USE OF FACEBOOK IN TEACHING
A Case Study of a Fluid Mechanics Course

Sachin A. Mandavgane
Visvesvaraya National Institute of Technology • Nagpur, India

Social media is increasingly being used for educational purposes. According to Wikipedia, Facebook (FB) is used by many undergraduate students (Figure 1).[1] As can be seen in the figure, the majority of users are in the age group of 18–25 years. Similar results are also reported by Bicen and Cavus.[2] A recently published statistic indicated that about 70% of users visit the site daily and more than 50% visit more than once a day (Figure 2). As of June 2014, FB had over 1.3 billion active users.[3] College students use FB in a plethora of ways to perform a wide range of social tasks, including staying in touch with friends from high school, hometowns, and other departments, or coordinating social activities and college clubs. However, the use of FB as a teaching-learning tool inside and outside the classroom has not yet been explored in-depth. It has been hypothesized that undergraduates would like to use FB for learning if they get the opportunity.

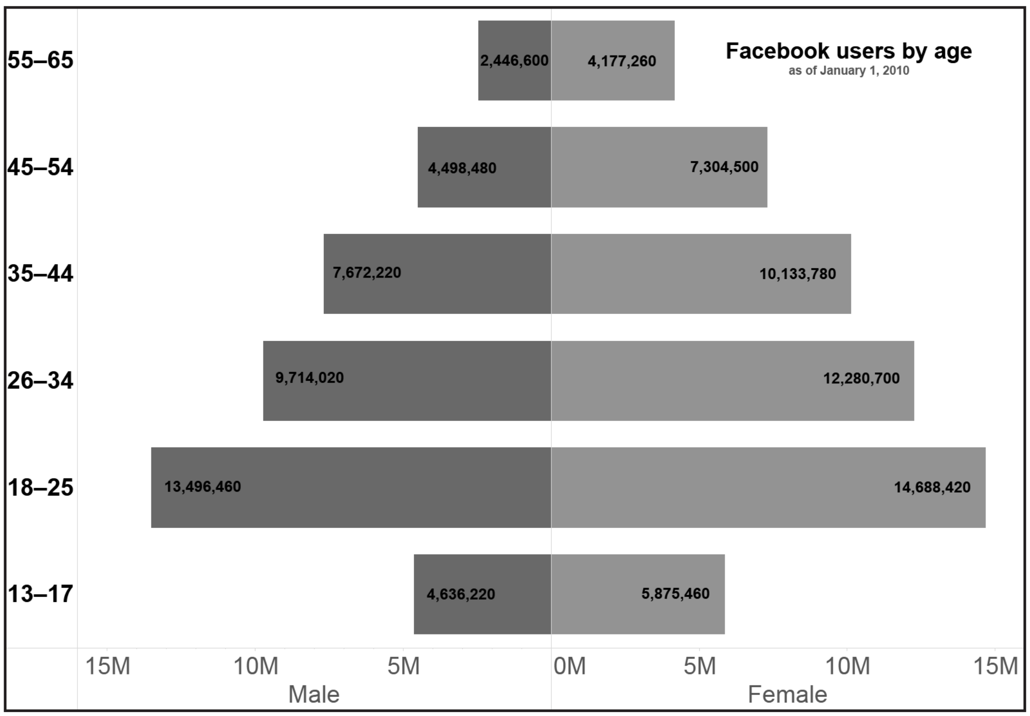


***Figure 1.** Population pyramid of Facebook users by age. Data as of Jan. 1, 2010 (Source: Wikipedia page of Facebook).*

An OnlineCollege.org report explored various ways to use FB in the classroom.[4] The report suggested that teachers can

***Sachin A. Mandavgane** is an associate professor in the Department of Chemical Engineering at Visvesvaraya National Institute of Technology, India. He received his UG, PG, and Doctoral degree from Laxminarayan Institute of Technology, India. His research interests include adsorptive separation, waste and biomass utilization, sustainable engineering, and Indian traditional knowledge. His teaching interests include use of social media for teaching and UG research.*

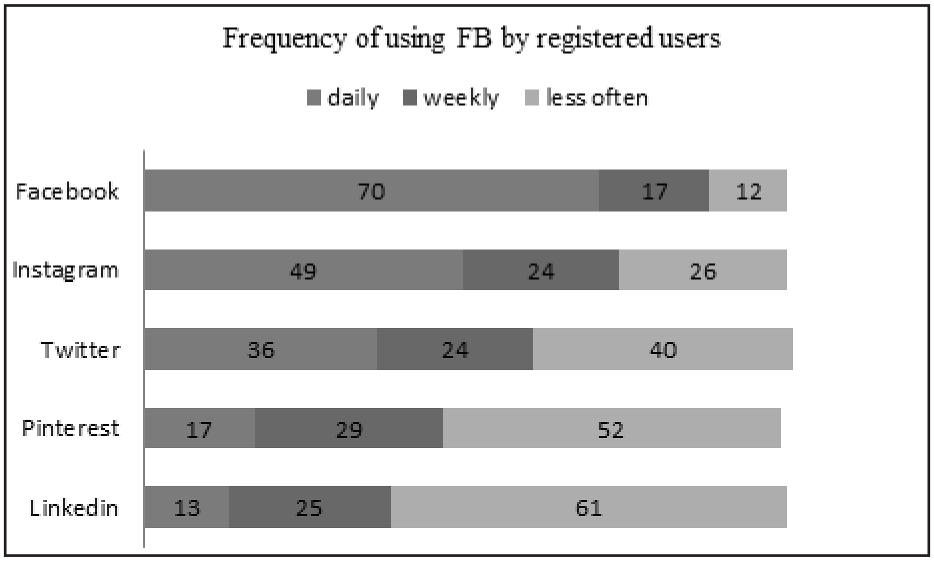


Figure 2. *Frequency of FB use by registered users (Source: Pew Research Center, Washington, DC, USA).*

Grosseck, et al[7] investigated how students perceive the use of FB for academic purposes and how/if they integrate it into their learning and training curricula. The authors found that most students spend a significant amount of time on FB for social reasons and less for academic purposes. This is the case even if they take part in discussions about their assignments, lectures, study notes, or while sharing information about research resources, etc.

To the best of this author's knowledge, no article has thus far reported on the use of FB in engineering education and in particular about fluid mechanics (FM). Herein, a case report is presented on the use of FB for teaching/learning/assessing the FM course for undergraduate chemical engineering students. An FB page entitled "Fluid Mechanics Videos" (<https://www.facebook.com/fluidmech>) was created and students were given an assignment to make a video about the application of FM in day-to-day life then upload it on the FB page. In this paper, the students' feedback on this eLearning module is presented along with advantages of achieving various accreditation objectives through the video-making (VM) assignment.

utilize FB for facilitating class projects, enhancing communication, and engaging students in a manner that might not be entirely possible in traditional classroom settings. Another report by TeachThought suggested utilizing FB in education by category.[5] Among the suggested categories, a few have been tried, whereas others are just suggestions that require further validation. Kabilan, et al.[6] found FB a useful and meaningful learning environment that supported, enhanced, and/or strengthened students' learning of English at University Sains Malaysia, Penang. For effective utilization of FB as a learning tool, the authors suggested integrating this social medium with predetermined learning objectives and outcomes.

Bicen and Cavus[2] studied the trends of FB usage among undergraduate students using a survey, which addressed the following:

- *Common places where Facebook is used (*e.g., *home, cafe).*
- *Time spent by students (in hours/day) to perform various activities on Facebook.*
- *The most preferred Facebook tools by students (*e.g., *chats, games).*

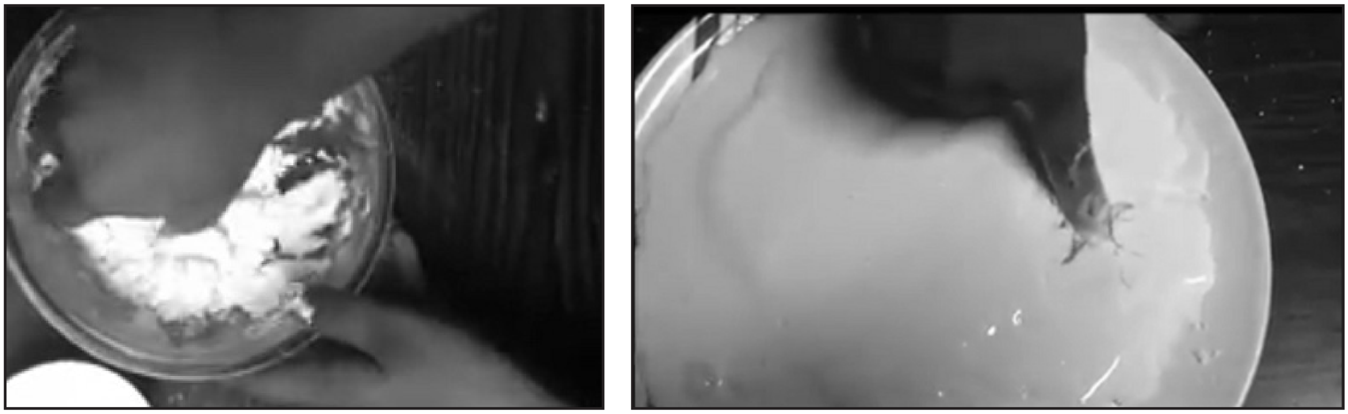
The survey results showed that the home is the most preferred place for using FB (29%) and most students (32%) used FB for more than 4 hours mainly for exchanging messages and private/personal chats. A similar result was reported by Madge, et al.,[1] who evaluated first-year undergraduates' opinions on using FB via an online survey. A majority of students in that study noted that they use FB mostly for social reasons, rather than for formal teaching/learning purposes. Some students noted that FB is sometimes used informally for learning purposes.

ABOUT THE FM COURSE

The FM course covers the following topics[8,9]: properties of fluid, fluid statics, law of conservation of mass/momentum/energy, flow of incompressible fluid through pipe, flow past solid, flow through a porous medium, transportation and metering of fluid, and agitation and mixing of fluid. The author of this paper regularly provides conventional assignments such as quizzes and problems from the textbooks[8,9] to his students. It was thought to design an assignment where

- *the probability of copying is zero*
- *every student group gets a unique problem, which needs to be solved by innovativeness and creativity*
- *students will think originally*
- *the author will meet accreditation objectives*
- *students enjoy learning*

Following the assignment, the students were asked to make a video demonstrating the principles of FM learned in the classroom. All students welcomed this idea and made videos very enthusiastically. The learning objective of the VM exercise was to make students demonstrate the fundamentals of FM in a creative and innovative way.



Figures 3. *Snapshots from a video demonstrating the non-Newtonian fluid principle. (A, left) Corn flour and water are mixed in a bowel. (B, right) Response of flour paste when applying shear (force) by putting and moving a finger in the paste.*

CASE STUDY

The author of this paper is an associate professor of chemical engineering and has been teaching the FM course to second-year B Tech Chemical Engineering students since 2010 in VNIT, Nagpur, India.

Course name: Fluid Mechanics (CML 262)

Course level: second-year

Number of students registered: 90 (July-December 2014)

Upon completion of 75% of the course module, all students were asked to form teams of four. Each student team was then asked to make a video on the application of FM in day-to-day life. Students generally have smartphones or at least one in the team has a device with a good-quality camera. The student teams were briefed by the study author about how to select a topic for this VM assignment. The VM assignment had the following conditions: (1) at least one of the team members should appear in the video (this curbs the possibility of copying any online material); (2) the commentary on the underlying FM principle in the video should be given only by team members; (3) the video should be uploaded on FB. An FB page entitled “Fluid Mechanics Videos” has been created where videos are uploaded and tagged to each team member and to the author. Thus, the video appears on the FB timeline of each member and the author; the video can also be viewed by the students’ friends. Thus, the uploaded videos get wider visibility, more comments, and reviews by friends, alumni, faculty, and peers. In the last four years of teaching, students prepared videos covering the following topics of fluid mechanics: properties of fluid (surface tension, viscosity, buoyancy, flotation, etc.), stress-strain relationship of non-Newtonian fluids, law of conservation of mass/linear momentum/energy, applications of Bernoulli’s equation, flow past solid, and flow through a porous medium.

ABOUT VIDEOS

Video of non-Newtonian fluid

A group of students planned to make a video on non-Newtonian fluid. This group searched and read about different fluids and found examples of household non-Newtonian fluids such as honey, toothpaste, paint, ketchup, custard, and shampoo. To demonstrate fluid thickening, the students chose corn flour (made into a paste).

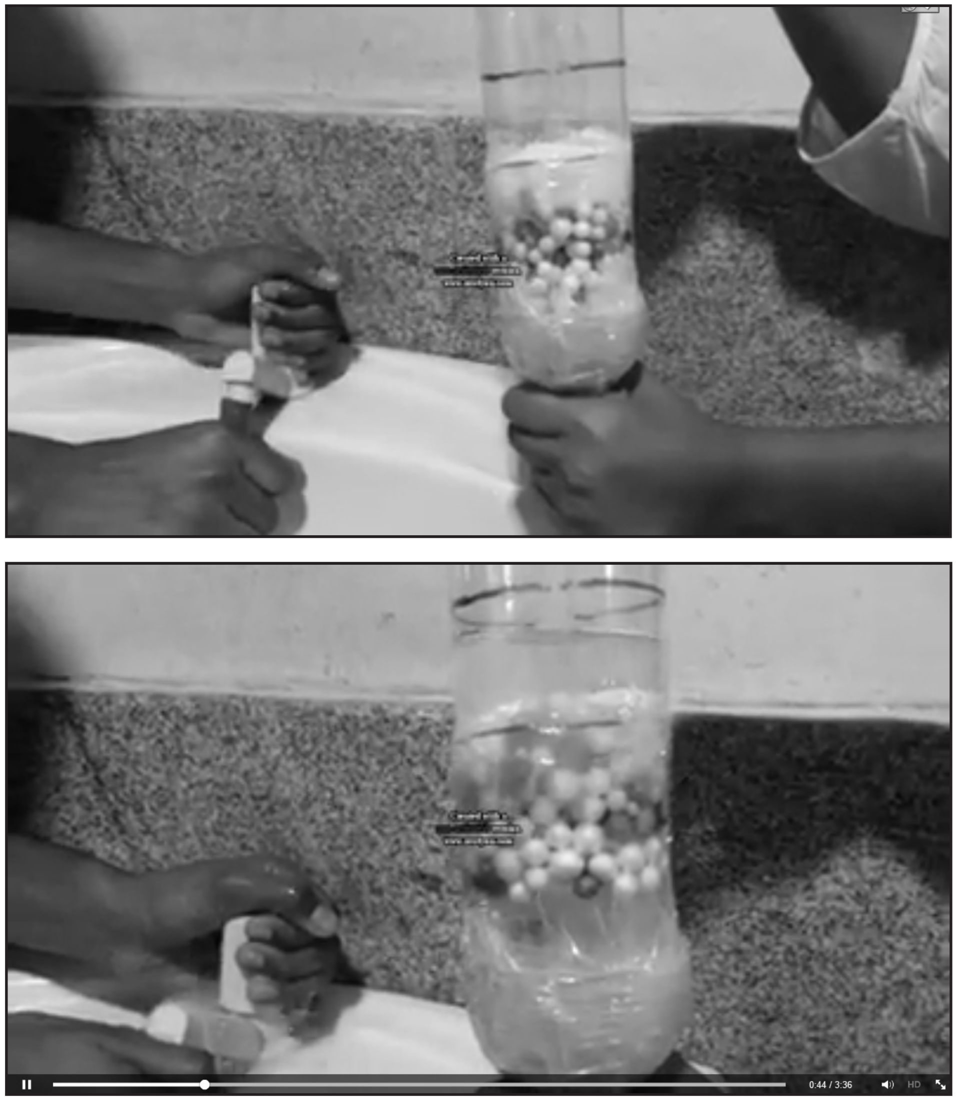
Project details

The students took an empty bowl and added two packets of corn flour into it and then added a bowl of water over the flour. The two constituents were thoroughly mixed until the mixture becomes pastelike (Figure 3A). Students then took the paste in hand and squeezed it. They noted that the paste converted into a solid form when force was applied; however, upon reducing the force, the paste converted into the liquid form and flowed out of the hand. To further demonstrate the response of flour paste to the applied shear (force), they put a finger in the mixture and tried to move it through the flour paste. At this point, the paste started to crack and it was very difficult to move the finger (Figure 3B). Thus, with shear the fluid thickened. The students also witnessed in real time a unique property of flour: If the flour is touched softly, then it behaves as a slurry and demonstrates “flowability.” However, if pressed with force, it gets “solidified” and no longer exhibits flowability.

When the students performed this experiment themselves, they could understand the relationship between shear stress and strain rate in non-Newtonian fluids. They made a video, showed it to their colleagues, and explained the underlying concept. They also uploaded the video on the aforementioned FB page. During their search of day-to-day use of non-Newtonian fluids, they identified and experimented with different fluids, and thus were able to understand the difference between Newtonian and non-Newtonian fluid concepts detailed in the FM course.

Video on fluidization

A group of students made a video to demonstrate fluidization using available resources in their hostel, such as a transparent drinking water bottle, Thermocol balls, rubber hosepipe, and cotton. They cut the bottom of the bottle and positioned it upside down. The mouth of the bottle was filled with cotton and the Thermocol balls were added over it to form a packed bed (Figure 4A). A rubber hosepipe was connected to a washbasin tap and its other end was connected to the mouth of the bottle. The tap was opened, allowing the water to flow through the pipe, and then into the packed bed. This caused an expansion of the packed bed (Figure 4B). Using this simple setup, the students demonstrated the fundamentals of fluidization such as inception of fluidization, minimum fluidization velocity, and expansion of bed. Using the same experimental setup, they changed the packing material and repeated the procedure. Thus, they learned the effects of density, sphericity, and voidage on fluidization phenomenon using various materials and their effects on the aforementioned properties.



Figures 4. *Snapshot of a video demonstrating fluidization. (A, top) A bottle was filled with Thermocol balls (the velocity of water at this point is zero and a state of packed bed is observed). (B, bottom) The velocity water is kept sufficient enough (minimum fluidization velocity) to expand and fluidize the Thermocol bed.*

Video on fluid statics

A group of students made a video to demonstrate Torricelli's law (Figures 5, next page). They made a simple arrangement using a transparent drinking water bottle. Three holes were made in the bottle at an equal distance using a nail as shown in Figure 5A. Water was filled up to the neck and allowed to come out through the holes. The trajectory of water was observed and it was found that water from the bottom hole travelled faster and farther (Figure 5B). Thus, these students through this video explained the relationship between the liquid level (potential head) and velocity. They also repeated the experiment using different household fluids such as oil and ketchup to understand how density and viscosity changes with different materials. By this experiment, students understood the basic fluid static equation and felt confident in applying it.

Video on continuity equation

Using the flow from a flush tank to commode as an example, another team explained the application of the continuity equation. Students recorded the video in the hostel washroom and explained the continuity equation using a flush tank, commode, and the discharge line (Figure 6, next page).

More videos are available on our FB page entitled "Fluid Mechanics Videos" (<https://www.facebook.com/fluidmech>).

ROLE OF INSTRUCTOR IN VM ASSIGNMENT

The instructor guided the students in preparing these videos, as well as helping them select topics. He also had two cabin meetings with each group (registration/guidance in selecting topic and presentation rehearsal). In the first meeting, each group came up with chosen topics for the VM assignment,

Figures 5. *Snapshots of videos demonstrating fluid statics.*

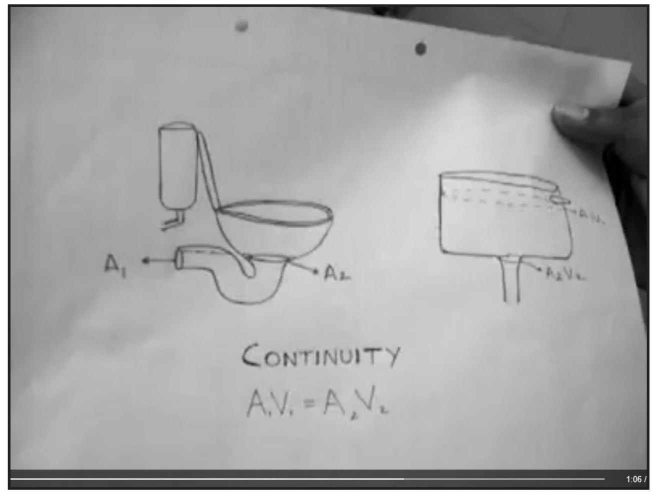


Figure 6. *Snapshot of a video demonstrating the Law of Conservation of Mass.*

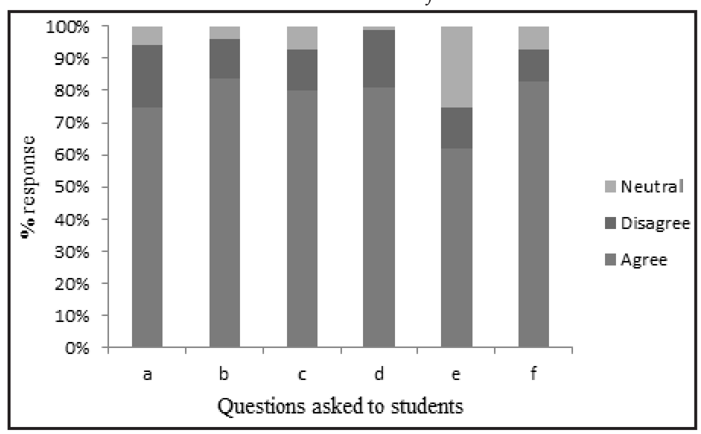


Figure 7. *Students' feedback on video-making assignment.*

which were discussed in detail. One suitable topic was eventually finalized. In the second meeting, the teams identified relevant studies and prepared a schematic representation of the video they planned to make. At this point, the author made midterm corrections and gave instructions as applicable. Finally, students submitted their videos to the department's teaching assistant (TA). The videos were viewed and analyzed by the author. For those videos that lacked either scientific components or proper presentation, the student team was asked to resubmit. For video resubmissions, hand-holding was provided by the TA and instructor. The author was involved right from ideation to preparation of video to final upload on FB. Once the videos were uploaded on FB, the instructor monitored comments on each video. He encouraged students to answer queries/comments. However, "likes" were neither monitored nor moderated.

FEEDBACK AND DISCUSSION

Feedback from 90 students of the 2014 chemical engineering batch was sought. Students were asked to provide their opinion about the assignment and the impact it had on them. Students were asked the following questions and their response is presented in Figure 7.

a. *Did the VM assignment in the FM course help you to learn the fundamentals of the subject and subsequently demonstrate them?*

b. *Did the VM assignment help you to think creatively about the course application in real life?*

c. *Did the VM assignment in the FM course help you to learn nuances of teamwork?*

d. *Did the VM assignment in FM course help you to improve your communication skill?*

e. *Did you seek help/assistance from anyone (friend/faculty) outside your department while completing the VM assignment?*

f. *Has your interest in the chemical engineering increased following the assignment?*

Overall, the students' responses were positive. The students found the course interesting, as they were able to easily correlate what they learned in the classroom with the world around

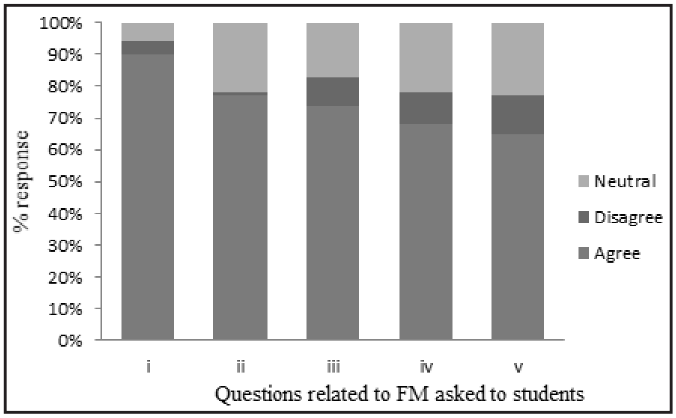


Figure 8. *Students' feedback on FM learning using video-making assignment.*

them. About 75% of students remarked that the assignment helped them to learn and demonstrate the fundamentals of FM. The assignment made students "think," and it taught them not only the course but also the learning process. About 84% of the students felt that this assignment made them think creatively and apply the various principles of FM in an innovative way.

Although each group was awarded the same marks, students strived for excellence and for getting positive and encouraging comments on their FB video posts. It was not the marks but the peer pressure that motivated students to perform better. Because each video is available in the public domain, every team tried to deliver its best to get more "likes."

Because the assignment is a team task, 80% of the students felt that they learned nuances of team collaboration with peers as well as learning to communicate effectively using the audio-visual medium. Interestingly, more than 60% of students sought help from a department other than their own department, indicating initiation of interdisciplinary efforts. These students mentioned that they had several discussions with students of mechanical engineering and civil engineering departments because they also study FM in their undergraduate course. For video editing, students consulted their friends in the architecture and computer science departments.

The study author's general observation in his professional career has been that most students take up chemical engineering not by choice, and thus lack motivation and interest. However, surprisingly 83% students opined that the assignment increased their interest in the chemical engineering program.

FM LEARNING EXPERIENCE

Students were asked the following questions and their response is presented in Figure 8.

i. *Will you be able to design a storage tank using fluid statics basics?*

ii. *How comfortable are you applying Bernoulli's equation (BE) to a real-life situation?*

iii. *How would you rate your competency to do basic piping design calculations for a given system?*

iv. *Will you be able to select a pump for any system correctly?*

v. *How would you rate your competency to design a fluidized bed/packed bed/agitating vessel?*

More than 90% of students opined that they will be able to design a storage tank by applying the principles of fluid statics. However, students found designing a fluidized bed, packed bed, and agitating vessel relatively difficult. When these students were consulted, they noted that selection of packing material, calculation of porosity, and selection of impeller made it difficult for them to design this equipment. More than 75% of students expressed increased confidence in applying Bernoulli's equation to real-life situations and designing pipes and pumps.

SOCIAL MEDIA TOOLS FOR EDUCATION

Based on our experience and reported literature on use of social media—particularly FB—for education, many interesting observations have emerged. Although the literature reports are conflicting, few authors advocate the meaningful use of FB in academics; by contrast, others fear that such applications compromise and disrupt young people's engagement with "traditional" education provision. Amid this debate, Selwyn[10] studied undergraduate students from a U.K. university and concluded that rather than affecting students' engagement with their formal studies, FB use must be seen as being situated within the "identity politics" of being a student.

By contrast, Wang, et al[11] provided experimental evidence that FB could be used as an educational communication and interaction tool. The authors of that study concluded that FB used in instructional methods helped students achieve better grades, higher engagement, and greater satisfaction with the university learning experience.

Roblyer, et al[12] carried out a comparative study by evaluating responses from faculty and students concerning FB use in academics. The results showed that students are much more likely than faculty to use FB and are significantly more open to the possibility of using FB and similar technologies to support classroom work. By contrast, faculty members are more likely to use "traditional" technologies such as email. Unless this tendency changes and faculty perceive FB and its sister technologies—both current and those to come—as additional opportunities for educational communication and mentoring, social networking sites (SNSs) may become yet another technology that had great potential for improving the higher education experience but failed to be adopted enough to have any real impact.

A survey carried out in University of Cape Town[13] (UCT) revealed that not only were UCT staff unwilling to "friend" students, but that students clearly stated that they would not accept friend requests from lecturers. Perhaps more important than student engagement with lecturers is the potential FB offers for students to engage with one another.

Although SNSs have the potential to be used for academic purposes, many faculty resist the option to deviate from the "traditional" method of teaching; however, students are enthusiastic and open to adopting SNSs for education, but unfortunately they have not perceived them as a tool for learning/training.

It thus can be hypothesized that SNSs can be meaningfully and effectively used only to supplement the "mainstream"/"traditional" method of the teaching–learning process. To make teaching purposeful, "direct" interaction between teacher and student is not negotiable. The Guru–Shishya tradition of education, which was successful for thousands of years, has proved the importance and necessity of "direct" and "real" contact between a Guru (teacher) and a Shishya (student). The "indirect" and "virtual" contact through SNSs can only supplement, enhance, and strengthen traditional classroom process, but can never substitute for it. SNSs can be best used innovatively for assignment, homework, group project, preparatory class, and team activities.

CONCLUSION

The FM VM assignment achieved accreditation objectives such as enabling students to relate fundamentals of FM to real-life situations and demonstrate the fundamentals of the course in an easy way through effective formulations. It also provided an opportunity to improve soft skills such as teamwork and effective communication. Such innovative assignments not only increased interest in the course but also in the chemical engineering program as a whole. Students opined that they felt confident in designing a storage tank, pipe, and unit operations equipment (*e.g.*, packed bed, fluidized bed, and agitator) after taking this assignment.

Although for purposeful teaching, "real" contact between teacher and student cannot be compromised, "virtual" contact though FB is proven to be a novel way to support and strengthen a traditional education system.

ACKNOWLEDGMENTS

The author is thankful to the students who enrolled for the Fluid Mechanics course and made videos about the application of FM in day-to-day life as a part of an assignment. The author is grateful to Dr. B.D. Kulkarni and Professor S.S. Gokhale for their guidance and encouragement. The author thanks Professor Prasad Dhurjati for his constructive comments on the first draft of the manuscript, and K. Anand Kumar for improving the language of this paper.

REFERENCES

1. Madge, C., J. Meek, J. Wellens, and T. Hooley, "Facebook, Social Integration and Informal Learning at University," *Learning Media and Technology*, **32**(2), 141 (2009)
2. Bicen, H., and N. Cavus, "Social Network Sites Usage Habits of Undergraduate Students: Case Study of Facebook," *Procedia: Social and Behavioural Sciences*, **28**, 943 (2011)
3. Facebook, <http://newsroom.fb.com/company-info/> [Last accessed: April 7, 2016]
4. Online Colleges, <http://www.onlinecollege.org/2009/10/20/100-ways-you-should-be-using-facebook-in-your-classroom/> [Last accessed: April 7, 2016]
5. TeachThought, <http://www.teachthought.com/technology/100-ways-to-use-facebook-in-education-by-category/> [Last accessed: April 7, 2016]
6. Kabilan, M.K., N. Ahmad, and M.J. Zainol Abidin, "Facebook: An Online Environment For Learning of English in Institutions of Higher Education?," *Internet and Higher Education*, **13**, 179 (2010)
7. Grosseck, G., R. Bran, and L. Tiru, "Dear Sir, What Should I Write on My Wall? A Case Study on Academic Uses of Facebook," *Procedia: Social and Behavioural Sciences*, **15**, 1425 (2011)
8. McCabe, W.L., J.C. Smith, and P. Harriott, *Unit Operations of Chemical Engineering*, 7th edition, McGraw Hill, New York (2005)
9. de Nevers, N., *Fluid Mechanics for Chemical Engineers*, 3rd edition, McGraw Hill, New York (2005)
10. Selwyn, N., "Faceworking: Exploring Students' Education Related Use of Facebook," *Learning Media and Technology*, **34**, 157 (2009)
11. Wang, J., C.C. Lin, W.W. Yu, and E. Wu, "Meaningful engagement in Facebook Learning Environments: Merging Social and Academics Lives," *Turkish Online J. Distance Education*, **14**, 302 (2013)
12. Roblyer, M.D., M. McDaniel, M. Webb, J. Herman, and J.V. Witty, "Findings on Facebook in Higher Education: A Comparison of College Faculty and Student Uses and Perceptions of Social Networking Sites, *Internet and Higher Education*, **13**, 134 (2010)
13. Bosch, T.E., "Using Online Social Networking For Teaching and Learning: Facebook Use at the University of Cape Town," *Communicatio. South African Journal for Communication Theory and Research*, **35**(2), 185 (2009) ❐