New Orleans JAZZED about Engineering Education

Student Perspectives for New Civil Engineering Majors

Dr. Kevin Chang P.E., University of Idaho - Moscow

Kevin Chang, Ph.D., P.E., is an assistant professor in the Department of Civil Engineering at the University of Idaho, where he is focusing on traffic operations and safety, transportation security, and engineering education.

Kevin is the current Chair of the ITE Transportation Education Council, Chair of the TRB School Transportation Subcommittee, member of the TRB Safety Management Committee, and Past President for the Washington State Section of ITE. He is registered as a Professional Engineer in Washington and California, and received his undergraduate and graduate degrees from the University of Washington.

Student Perspectives for New Civil Engineering Majors
(The Role of Technology)

Abstract

This research examines how today's incoming civil engineering student must prepare for his or her college career. Student perspectives from the bookends of the academic experience – from current freshmen to seniors – are uniquely gathered and disseminated, and their personal experiences are closely examined. The use and impact of technology and the role that it plays is also studied. The guidance and insights shared and developed by the students may be used to: guide curriculum development at the freshman level, formalize advising strategies, provide outreach to current high school students, and support department-level activities.

The incoming college student is required to declare his or her major prior to enrolling for classes as a freshman at some institutions. In addition to taking first-year coursework that typically consists of mathematics, chemistry, English, and selected elective courses, an introductory civil engineering course may also be required. The week-to-week curriculum of this class is usually at the discretion of the individual instructor, but the overall content should expose the student to: basic civil engineering problem solving skills; further development of software use, graphical analysis, and data analysis skills; and enhancement of oral and written communication abilities.

The freshman civil engineering major, already adjusting to the trials and tribulations of a college student, may also be faced with uncertainty with regard to his or her academic goals. For the incoming freshman, these issues may occur at two distinct levels. First, there may be uncertainty as to whether or not civil engineering is simply the right branch of engineering, as opposed to, for example, mechanical or construction engineering. Second, if the student is settled on civil engineering, developing a plan that streamlines their coursework to target one of the many sub-disciplines within civil engineering which include, but are not limited to: structural, transportation, environmental, surveying, geotechnical, and hydraulics will require some thoughtful short-term and long-term planning.

Introduction

The genesis for this research effort stemmed from the author's personal experience of returning full-time to an academic institution after spending nearly fifteen years as a practicing professional engineer in industry. The author's teaching responsibilities during his first three years included core civil engineering classes as well as two classes specifically designed for incoming freshmen and graduating seniors, respectively, Introduction to Civil Engineering (CE 115) and Civil Engineering Professional Seminar (CE 491). The interactions from in-class discussions and feedback collected from student surveys indicate that today's students possess a skill set and learning style that is heavily influenced by various forms of technology. The integration of technology as part of daily activities suggests that students must learn, adapt to, and incorporate constantly changing

and evolving software and hardware offerings. For students who choose not to, have not been able to, or may be reluctant to embrace the advancements of technology, or who have a learning disability, there is a likelihood that uncertain challenges or limitations may contribute to a substandard performance in the classroom not entirely due to limited technical comprehension. This paper provides a qualitative and timely assessment as to how today's students learn and the challenges they face, and identifies key observations with regard to the use of technology on campus and in the classroom.

Background

For each freshman student entering a four-year college or university engineering program, he or she is faced with a number of important choices. Each university or college administers its own set of admission requirements, and while certain schools allow each student to matriculate and go through the rigors of their freshman and sophomore year coursework before applying for their specific major or majors of their interest (University of Washington), other programs require a student to declare a major prior to enrolling as an incoming freshman (University of Idaho).

After the student has arrived on campus, there are additional program-specific requirements at the department level. For example, at the University of Idaho, each engineering department has established different requirements for its introductory course. There are six engineering programs at the University of Idaho; the Departments of Chemical and Material Engineering and Civil Engineering offer a one-credit course focused on introducing fundamental concepts and principles to new students, while the Departments of Computer Science and Mechanical Engineering require three-credit offerings in which the depth of classroom activities along with the contact time between the student and professor is comparatively more extensive. The content and structure of an introductory course has been vetted in a number of different textbooks and resources[1,2,3] and is not addressed in further detail in this paper but flagged as a topic for separate examination and discourse.

As previously mentioned, the University of Idaho requires a one-credit, two hour per week, Introduction to Civil Engineering course (CE 115) for all students pursuing a degree in civil engineering. The intent of this course is to introduce the student to the broad field of civil engineering and provide new opportunities to develop a skill set that will help foster individual growth and learning. This course assists the student in determining the area(s) of emphasis that he or she might want to follow for his or her bachelor's degree, and introduces the student to problem solving skills, software use skills, graphical analysis, data analysis, and oral and written communication skills. The overarching goals of this course include:
- Providing the student with an overview of the profession of civil engineering and a basic understanding of the subfields in the discipline;
- Providing the student with a basic understanding of the role and responsibility of engineers with an emphasis on ethical, safety, and licensing issues;
- Introducing the student to the global implications of civil engineering;

- Exposing the student to current civil engineering projects and their societal implications;
- Introducing the student to state-of-the-art technologies that are used in civil engineering practice;
- Introducing the student to the importance of communication as a tool for effective engineering practice;
- Providing the student with an introduction into team-building and the requirements for team participation;
- Introducing the student to professionalism through interaction with practicing professionals; and
- Helping the student determine an undergraduate track of study within the department.

It is the intent of this course to stimulate professional curiosity and growth in the undergraduate student to intensify his or her desire to pursue a professional career in civil engineering. The University of Idaho also requires its civil engineering students, in their final semester of academic study, to enroll in the Civil Engineering Professional Seminar offering (CE 491). This course is designed to provide graduating students with new opportunities to develop a skill set that will help foster their individual growth and learning. Class participants learn and practice oral and written communication skills using practical examples in their selected area of interest. The other goals of this course include:
- Further understanding of the civil engineering field and related topics;
- Developing multidisciplinary collaboration and team-building skills;
- Enhancing communication skills in both oral and written formats through writing and presentation exercises; and
- Providing support toward completion of their degree.

Each student is divided into teams for some assignments and activities. At the end of the semester, each student is required to complete a comprehensive exercise on a civil engineering project or program and give a formal in-class presentation. Guest speakers are also invited. This opportunity is provided so that students meet with and learn from individuals who are currently in industry and who can share their real-world experiences.

The presence and role of technology both in the classroom and as part of a student's learning environment as a general observation is not revolutionary; the introduction and widespread use of multimedia and internet-based resources have been present for more than two decades. The increasingly intimate connection between learning and technology, however, deserves further exploration. A review of literature identified that the incorporation of technology in the classroom is dependent on the individual faculty member who uses or chooses to use the various forms of media as well as the effectiveness of and access to the technology offered on campus in each individual classroom. Faculty members themselves may not find a synergy between their personality type or teaching style and the incorporation of technology. Alternately, the personal choice to use technology will be influenced by how a facility, which previously may have consisted of wall-to-wall chalkboards, has been converted into a so-called "high-technology" classroom.[4,5] As the use of technology becomes a mainstream and

integral part of the teaching and learning environment, this research addresses the impact of technology by specifically examining how students view, adapt to, and embrace these evolving high-technology forms of media to learn and communicate.

Methodology

Over the course of the last two years, the observations and insights of students from the ends of the academic spectrum, namely incoming freshmen and graduating seniors, were gathered and documented. For this research effort, the abilities and perspectives of the students taking CE 115 and CE 491 were determined two different ways. First, an in-class survey was administered to the CE 115 class (n=49 each year) at the beginning of the Fall 2014 and Fall 2015 semesters asking each student to self-assess his or her proficiency in common Microsoft Office products such as Word, Excel, and Powerpoint. These applications were chosen because they are widely used for the purposes of completing assignments and submitting other course deliverables, and Microsoft Office is available as a free, downloadable software package to all University of Idaho students. Personal computers loaded with Microsoft Windows have consistently represented nearly 70% of the market share during the "back-to-school" sales period, with sales percentages of 75% in 2012, 72% in 2013, and 68% in 2014.[6] Second, the students from both courses provided insight on university life for an incoming freshman student target audience. At the end of the Fall 2015 CE 115 and CE 491 (n=6) courses, each student shared his or her college experience in the form of a short guidance letter and was specifically asked to reflect upon the role of technology and to describe how technology had influenced: how they studied, how they interacted with their peers and with their professors, and how they personally adapted to change. All of the responses were then gathered and grouped in broad categories, and specific student comments are italicized for emphasis in the subsequent sections. The University of Idaho's Institutional Review Board provided guidance and granted approval on the reporting of this study.

Results

Student Perspectives

Given the open-ended nature of the request to students, there was a broad range of responses. Today's university student population represents a cross-section of society across gender, racial, political, and cultural boundaries. Although specific demographic data were not collected in these specific classes, the University of Idaho's undergraduate student population of approximately 8,800 students consists of a gender breakdown that is approximately 60% male and 40% female, and a student ethnicity that is 77% white, 9% Hispanic or Latino, 5% International, and 9% representing other affiliations.[7]

The civil engineering students noted that there was a strong sense of community at the University of Idaho, likely linked to the small, college-town setting. While some students enjoyed smaller class sizes others reflected that the classes were large and unfocused on the student. This was influenced by where the student attended high school and the specific course(s) that they were taking as freshmen. The transition for students from

high school to college can be challenging, and previous studies have documented and discussed how students negotiate this transition.[8]

> *"The Civil Engineering Department was welcoming to all of the new students. In just the past three months, I have been invited to a multitude of clubs, organizations, and help groups by just the civil engineers … they consistently are trying to involve the new students with projects and meetings. The integration of the young engineers with the older ones is amazing and is one of the main reasons why I have stayed with civil engineering as my declared major at the University of Idaho."*

After enrolling at the University of Idaho, each student's exposure to technology is introduced differently. One initial contact point occurs during on-line pre-registration, which is required to ensure that the student appropriately starts his or her academic career by enrolling in the proper courses within a given department. During future semesters, civil engineering faculty are strongly encouraged to address all enrollment and advising matters using the on-line Degree Audit application. Each student begins the process by identifying his or her desired courses in the on-line planner prior to meeting with his or her advisor, and this effort allows the advisor to quickly review course load prior to a face-to-face meeting. User comments by either the student or advisor is stored in the system, and registration holds are lifted with the click of a button after the advising meeting.

Multi-Functional Utility of Laptops and Tablets

The need for a student to have either a laptop or tablet device is becoming increasingly essential. Students recognize that these devices are multi-purpose tools; writing a term paper using a word processing application or solving tabular data using spreadsheet software are two ways on a long list that also includes accessing on-line textbooks, checking personal e-mail, and electronically communicating with friends and family.

> *"The skill that most prepared me for college had to be my compatibility with my laptop. I was used to using my laptop about once a week (in high school) which got me very prepared for college."*

> *"Technology plays a large part in the college experience. If I didn't have a laptop, I don't know what I would do. There are computer labs around the campus, but it much more (convenient) to have your own."*

Students are finding that homework assignments and grades are increasingly posted online, and that some professors prefer online submission of homework. Students noted that when group projects are assigned, a cell phone, smart phone, or laptop is essential in order to communicate and coordinate with other group members so that the project can be completed. The availability of having a laptop or tablet nearby, along with a wireless or hardwired internet connection, demands vigilance on the part of each student as a new distraction to studying now exists. The "one-stop shop" nature of an internet-connected

device opens the door for easily accessible on-line distractions in the form of: social media such as Facebook, Instagram, Snapchat, and Twitter; popular games such as Candy Crush Saga and Angry Birds, video streaming applications such as Netflix, and communication platforms such as Skype and Facetime. The primary use of a laptop or tablet, either for learning or for entertainment, is constantly blurred.

> *"... technology plays an important role (as the) laptop has taken the place of my book bags ... all my school works are in my laptop in PDF ... every assignment is in .doc or .docx format ...I type assignments and communicate with friends at the same time. In short, learning has never been as easy as it is now."*

> *"Being computer savvy is vital to surviving college ... email, online assignments, being familiar with the cloud ... all these things will make college life so much smoother. Technology has become paramount to the modern classroom."*

> *"I cannot imagine myself without my cell phone and laptop. (When) I feel lonely or nostalgic, I use free apps to contact and talk with my family and friends ... Facebook, skype, WhatsApp, Imo are some of the communication apps that I use very frequently ... I use my laptop not only to do my assignments but also I feel the most important thing for any student is laptop with internet connectivity."*

> *"... it's easier to procrastinate on computer homework, because, well, there are all those sites to look at just a click away."*

> *" ... (there is) a computer lab around every corner to turning all, and I mean all, of your homework online ... the down time that comes along with college makes you find yourself browsing the internet a lot in college ... I wish I would have used that time on my phone to research my studies but instead I was playing a game or checking social media..."*

> *"Many classes have transitioned to online homework assignments ... and while technology can and is a wonderful resource tool, online assignments can be frustrating..."*

> *"Electronic textbooks save money, are searchable, and do not weigh down your backpack, but with open book tests they are a problem. Taking notes on the computer improves speed and archive-ability but works better in some classes than others."*

Student Proficiency in Word, Excel, and Powerpoint

Prior to beginning their college careers, most students appear to have had some exposure to basic word processing, spreadsheet, and presentation software. During the CE 115 course in Fall Semester 2014 and Fall Semester 2015, students were asked to rate their perceived level of proficiency with Word, Excel, and Powerpoint on a five-point scale. A rating of one implied little to no proficiency, while a rating of five implied significant

proficiency or expert knowledge of the application. The collective results from the classes are summarized in Table 1:

Table 1: Student Self-Assessment With Regard to Software Proficiency

	Average (2014)	Standard Deviation	Average (2015)	Standard Deviation
Word	4.32	0.53	4.39	0.64
Excel	2.90	1.02	2.98	1.03
Powerpoint	4.03	0.77	3.92	1.06

These results indicate that the assumed level of proficiency of these three applications vary. The average student is not entirely comfortable with Excel, but the range of student understanding and comprehensive is broad. For these reasons, how should an instructor ensure that a student knows the fundamentals of Excel and does not need any remedial instruction? Since the student is typically expected to develop a spreadsheet, create a graph, and generate tables during their college career, at least one Excel exercise is embedded as part of the CE 115 curriculum. The student survey identified at least six students who had never used Excel in their K-12 schooling, and at least one student who had never used Powerpoint.

With regard to presentation software, some students favor the use of Prezi or Google Slides over Powerpoint. While the development methodology and output are generally similar, the files are not always perfectly compatible between different applications; this results in formatting issues which can impact a final presentation or final project submission for a student.

Communication Between Professors and Students : How and When

Communication methods continue to evolve. Students acknowledge checking their VandalMail (University of Idaho's internal electronic mail system) and personal e-mail accounts regularly, as well as Blackboard Learn, an on-line learning management system, for course postings and updates. Students utilize these applications to contact their professors for questions, and e-mail exchanges occur throughout the day and during evenings and weekends. It is not common for the teaching professional to limit the times during which a student is allowed to send a message or ask a question.

> *"The biggest challenge I had to adjust to was getting use to checking my VandalMail every day and going on to Blackboard to check for grades and assignments ... in high school, everything was turned in by paperwork ... now I automatically check my mail every day, and constantly go on the computer to check for homework updates."*
>
> *"In high school, you just had to walk into their classroom and (your teacher was) there ... but in college, you mostly e-mail your teacher to get (in) contact with them. Also, they have office hours so you're able to talk one on one with them ...*

it's different to communicate with them than how we were used to communicate with our professors in high school.

Student Accessibility to Online Support

Online companies like Chegg and Slader provide detailed steps that solve homework problems from popular textbooks across all disciplines for a small user fee. While the resources provided may benefit the student who is conscientiously investing the time to thoughtfully work through each assignment and only utilizing these sites as a simple check, some students find these sites to be an efficient way of copying a homework assignment prior to the submission deadline, which effectively tempers the value of the homework assignment. Additionally, message boards on these sites are provided so that students can provide user feedback in the event that incorrect information has been posted. Given the widespread availability of these sites, the value and format of homework assignments deserves further examination. If access to solutions is rampant among a large segment of the student population, providing the final solution to all students would level the playing field. Alternately, the professor may be inclined to develop new problems or select problems from a secondary source other than the textbook used for the course being taught.

> *"I know that Chegg is right there and you can find solution manuals on Google but this is not going to help you when it comes to the test."*

Learning Fundamentals Remain Unchanged

Despite the advancements and influence of technology, students recognize that the fundamental tenets of learning have remained unchanged. For the student who is declared as a civil engineering major or initially selected civil engineering as his or her major, the responses reflected themes that emphasized a desire to be a problem-solver with an employment future that included design and managing "big problems". Parental or family influence was another contributor.

> *"Engineering was a word in high school that was simply synonymous with "employment" and "money" and "oh you should become one" … no one actually took the time to explain to me what it truly means to be an engineer on a day to day basis…"*

> *"My counselor never even told me that college classes were not every day of the week."*

When asked to provide their personal recipe for academic achievement and success, students reflected that given the academic demands of an engineering degree, increased personal responsibilities, and the enticement of extra-curricular activities, it was imperative to possess good time management skills and proper study habits to limit any procrastination tendencies. Students suggested that a good rule of thumb was to set aside more time than needed and use some sort of planner for organizational purposes.

Students recognized that they needed to care about their grades and go to class to be engaged, and that success in the classroom would require them to study more than high school. The engineering students were particularly aware that they seemed to be busier than their friends in other majors. Students also recognized that being involved in clubs was a valued part of the college experience. In addition, strong mental health was directly related to good physical health. Quality sleep management, along with incorporating some form of regular physical activity and developing good eating habits (despite the repetitious cafeteria food) was necessary. Lastly, one student astutely recognized the value of advocating for oneself and reaching out to professors and advisors was one such way to do so.

> *"Put your studies first, go to class, utilize resources provided, get to know colleagues and make time for hobbies."*

> *"When I first came to college I didn't have a laptop. Due to much of your homework being online it is a necessity to have a computer you can carry around with you. Also, use your phone as a planner and organize and manage all of your deadlines and events that way so you can be alerted by your phone when you have something big coming up later that day or the next day so you can stay ahead of the game. Having and laptop and organizing yourself that way will play and huge role in making your educational experience much better and make your life not as stressful."*

Faculty Perspectives

As technology needs continue to evolve for the student, the impacts experienced by the professor, particularly for anyone returning to an academic environment after an extended absence, can be far more dramatic, and it is under this fundamental principle that this research effort was undertaken. The advent of advancing technology requires professors to be nimble and to recognize that today's technology-driven society influences how students learn, study, and interact with one another.

The infrastructure and buildings may be static, but there are rampant changes in the classroom. Whiteboards have replaced many or most chalkboards and some have the capability to save and store any text written. Various technological media are now common in any teaching environment. Projectors and document cameras have replaced overhead and slide projectors that were favored by those who desired to show graphics and images. Computer networks are seamlessly connected so that a professor can share[9] or develop material from his or her office (or home) and then directly transfer to the cloud or a shared drive that is linked to any classroom computer. These conveniences further promulgate a wireless world where cloud computing, defined as the practice of storing regularly used computer data on multiple servers that can be accessed through the Internet,[10] is increasingly rampant. At the University of Idaho, when technical issues do arise in the classroom, technical support services are notified using the classroom desk-pad, and an in-person response usually occurs within minutes of notification.

Data Analysis and Recommendations

There are inherent benefits for today's college professors and civil engineering department leaders to foster practices that regularly review the content and curriculum of classes and to ensure that each student possesses the fundamental skills and tools needed to complete basic assignments. For starters, based on student feedback reflecting the essential need to have a personal laptop or tablet, colleges and departments would be well-served to monitor ownership rates and to consider providing or loaning such a device to the declining number of students who still do not own one. Given their ever-increasing utility and affordability, it seems only a matter of time until these devices are incorporated and used as part of every course requirement or department curriculum.

As determined in this research, many students are not entirely comfortable using a spreadsheet application such as Excel, yet there is not always an opportunity for students to expand their skill set in a dedicated class. A professor teaching an introductory course would be well-advised to conduct some level of assessment to determine how proficient their students are with respect to basic word processing and spreadsheet development skills, and special attention should be given to international students whose learning curve and exposure may differ from domestic students. As technology continues to advance and reach larger segments of the population at an increasingly younger and younger age, the assumption that students will have developed a fundamental understanding of these applications prior to the start of their college careers seems increasingly appropriate.

Professors should establish ground rules with regard to communication protocol to ensure that student expectations are being met; there are no set protocols in terms of how quickly a response is required. In today's world where the prevalence of texting has replaced the phone call or e-mail, the professor must determine how student correspondence will be handled away from the classroom by establishing response times and expectations.

Students and professors alike must adapt to an increasingly paperless environment with online versions of textbooks, documents posted to shared sites as a portable document format, or .pdf, and electronic submission of homework assignments and tests. While current students representing the Millennial Generation may find this arrangement to be easily adaptable, seasoned professors more accustom to traditional paper media may themselves experience some difficulty or frustration adjusting to these changes. As class websites and online platforms become the gatekeeper for each class, the professor must determine how, and to what level, information will be provided. For example, the posting of homework assignments and lectures can provide the student with the convenience of being able to refer to or downloading course materials to assist with study efforts, but this online availability may deter other students from attending class in its entirety knowing that this information will be accessible. Given the widespread use of online solution databases, the instructor may decide to modify existing questions or develop new homework questions so that a student's ability to access and simply copy the solution is eliminated. However, this requires an additional investment of time on the part of the instructor who must not only write new questions but must also work through

each new problem to ensure that a solvable outcome exists. Grades are often posted online as well. According to students, the extent that this information is provided varies from professor to professor and its merits deserve further examination.

Conclusions

The methods as to how we communicate, specifically in the context of a classroom environment between the professor and student, as well as outside the classroom between students, reflects how technological advances in our society in the form of wireless communications and texting, and using smartphones and tablets, have influenced and changed how we fundamentally interact with each other. For these reasons, this study has sought to determine how and to what level students use technology to learn in the classroom, along with specific classroom environment characteristics and teaching methods conducive to student success. For the student, the advent of technology and all of the options available introduces some protocol variability and inconsistency from class to class that previously did not exist. The degree to which: information is posted on a course website, homework may be submitted, and on-line grades are posted varies from professor to professor and from class to class. While technology has lent itself to modern-day conveniences that previously could not be enjoyed, streamlining how we use this technology at an institution remains a very fluid process.

Given the likely generational differences between professor and student, the level to which adaptability occurs will determine: how much a student is able or willing to learn in the classroom, the rapport and relationship that each young man or woman will have with his or her professor, and the level of fulfillment that the professor will experience when teaching a particular class or student. The results indicate that these generational changes are influencing how interaction and learning is occurring in the classroom and influencing how information is to be conveyed to students.

This paper has shared insights with regard to how technology is shaping and changing the fundamental ways in which students interact and learn. Future research should be guided to determine next steps as to how the next generation of students can learn effectively, including the usage of interactive classroom applications,[11,12] and how professors and instructors can be certain that their teaching efforts are reaching the audience in the manner that it was intended.

Bibliography

[1] Landis, R. B. Studying Engineering: A Road Map to a Rewarding Career. Discovery Press, Los Angeles, 2013.
[2] Moaveni, S. Engineering Fundamentals: An Introdcution to Engineering. Cengage Learning, Boston, 2016.
[3] Eide, A., R. Jenison, L. Northup, and S. Mickelson. Engineering Fundamentals and Problem Solving. McGraw-Hill Higher Education, New York, 2011.

[4]Gueldenzoph, L., S. Guidera, D. Whipple, C. Mertler, and L. Dutton. (1999). Faculty Use of Instructional Technology in the University Classroom. Journal of Educational Technology Systems, 28(2), 121-135.

[5]Brill, J. and C. Galloway. Perils and Promises: University Instructors' Integration of Technology in Classroom-Based Practices. (2007). British Journal of Educational Technology, 38(1), 95-105.

[6]Endler, M. Microsoft, Google & Apple: Education Smackdown. Information Week, September 26, 2014. http://www.informationweek.com/software/enterprise-applications/microsoft-google-and-apple-education-smackdown/d/d-id/1316109. Accessed Jan. 27, 2016.

[7]University of Idaho Fast Facts. http://www.uidaho.edu/about/fast-facts. Accessed Jan. 27, 2016.

[8]Clark, M. (2005). Negotiating the Freshman Year: Challenges and Strategies Among First-Year College Students. Journal of College Student Development, 46(3), 296-316.

[9]"cloud computing." Merriam-Webster.com. 2016. http://www.merriam-webster.com. Accessed Jan. 20, 2016.

[10]Peters, A., K. Beddoes, S. Brown, and K. Chang. Transportation Engineering Instructors' Decision-Making Processes for Course Changes. (2015). Journal of Professional Issues in Engineering Education and Practice, 10.1061/(ASCE) EI.1943-5541.0000271, 04015018.

[11]Fitch, J. Student Feedback in the College Classroom: A Technology Solution. (2004). Educational Technology Research and Development, 52(1), 71-81.

[12]Ricoy, M. and T. Feliz. Twitter as a Learning Community in Higher Education. (2016). Journal of Educational Technology and Society, 19(1), 237-248.