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Understanding our students: a technology and construction baseline survey

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Abstract

This paper reports and discusses the findings from the initial set of data obtained from our Technology and Construction Baseline survey, which was designed as a questionnaire to be answered by civil engineering students. The survey captures students' preferences of lecture format, learning activities, ways of interaction, and use of modern technologies to support learning. It also assesses students' level of acquaintance with seven areas of knowledge in construction management. Such knowledge about where our students are in terms of technology skills and domain knowledge is important to the successful deployment of student-centered technology-assisted teaching. From the 280 data points collected so far, it was found that today's students have a different skill set, interaction style, and expectations for the learning environment as the result of technology exposure and influence. These findings give instructional designers important insight into how our students have changed, and hence help them take advantage of the new learning skills the students have to offer and match their higher expectation for engagement in learning.

Keywords: technology skill assessment, learning preferences, technology-enhanced instruction

1 Introduction

Teaching construction at the university level is a challenging task due to the complexity of construction activities and the logical/temporal/spatial interdependencies among them. For effective learning, students need something more animated, more intriguing, and more tangible than traditional classroom materials to support the cognitive processing of the plethora of information they are presented with. With the advancement of modern technology, this challenge can be overcome by creating a learning environment that virtually expands the classroom beyond the walls of the engineering school building.

The creation of an effective technology-enhanced teaching tool has to be a deliberate effort to place pedagogical objectives at the center of the design, as a computerized activity is neither inherently active nor inherently educational. In addition to good pedagogy, innovative interface design and a strong commitment to the student-centered approach are a must. This includes knowing the strengths and weaknesses of a new generation of students and their expectations for learning.

In Prensky's (2001) study of the "digital native learners", a term used to refer to the current generation of college students, the author found that the average student in college today has spent some 5,000 to 10,000 hours on video games, 10,000 hours watching TV, watched 500,000 commercials, and spent less than 5,000 hours reading books. 70% of students play video, computer or online games at least once in a while; 30% of them even do so during class. Most of student gamers find games exciting, challenging and pleasant.

The early and constant exposure to technology has profoundly reshaped the students' skill set, interaction style, and expectations for the learning environment. The students sitting in our classrooms today are the most technology-savvy generation that has ever lived. They are accustomed to being in control of what they do, what they see, and what they learn. They generally have high expectations for excitement, engagement, and more personalized experiences. Understanding these aspects of student perceptions can help channelling instructional effort in the right direction, and as a result, improve teaching effectiveness.

With the intention to examine these general perceptions in mind, we created a survey called the Technology and Construction Baseline Survey to gather information on our students' technology and domain knowledge background. The purpose was to get a picture of how much the students use and appreciate technology, their readiness and/or expectations for technology deployment in the classroom, and what type of technology would be appropriate given their background and experience in the construction domain. We believe that this information will give us, as educators, important insight into how our students have changed, and hence help them take advantage of the new learning skills they have to offer as well as match their higher expectation for engagement in learning.

2 Descriptions of survey

The survey is designed as a questionnaire to be answered by civil engineering students in the United States, Canada, Australia, the United Kingdom and other equivalent systems. It has three sections: Demographic and Background Information, Technology Attitude and Exposure, and Construction-Related Knowledge. The first section captures basic participant information such as age, gender, academic major and standing, work experience, and intended work area after graduation. The questions in the other two sections help reveal where our students are in terms of technology skills and domain knowledge, which is deemed important to the successful deployment of student-centered technology-assisted teaching.

2.1 Technology attitude and exposure

There are two groups of questions in this section. The first part has 14 multiple-choice questions concerning students' preferences of lecture material format and learning activities (PowerPoint presentations, simulations, videos, group work, background activities in lectures, etc.), ways of interaction with peers and professors, and the use of modern technologies to support learning (such as email, online forums, social networks, etc.). In the second part of this section, students are asked to rate their skill level for each of the 20 popular technology groups on the scale from 1 to 5, with "1" being "no skill", "2" being "beginner", "3" being "low intermediate", "4" being "high intermediate", and "5" being "expert". These 20 groups are divided into four categories: hardware (basic hardware, touch screen devices, sensing technologies), task specific applications (office document tools, graphic & web design tools, time/task management tools, knowledge & data management tools, structural and architectural design tools, 2D & 3D-CAD, computational tools, computer games), project management applications (scheduling, 4D tools, estimating, contracts), and general web applications (email & instant messaging, search engines, social networks, web/video conferences, electronic resources).

2.2 Construction-related knowledge

The third section of the survey is dedicated to assessing students' level of acquaintance with seven areas of knowledge in construction management: cost and schedule control, field management, contracts and delivery methods, project economics, materials and methods, safety, and green construction. For each of these topics, the students are to score their own knowledge of the topic on the scale from 0 to 5, with "0" being "no knowledge", and "1" to "5" corresponding to the five levels on the Bloom's taxonomy of cognitive domain: "1" is "remembering", "2" is "understanding", "3" is "applying", "4" is "analyzing", and "5" is "evaluating/creating". The Bloom's taxonomy has long been used in instructional design to help teachers define clear learning objectives that are more tangible, and hence more measureable by specific metrics. We incorporate this taxonomy in the questions to help teachers align student background knowledge with the desired learning goals in a more systematic manner. To help students give better answers to these questions, we provide brief descriptions for each of the learning levels, together with examples as shown in Table 1.

Table 1. Explanations of Bloom's taxonomy with examples

Level of acquaintance	Example – Safety Management
0 – I never heard of this concept.	
1 – (Remembering) I recall/recognize this concept	Know the safety rules.
2 – (Understanding) I can explain the basics of this concept and give some examples.	Explain the procedure of evacuating when an emergency occurs.
3 - (Applying) I can implement this concept in a problem with minimum instructions.	Recreate a similar set of previously learned safety rules for a similar facility.
4 – (Analyzing) I can look at a problem and break it down into conceptual components, such as assumptions, context, hypothesis, evidence, structure.	Recognize all the important components interacting in an emergency situation, such as weather, equipment, human psychology, physical layout, emergency response capacity, and how each component can influence the emergency procedure.
5 - (Evaluating/Creating) I can make a judgment or take a stand about a problem related to this concept. I can challenge the learned concept based on my prior knowledge and experience, and create a new viewpoint or practice.	Realize the inappropriate or dangerous safety practices in a setting different from conventional. Develop new rules to address the uniqueness of the situation.

3 Survey results and discussions

3.1 Surveyed population

To date, the survey has been completed by 280 students from eight civil engineering and construction-related schools in the US and one from Australia. 80% of the participants are in the age range from 18 to 25, and 16% from 26 to 35. The male to female ratio is 3 to 1. GPA and academic standing information are shown in Figure 1.

3.2 Significance of student background

In general, the level of academic achievement of students might play an important role in choosing instructional format and defining learning goals and activities. According to Issa et al (1999), low-scoring students tend to benefit more significantly from multimedia-based instructions than high-scoring students. Teachers can also adjust learning goals to place more emphasis on either basic knowledge for lower-scoring groups or higher-level thinking skills for higher-scoring groups depending on the perception of the students' academic achievement level. Similarly, group work has been proven effective in improving the performance of under-representative groups. Therefore being aware of student diversity in terms of gender, ethnicity, as well as cultural and educational background will help teachers design instructions that are accommodating to their audience. These are by no means the sole criteria in designing instruction, however, they are important aspects of universally effective instruction.

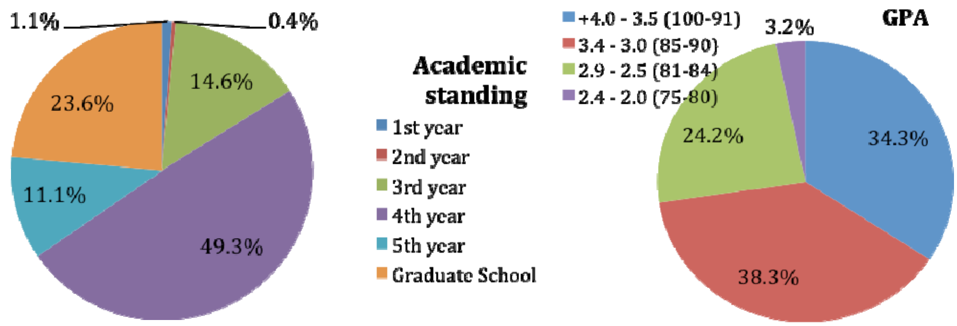


Figure 1. GPA and academic standing of surveyed population

3.3 *Student work experience*

The data from our survey reveal that one third of the students surveyed did not have any work experience of any kind in construction, as shown in Table 2. 30% to 40% of them have some experience in project management, engineering/design, site supervision or labor. Roughly 20% have work experience in operations, project controls and other areas such as sustainability design, accounting, and marketing. While the work experience of students covers a wide range of specialties, most of them intend to build their career in either project management (57%) or engineering/design (25%). Knowing what students want to do after they graduate will help educators design more effective curriculum in order to equip them with appropriate knowledge for their desirable future career, as well as introduce them to other areas of knowledge to give them more perspective. This is equally applicable to the design of individual courses.

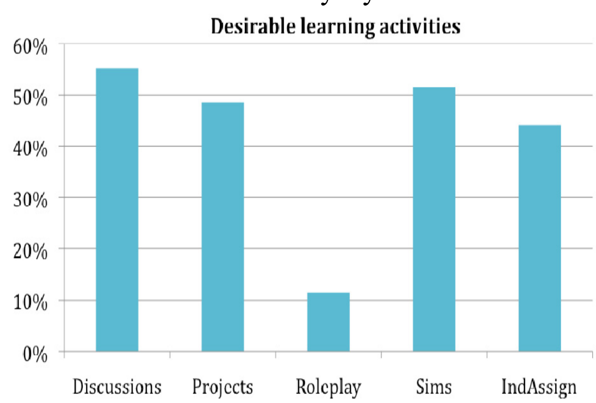
Table 2. Students' work experience and expected work area after graduation

Work experience area	% students with experience	% student expected work area after graduation
None	33.6%	
Engineering/ Design	32.5%	24.6%
Facilities Management/Operations	19.3%	1.4%
Project Management	40.4%	56.4%
Site Supervision	29.3%	5.0%
Project Controls	21.8%	2.1%
Labor	36.8%	0.0%
Other	18.9%	10.4%

3.4 *Students' preferences for learning format and activities*

In terms of engagement in learning, our survey found that only 56% of students stay focused in class, while the other 44% do some background activities ranging from internet surfing, writing emails, to playing games. In doing so, half of them miss a few points in the lecture, and about 25% admit that learning is disrupted. Despite the fact 58% of students think that PowerPoint presentations are sufficient as a learning aid to help them follow the instructors, these findings suggest that a lot of room is left for improving students' engagement in class. It might be a long shot to think that lectures can be as addictive as games are to the students, but a more aggressive use of technology in classes might make learning look more friendly and attractive to students. In addition to individual assignments, 50% of the students surveyed want to have some sort of simulations in their class. Many of them also favor a much greater amount of interactions with peers and professors through in-class group discussions, group projects, role-playing, and real life examples or case studies (Figure 2). While technology cannot substitute for face-to-face interactions, it definitely can facilitate such conditions to a large extent and in some cases is a great alternative where hands-on learning is infeasible.

The positive impact of technology as used in videos/animations is confirmed by our data, with more than 75% of students finding them engaging and believing they help remember and understand learning materials better, as shown in the second part of Figure 2. Engagement, it turns out, might be the single most important factor in improving learning for today's students (Prensky, 2001). While content is always at the core of good instruction, engagement is the means to deliver this content to the students effectively. This makes active learning, for which engagement is the key condition, a necessity, not an option. Technology with its engaging power, therefore, seems to be an appropriate resolution to make the best out of the skills students already possess and create the conditions for learning instructors strive to achieve. The fact that a vast majority of our students (94%) consider themselves either confident, savvy or very savvy with technology suggests that they will enjoy this inclusion of a familiar everyday artefact into the classrooms traditionally perceived as unexciting.



Impact of videos/animations on learning

Opinion	Response %
Engaging	43.6%
Better retention	48.4%
Better understanding	45.5%
Engaging but no impact on understanding/retention	22.2%
Distracting	1.8%

Figure 2. Students' preferences for learning activities and videos/animations

3.5 Students' technology exposure and skills

In general, our students seem to have a very positive attitude toward technology and its use in the classrooms. Their familiarity with and knowledge of specific groups of technological tools, however, are not even across the board. Understanding what types of technology the students are good at using (or learning to use) will help instructors provide enough training (if necessary) or choose appropriate hardware and software to support the teaching of specific domain knowledge. In our case, the students are generally very familiar with basic hardware, touch screen devices, office document tools, and computer games. They are much less competent when it comes to project management applications, technical applications (graphic, 2D-3D, computations), or research applications (knowledge/data management). This information will come in handy when instructional designers have to choose certain features for a software application in order to accommodate the students' level of technology sophistication.

3.6 Construction background knowledge

Students' background in the domain to be taught is an important benchmark based on which learning goals are defined. This is the reason why we dedicated part of the survey to examining the students' level of knowledge for the seven major areas in construction management. It was found that the level of knowledge the students possess is higher for the topics of materials, methods and safety. For the other topics, only roughly a third of the students have the ability to apply the concepts in new contexts, do analysis or make critical evaluations (Figure 3).

As these data are captured as students' self-assessment, some level of subjectivity and bias is expected to exist. To reduce this effect, we made an attempt to provide students with relevant examples for each of the answer choices. The results, therefore, should be used as a guideline for teachers to determine appropriate learning goals for the subject being taught. It might also be useful in making assessment of learning by measuring the level of knowledge after the learning experience and comparing that to the starting point.

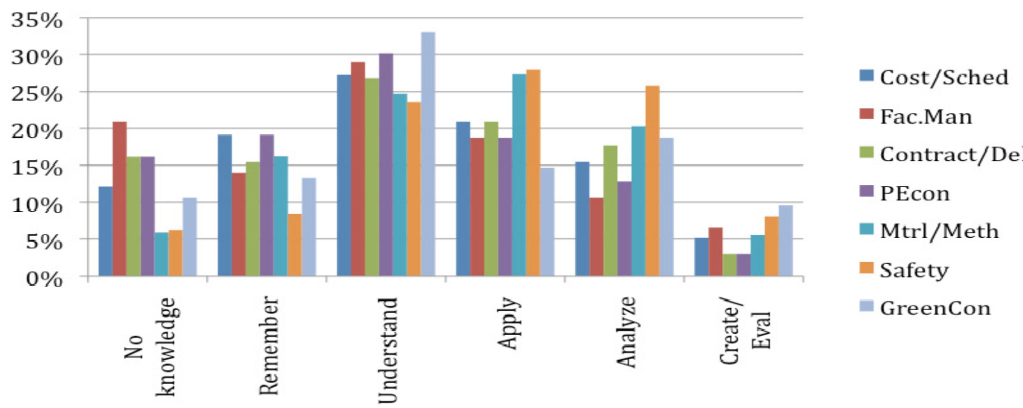


Figure 3. Students' background knowledge in construction management

4 Conclusions

The technology and construction baseline survey we designed serves the purpose of capturing students' attitude toward and skills in using technology, as well as their current level of basic construction management knowledge. The data collected to date reveal important aspects of students' learning expectations regarding the use of technology and other learning tools in class. It has been found that students generally prefer to have a variety of learning activities and media, with a strong favour for technology-enhanced learning strategies (such as videos, simulations, animations), interactions (with peers and professors), and relevance to the real world. These preferences suggest that today's students will perform well and benefit from the integration of technology in instruction to improve the level of engagement for the learning experience.

Currently, the survey is online for convenient maintenance and data collection. We expect to keep this survey active for an extended period of time. As the database expands, there will be opportunities to analyze the data in a much greater depth. For example, we can do correlation analysis between the level of academic performance and the amount of construction experience, or investigate if a pattern exists for technology savvy and preferences of learning activities. These observations will be extremely valuable to the process of designing instruction, and more specifically, instruction enhanced through the use of technology.

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