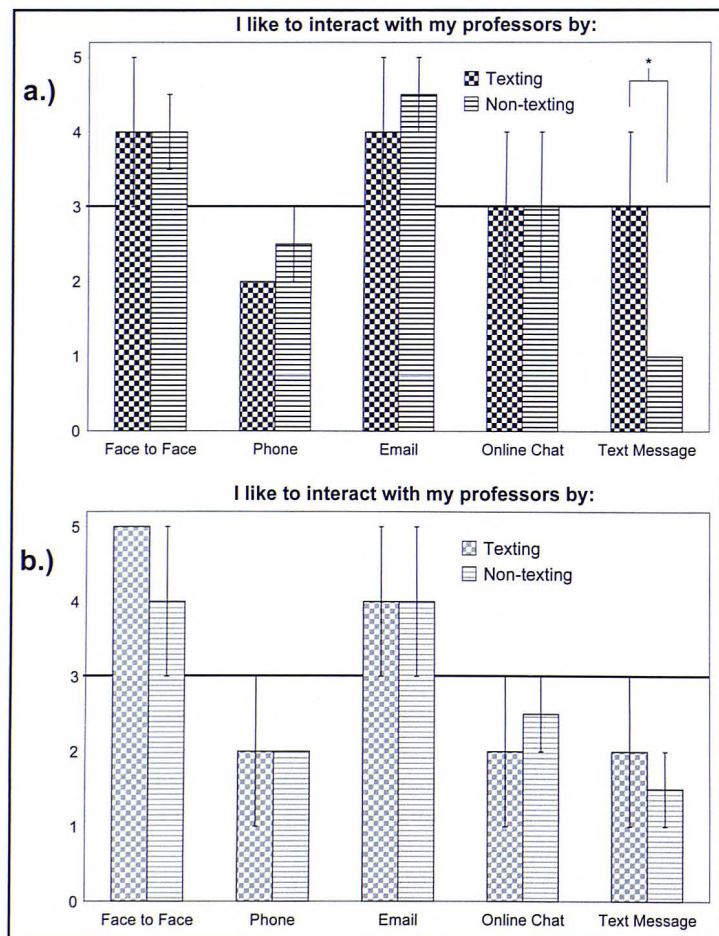
We tested these hypotheses during Material and Energy Balances in the Fall semester, 2010. The class was composed of 54% (38 of 71) first-semester sophomore chemical engineering majors with the remainder a distribution of years and programs (including biotechnology, environmental engineering, and chemistry). Recognizing the relative youth of the students in the class—students who are still learning to navigate college life to some measure—we felt that this class provided an ideal setting for testing whether using a relatively new mode of student-instructor communication would improve the frequency and utility of student-instructor interactions and, in turn, improve student performance, learning, retention, and attitude toward the discipline.

The study was set up with two parallel class sections, one in which student-instructor communication by text messaging was enabled in addition to the more traditional e-mail, phone, and face-to-face meetings. In the other section, only e-mail, phone, and face-to-face meetings were made available to the students. It should be noted that the instructor was the same for both sections and tried to be consistent in his interactions with the students. With this experimental design, we sought to determine if the availability of text messaging would change student perceptions and behaviors regarding the use of texting for communication with the instructor regarding course content.

Each day at the end of class, the students in both sections were asked to submit "muddiest point" papers detailing the



**Figure 1.** Comparison of utility of different communication strategies. Students were asked which communication methods they felt were most useful for getting assistance from their professors. Rating scale: 5 = always useful, 4 = useful, 3 = neutral, 2 = rarely useful, 1 = not useful. Only face-to-face meetings and e-mail were favorably viewed. These attitudes did not change between pre-term and post-term surveys. Data are reported as the median  $\pm$  the median absolute deviation; non-parametric statistical analysis by Mann-Whitney-Wilcoxon rank sum test; ranksum function in MATLAB with a significance threshold of  $p = 0.05$ .



## RESULTS AND DISCUSSION

We first wanted to measure students' perceptions of both the value in using a variety of modes for course communication as well as the students' preferences for one mode over another (Figures 1-3; note that throughout the results black shading and patterns are for pre-term data while gray shading and patterns are for post-term data; patterns are used to distinguish data from the texting and nontexting sections). Students indicated that face-to-face meetings and e-mail were the most effective means of getting course assistance (Figure 1), and these attitudes did not markedly change from pre- to post-term whether analyzed for all the students (Figure 1) or by comparing the students within each section (data not shown).

**Figure 2 (left).** Comparison of preference for different communication strategies. Students were asked which methods they preferred for communicating with the course instructor in pre-term (a.) and post-term (b.) surveys. Rating scale: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree. As with the utility question (Figure 1), only face-to-face meetings and e-mail were preferred. Interestingly, pre-term preferences showed a significantly more positive attitude toward texting among the students in the texting section (a, checkerboard). Data are reported as the median  $\pm$  the median absolute deviation; non-parametric statistical analysis by Mann-Whitney-Wilcoxon rank sum test; ranksum function in MATLAB with a significance threshold of  $p = 0.05$ . \* indicates  $p = 0.004$ .

most confusing part of the day's lecture. In the texting section, responses could be submitted by paper or text message, while in the nontexting section all of the submissions were on paper. Students in the texting section also had the number at their disposal for use outside of class. The classroom assessment exercise served to initiate the process of texting in the texting section and to give students regular reminders of its availability. We felt that this was a fair way to ensure that the students did not forget about the availability of the texting channel while not biasing them into thinking we wanted them to use it.

To assess the project, we recorded the number of text messages sent to the instructor and TA, attendance at office hours (name and section of each student), and the number of e-mail messages sent to the instructor and TA. In addition, we performed pre-term and post-term surveys investigating students' attitudes and preferences regarding student-instructor communication. We presumed that students would not have been given the opportunity to use text messaging in their earlier courses (our pre-term survey data bore this out with only two students indicating they had previously used text messaging to contact a professor).

There was, however, a difference in attitude towards texting between the two sections in the pre-term surveys (Figures 2a and 3a), although this difference was not evident in the post-term results (Figures 2b and 3b). The difference in initial attitude may be a reflection of the timing of the pre-term survey. Both sections were surveyed immediately following the first class of the semester during which the syllabus was discussed and the students in the texting section were made aware of the availability of texting communication. The students' audible response to this information (excited murmuring) suggested that they were glad to have this communication channel available. This alone may be evidence suggesting that making text messaging available to students may improve their engagement.

Why then did the difference not persist? Firstly, despite their near universal use of text messaging to communicate with each other,<sup>[9]</sup> the students hardly used texting to communicate with the instructor and TA during the term—only 22 total messages were sent to the instructor and TA during the entire semester. Similar reluctance has been seen by others in relation to using Facebook and Twitter to interact with instructors<sup>[11,12]</sup> and was specifically described by some students' comments in the open-ended sections of both the pre-term and post-term surveys:

*"I would never text message a professor or TA. It just seems weird to me."*

*"Personally, I would find text messaging my professor to be really strange."*

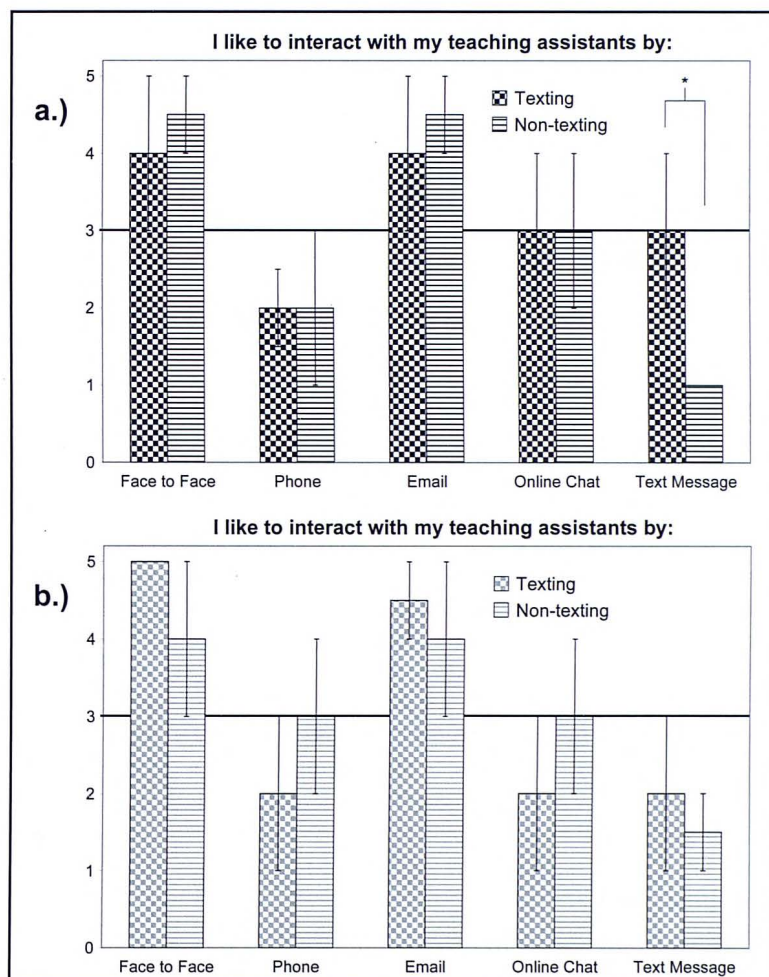
Based on these results, we speculate that students, in general, consider text messaging an immediate, informal, and private approach to communication with their peers and social networks that is not suitable for purely professional contacts such as instructors.

Secondly, at the end of the first lecture, a number of students attempted to text muddiest-point responses but could not due to lack of cellular signal in the classroom. This very likely limited the frequency of texting responses, whether in or out of class, for the entire term, if for no other reason than the number was not already stored in the students' phones. This should also serve as a caveat for those who may be interested in applying cell phone-based technologies in the classroom for any purpose.

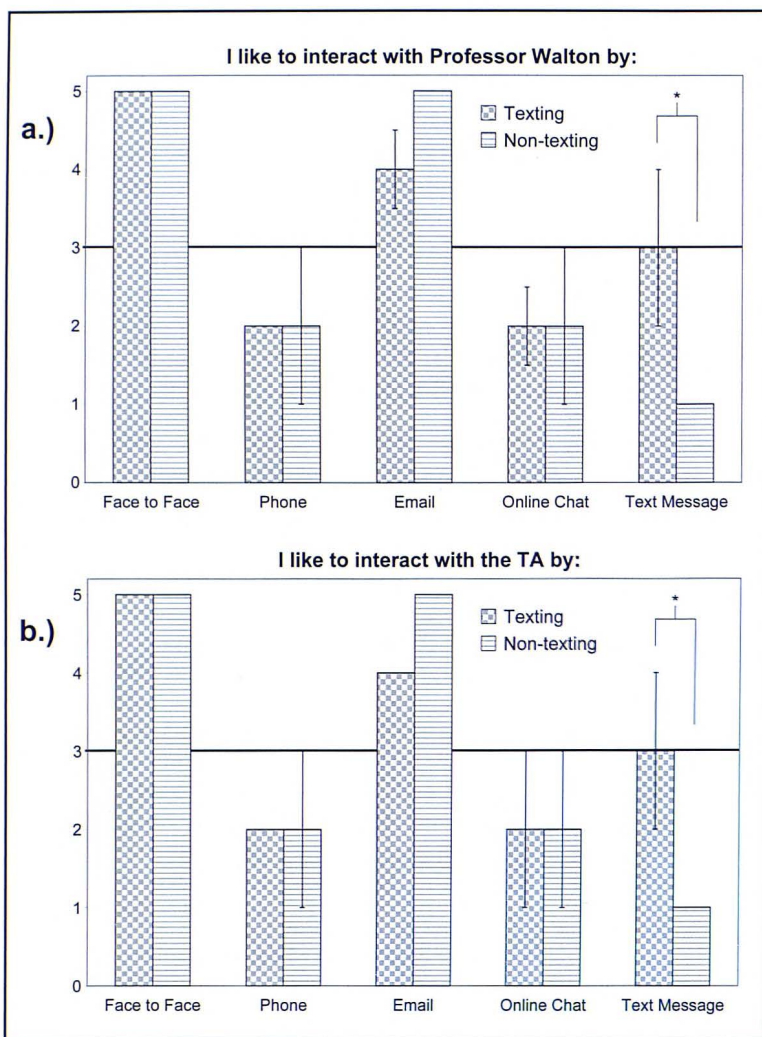
Ultimately, the number of muddiest-point submissions by paper (over 1,000) far exceeded the

number by text message (8). Perhaps with their pencils/pens already in hand for note-taking, paper submissions proved more convenient. Another explanation is that longer submissions or submissions containing mathematical symbols, though both of these were rare, were more easily completed by paper. Regardless, this underscores that students will decide which learning approach they feel is best/easiest for them, making it important to demonstrate the value of new technologies being used in instruction.

It should be noted that the text messages that were sent outside of class were not about course content but rather setting up meetings or letting the instructor know that the student would not be able to attend class. The instructor and TA did not make the students aware that



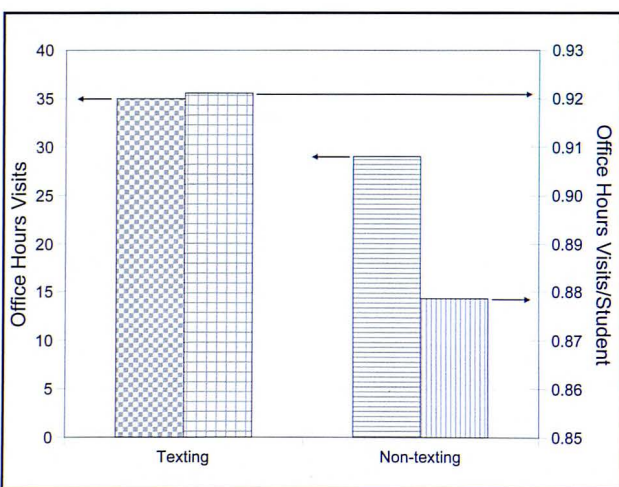
**Figure 3.** Comparison of preference for different communication strategies. Students were asked which methods they preferred for communicating with the course TA in pre-term (a.) and post-term (b.) surveys. Rating scale: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree. As with the utility question (Figure 1), only face-to-face meetings and e-mail were preferred. Interestingly, pre-term preferences showed a significantly more positive attitude toward texting among the students in the texting section (a, checkerboard). Data are reported as the median  $\pm$  the median absolute deviation; non-parametric statistical analysis by Mann-Whitney-Wilcoxon rank sum test; ranksum function in MATLAB with a significance threshold of  $p = 0.05$ . \* indicates  $p = 0.006$ .



text messages sent to them would not go directly to their phones. Perhaps if they knew that sending text messages outside of class would not interrupt the instructor and TA, they would have been more likely to text. Alternatively, if they knew that they would not necessarily receive an immediate response to a text, perhaps they would be even less likely to send messages in this manner. In future studies, we will continue to explore these questions.

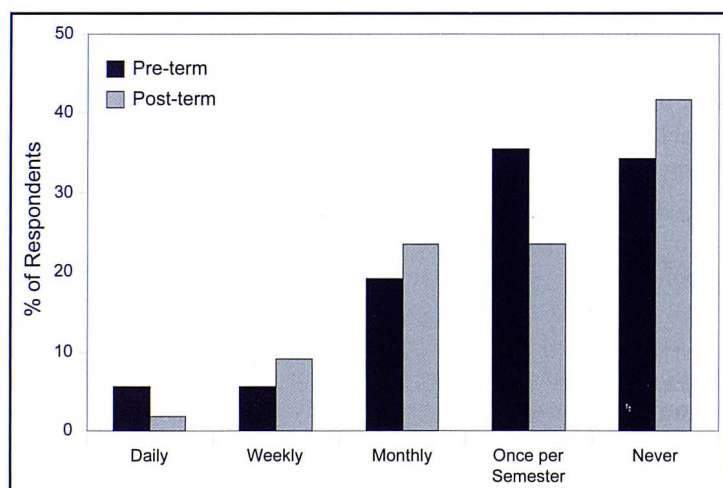
### Potential Impact: Text Messaging Availability

Despite no persistent change in expressed preferences towards communication and little overall use of texting, having the texting channel available may still have had an impact on student attitudes and behavior. In comparing the post-term results from the two sections, there was a significantly higher, if still only neutral, rating of text messaging in the texting section vs. the nontexting section, but only in regards to the specific instructor and TA (Figure 4).

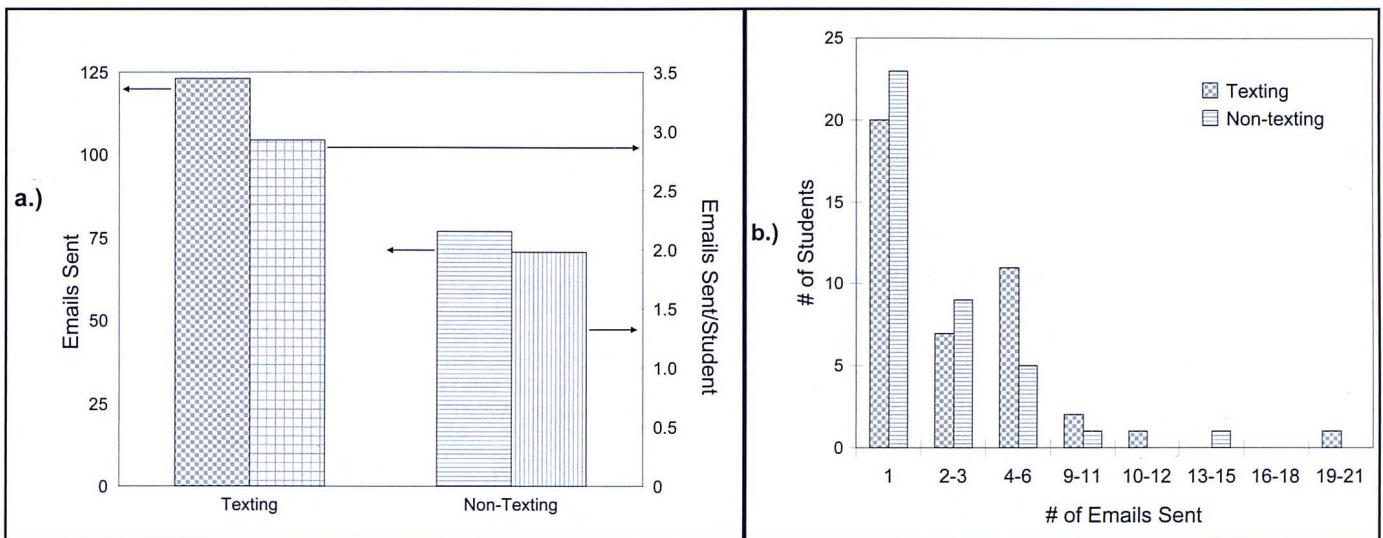


**Figure 5.** Impact of the availability of texting on student attendance at office hours. Students in the section with texting attended office hours more times overall (checkerboard, left axis) and at a slightly higher per student frequency (boxes, right axis) than students in the section without texting (horizontal and vertical lines, respectively).

**Figure 4 (left).** Impact of the availability of texting on post-term student preferences. A comparison of the post-term preferences from the texting (checkerboard) and non-texting (horizontal lines) sections shows that the texting section expressed a significantly higher preference for text messaging with regards to the specific instructor (a.) and TA (b.). Rating scale: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree. Data are reported as the median  $\pm$  the median absolute deviation; non-parametric statistical analysis by Mann-Whitney-Wilcoxon rank sum test; ranksum function in MATLAB with a significance threshold of  $p = 0.05$ . \* indicates  $p = 0.002$  (a) or  $p = 0.024$  (b).



**Figure 6.** Pre-/post-term comparison of students' interactions with any single instructor. Students were asked how frequently they met with their instructor outside of class for any reason. Roughly 90% of respondents said monthly or less frequently.



**Figure 7 a. (left) and b. (right),** Impact of the availability of texting on student e-mail communication. a.) Students in the texting section e-mailed the instructor and TA more times during the semester (checkerboard, left axis) and with a greater per-student frequency (boxes, right axis) than students in the section without texting (horizontal and vertical lines, respectively). Standard deviations on the frequencies are not shown for image clarity. Mean  $\pm$  standard deviations for the texting and non-texting section frequencies are  $2.9 \pm 3.8$  and  $2.0 \pm 2.8$  e-mails/student, respectively. b.) Shown are the histograms for the number of students who sent a certain quantity of e-mail messages to the instructor and TA. The results show that the bias seen in (a) is not simply a result of all of the most prolific e-mail senders being in the texting section.

Thus, while general attitudes remain unchanged, the attitude with respect to specific individuals, with whom the students have established a rapport, improved. As such, it may be that repeated opportunities to use texting for classroom purposes may make it less unusual and uncomfortable for students. Students entering/attending universities today will increasingly have had opportunities to use texting to interact with their high school teachers and college professors, so attitudes may be evolving even now. Nonetheless, regarding our first hypothesis, our results indicate that students currently do not prefer to text message with their instructors, rather stating that e-mail and face-to-face contact are still the preferred modes of contact for professional endeavors.

Examining our second hypothesis, did the availability of texting, despite its limited use, influence students' behavior regarding other modes of contact? The students in the texting section did attend office hours more frequently than students in the nontexting section (Figure 5), although the increase was minimal (examine scale of right axis in Figure 5). In fact, when comparing pre-term and post-term self-reported likelihood to interact with their professors outside of class, no increase in self-reported interaction frequency was seen, either when examined for the class overall (Figure 6) or by section (data not shown). Unfortunately, disengagement has been found to be common among engineering students, worsening with increasing seniority.<sup>[13]</sup> The availability of texting does not seem to have improved engagement by the metrics of increased face-to-face contact at office hours or self-reported face-to-face meeting frequency.

Yet there may still have been an effect. In comparing the number and frequency of e-mail messages sent by students in each of the two sections (Figure 7a), students in the texting section e-mailed the instructor nearly 50% more frequently than the students in the nontexting section. It is often the case that a few students e-mail frequently while many students rarely do so. We wanted to ensure that it was not simply a situation where all of the prolific e-mail senders happened to be in the texting section (Figure 7b). The data show that while the most prolific sender (20 messages) was in the texting section, the second most prolific (14 messages) was in the nontexting section. With both sections of similar size (~40 students) and generally comparable in demographics, we could not identify another obvious reason for students from the texting section to contact the instructor more frequently. Although the result is not statistically significant ( $p = 0.20$  by t-test comparing the per student means for each section), it does suggest that students in the texting section may have perceived a better rapport with the instructor, a factor known to support learning,<sup>[14]</sup> and so were more willing to initiate or sustain some form of communication with the course instructor.

We attempted to assess whether this sense of enhanced rapport existed by asking the students if they felt that the instructor and TA for the course were "cool," leaving it to the students to define what cool means to them. With regards to the course instructor and TA, all of the students in both sections rated them highly, so no difference was seen between the sections (data not shown). When comparing professors and TAs in general, however, the texting section rated professors

and TAs that use texting as significantly more “cool” than students in the nontexting section (Figure 8). We believe this result to be a reflection of a greater sense of rapport between the students in the texting section with the instructor and TA, supporting our contention regarding the relatively higher e-mail contact from the texting-section students.

## CONCLUSIONS AND FUTURE DIRECTIONS

First, our data strongly suggest that students choose e-mail and face-to-face contact as their primary modes of communication, even with other choices available. We do not fully understand the motivations for these choices, however, especially in light of the evidence about different communication modes they use with peers. Second, students do not take full advantage of opportunities to interact with their instructors, regardless of the means available to them, potentially leading to long-term disengagement from their coursework and impediments to their success.

Further study will be required to confirm if the availability of text messaging can serve as a means of driving greater rapport and engagement and establish any downstream relationship to improved student retention and/or performance. We will continue to make text messaging available to the students as a means of communication, as we believe both in the impact made and that students’ attitudes will continue to evolve towards accepting the technology as a means of professional communication. As with any aspect of course construction, instructors need to manage it in a way that is practical for them (e.g., use e-mail to respond to texts, establish guidelines for use).

Absent from our current study was the impact of student-student interactions on student engagement and performance. In particular, what utility do social network sites have for students with respect to their coursework? Also, does class size influence the likelihood that students will use texting? As we go forward, we will also begin to investigate these and other important questions regarding how best to engage and teach students in the current age.

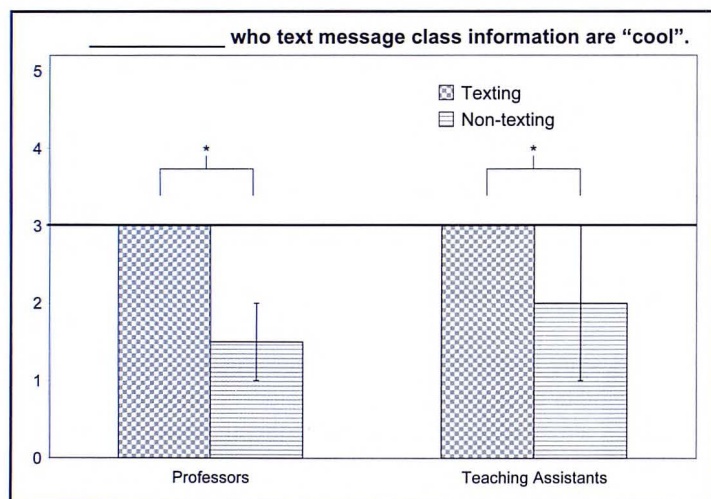
## ACKNOWLEDGMENTS

We would like to thank the students for their willingness to participate in this study. We would also like to thank Joanna Bosse, Robin DeMuth, Deborah DeZure, Dana Infante, Khadidiatou Ndiaye, Tobias Schoenherr, Cindi Young, Mark Urban-Lurain, and Nicole Ellison for helpful discussions about this work. Funding support was provided by the Lilly Fellowship program at Michigan State University. Portions of this work were previously presented at the 2011 ASEE Annual Conference and Exposition and published in the corresponding Proceedings.

## REFERENCES

1. Chickering, A.W., and Z.F. Gamson, *Seven Principles for Good Practice in Undergraduate Education*, American Association for Higher Education (1987)
2. Arum, R., J. Roksa, and E. Cho, *Improving Undergraduate Learning: Findings and Policy Recommendations from the SSRC-CLA Longitudinal Project*, Social Science Research Council <[http://higher.ed.ssrc.org/files/SSRC\\_Report.pdf](http://higher.ed.ssrc.org/files/SSRC_Report.pdf)> (2011)

3. Babcock, P.S., and M. Marks, “The Falling Time Cost of College Evidence from Half a Century of Time Use Data,” *The Review of Economics and Statistics* (2011)
4. Liberatore, M.W., “YouTube Fridays: Engaging the Net Generation in 5 Minutes a Week,” *Chem. Eng. Ed.*, **44**(3) 215 (2010)
5. Hadley, K.R., and K.A. Debelak, “Wiki Technology As a Design Tool for a Capstone Design Course,” *Chem. Eng. Ed.*, **43**(3) 194 (2009)
6. Heys, J.J., “Group Projects in Chemical Engineering Using a Wiki,” *Chem. Eng. Ed.*, **42**(2) 91 (2008)
7. Adams, R., D. Evangelou, L. English, A.D. Figueredo, N. Mousoulides, A. Pawley, C. Schifellite, R. Stevens, M. Svinicki, J.M. Trenor, and D.M. Wilson, “Multiple Perspectives on Engaging Future Engineers,” *J. Eng. Ed.*, **100**(1) 48 (2011)
8. Stross, R., “What Carriers Aren’t Eager to Tell You About Texting,” *New York Times*, <<http://www.nytimes.com/2008/12/28/business/28digi.html>> (2008)
9. Lenhart, A., R. Ling, S. Campbell, and K. Purcell, *Teens and Mobile Phones*, Pew Research Center Internet and American Life Project, <<http://pewinternet.org/Reports/2010/Teens-and-Mobile-Phones.aspx>> (2010)
10. *Google Voice—One Phone Number, Online Voicemail, and Enhanced Call Features*, available from <<http://www.google.com/voice>>
11. Hewitt, A. and A. Forte, “Crossing Boundaries: Identity Management and Student/Faculty Relationships on the Facebook,” in *CSCW2006* (2006)
12. Johnson, K.A., “The effect of Twitter Posts on Students’ Perceptions of Instructor Credibility,” *Learning, Media & Technology*, **36**(1) 21 (2011)
13. Eris, O., D. Chachra, H.L. Chen, S. Sheppard, L. Ludlow, C. Rosca, T. Bailey, and G. Toye, “Outcomes of a Longitudinal Administration of the Persistence in Engineering Survey,” *J. Eng. Ed.*, **99**(4) 371 (2010)
14. Murray, H.G., “Low-Inference Classroom Teaching Behaviors and Student-Ratings of College-Teaching Effectiveness,” *J. Ed. Psychology*, **75**(1) 138 (1983) □



**Figure 8.** Student attitudes towards professors and TAs who use texting for course communication. Students in the texting section declared professors and TAs who text to be significantly more “cool” than did students in the non-texting section. Rating scale: 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree. Data are reported as the median  $\pm$  the median absolute deviation; non-parametric statistical analysis by Mann-Whitney-Wilcoxon rank sum test; ranksum function in MATLAB with a significance threshold of  $p = 0.05$ . \* indicates  $p = 0.022$  (professors) or  $p = 0.031$  (teaching assistants).