Classes where the instructor engaged the students with the subject through questioning and did so with intentions of assessing student learning and stimulating critical thinking motivated the authors to prepare for class and read their textbooks. In general, these atmospheres for learning created enthusiastic class preparation. Even when other course requirements competed for time, knowing that the instructor would undoubtedly call on every student in the class by name at some point often served as a motivator to prepare for class as neither author wanted to be perceived by their peers as either unprepared or incapable. This experience led the authors to investigate how this type of questioning in the classroom might address the problem of ill-prepared students.

QUESTIONING

Asking questions helps generate intellectual excitement and developing interpersonal rapport (Wankat and Oreovicz 1993). Asking students questions helps keep students active and engaged in the classroom. It helps break up the potential monotonous flow of the class by avoiding a one-way conversation where the instructor does all the talking. It can help clarify points of confusion and help students and the instructor assess student understanding. Correct answers may serve as an indicator to the instructor that it is acceptable to either move deeper into the topic of discussion or onto the next topic (Nilson 2010). Enthusiastic and positive feedback for correct answers and encouraging feedback for incorrect answers builds rapport and encourages students to not only volunteer answers to questions but encourages them to ask questions themselves. Wankat and Oreovicz encourage instructors to pause after posing a question to the class as a group before calling on a student (Wankat and Oreovicz 1993). In doing so, it causes all students to begin to formulate an answer in their own mind before the instructor calls on an individual student. This keeps the student engaged and allows them to self-assess their understanding of the material.

When questioning students, there is value in linking questions to learning objectives for the class and asking questions at different levels of Bloom's Taxonomy (Bloom 1956). Questions can range from the lowest level of recitation and knowledge to the highest level of critical thinking with evaluation questions. At the beginning of a block of material, both the instructor and students may feel more comfortable at the Knowledge Cognitive Level. However, instructors should look for opportunities to get to higher levels of Comprehension, Application, and Analysis as quickly as possible to keep students from getting bored (Nilson 2010). Even at the beginning of a block on a new topic, instructors can use questioning to tie new material to previously learned material in the course or in the discipline curriculum, helping both the instructor and the student to identify gaps in memory. Seeing information multiple times through repetition improves an individual's ability to recall or repeat information. Similarly, a student's ability to learn a concept and recall information when needed improves through answering questions (Bain 2004).

Questioning can serve as a motivator to come to class prepared. Unfortunately, research shows students often fail to read due to a lack of self-confidence in their ability to comprehend the book (Lei, Bartlett, Gorney, and Herschbach 2010). Others have the misconception it will make no difference in their learning, as many instructors fail to integrate the book with their lesson plan. One of many strategies recommended to get the students to prepare in literature is to build links to the course through questioning (McKeachie 1999). Other strategies mentioned by McKeachie included using the reading in either individual student or group class exercises and building reading assessment into the grading structure. Bucknell University experimented with

several random quiz strategies before and during class that involved a roll of the dice. While this strategy increased the students' preparation for class, it increased their anxiety (Carney, Fry, Gabriele, and Ballard 2008). Others have modified the Bucknell University experiment to increase student preparation while reducing some of their anxiety. Some variations include allowing students to use open note learning logs for their quizzes and allowing students to take a group quiz for grade after attempting an individual quiz (McKeachie 1999).

"IN-CLASS ASSESSMENT" IMPLEMENTATION

After being influenced through personal experience of being motivated to complete assigned readings through in-class questioning and confirming the benefits of asking questions through literature review, the authors developed and implemented an "In-Class Assessment" strategy in one semester of a Design of Steel and Wood Structures course with 3rd year (junior) undergraduate students. In the student's study guide available to them before the start of the course, the authors provided an advance sheet for every lesson, listing the specific lesson objectives and reading assignments. The lesson objectives established the concepts all students were expected to understand. All reading assignments were very specific. For example, in lieu of assigning entire chapters for students to read knowing they would make a strategic decision about how to spend their time, students might be asked to "READ" one or two specific sections out of the text, "SKIM" the Load Resistance Factor Design (LRFD) example problem, and "SKIP" the corresponding Allowable Stress Design (ASD) example problem. In short, the readings were intentionally reduced to the bare minimum required for lesson preparation. The course was presented using 35 each, 75-minute lessons. Students were expected to spend 20% of their out-of-class time preparing themselves for a given day's lesson with the remaining 80% spent reviewing material from the previous lesson and working on homework.

Throughout the semester, students sat in their Engineering Design Problem (EDP) groups in rows of three students each. The EDP was a semester-long project with three Design Submissions and three In-Progress Reviews that culminated in the design for a complete steel structural system. At the start of each lesson which had assigned reading in the syllabus, the instructor opened the class with a roll of a dice or some other random method to choose one person from each EDP group to represent their team in front of the class. The randomness of the individual selection was intended to serve as a motivator for everyone in every team to prepare for each lesson. Once selected, each lucky student stood in front of their peers and answered a randomly-selected question written by the instructors. Adding fuel to the motivational fire of having to stand in front of peers to answer a question, the correct or incorrect answer not only affected the grade of the individual answering the questions but also impacted the grade of the entire team. In other words, if the individual answered the question correctly, the entire team could celebrate as they all earned their point for the day. If the student failed to answer the question correctly, the entire team lost their point for the day. Students were encouraged, "Don't let your teammates (or yourself) down – come to class prepared!"

The authors attempted a three-prong approach in hopes of getting student buy-in and motivating them to embrace the idea of preparing for class and reading their textbooks. One of the things the authors wanted to avoid at all costs is to have the "In-Class Assessment" become a "haze" or uncomfortable ritual where students felt too much pressure to perform and resented coming to class. Nilson warned that "unless questions are posed in a light-hearted tone", students might feel like they are "getting hammered and take offense" (Nilson 2010). Thus, the first prong involved having fun with the assessment. The authors used dramatic dice rolls, random number

selections, “rock, paper, scissors”, and a myriad of other active ways to both choose who from each team would answer the question and what question each student would get. The laughter and excitement that would come from some of the random selections could be heard down the hallway. In addition, the instructors wanted to be sensitive to students who were arguably overly concerned with grades. To address this particular concern, the instructors included the points associated with in-class assessments as part of the homework grade. With individual homework due on average every five to six lessons, the team “In-Class Assessment” grade was only worth 5 of 100 points towards an individual homework grade. In addition, the instructors often injected team bonus opportunities in each block (e.g. which team could weld the strongest connection competition) that would be used to offset points from missed questions. What could easily have been considered a haze turned into an active and fun way to start class.

The second-prong in getting students to embrace the assessment and value the learning associated with reading involved a focus on the intellectual excitement aspect by asking good and fair questions. Literature suggests that good questions are short, clear, and unambiguous (Wankat and Oreovicz 1993). For each lesson for this semester, one instructor re-read the assigned reading and developed the questions for the lesson, while the other instructor reviewed the question to ensure it met the “good question” criteria. The authors also felt the questions should be closely tied to the assigned reading and reach different levels of Bloom’s taxonomy. Thus, the randomness of the questions left some students defining or listing key terms while others had to explain or compare concepts. Ensuring every question could be answered if the reading was completed and understood was geared towards eliminating the misconception that completing the reading made no difference in their learning.

The third, and possibly most important prong, was to listen carefully to the students’ answers and to respond accordingly to their answers. Correct answers received a motivating “GREAT JOB” from the instructor while the student often received a high five or chest bump from their peers. Incorrect answers or answers that were not completely correct received a positive response from the instructor for trying. More importantly, these less than correct answers quickly turned into teaching opportunities geared towards the ultimate purpose behind the “In-Class Assessment” – to improve student learning. Thus, incorrect answers were often either fielded to someone else in the group or offered to the class for a volunteer to answer. This often led to someone quickly answering the question correctly with the hopes of motivating the student who missed the question to be better prepared next lesson. On rare occasions, a student would fail to guess at a question and simply respond with, “I don’t know.” In those situations, the authors attempted to rephrase the question just in case it did not meet the “good question” criteria. A failure to answer at this point once again turned into a teaching opportunity. In some instances, the question was turned to the class or to someone else in the student’s team. Other times, the instructor walked the student towards an answer by breaking down the question into little pieces or by relating the question towards a basic concept previously learned. If there was any remaining confusion regarding the correct answer to a question, instructors would place extra emphasis on that particular topic in the upcoming lesson.

ASSESSMENT OF THE “IN-CLASS ASSESSMENT”

Dating back to at least 1999, students in this course have filled out an anonymous daily survey known as the “Time Survey” that records the amount of time spent outside of class on the course. As shown in Figure 1, the trial run of “In-Class Assessment” during term 2018-2 helped contribute to the highest amount of time spent outside of class since 2001! The 113.7 minutes per

lesson was a 30 minutes per lesson increase over the same course presented one semester earlier without "In-Class Assessment". While there might be other factors that could have contributed to this bump, the curriculum itself was largely unchanged. Despite the large bump in time spent outside of class, the 113.7 minutes per lesson were still under the guidance of two hours outside of class for every hour in class (75 minutes each lesson in class = 150 minutes each lesson outside of class).

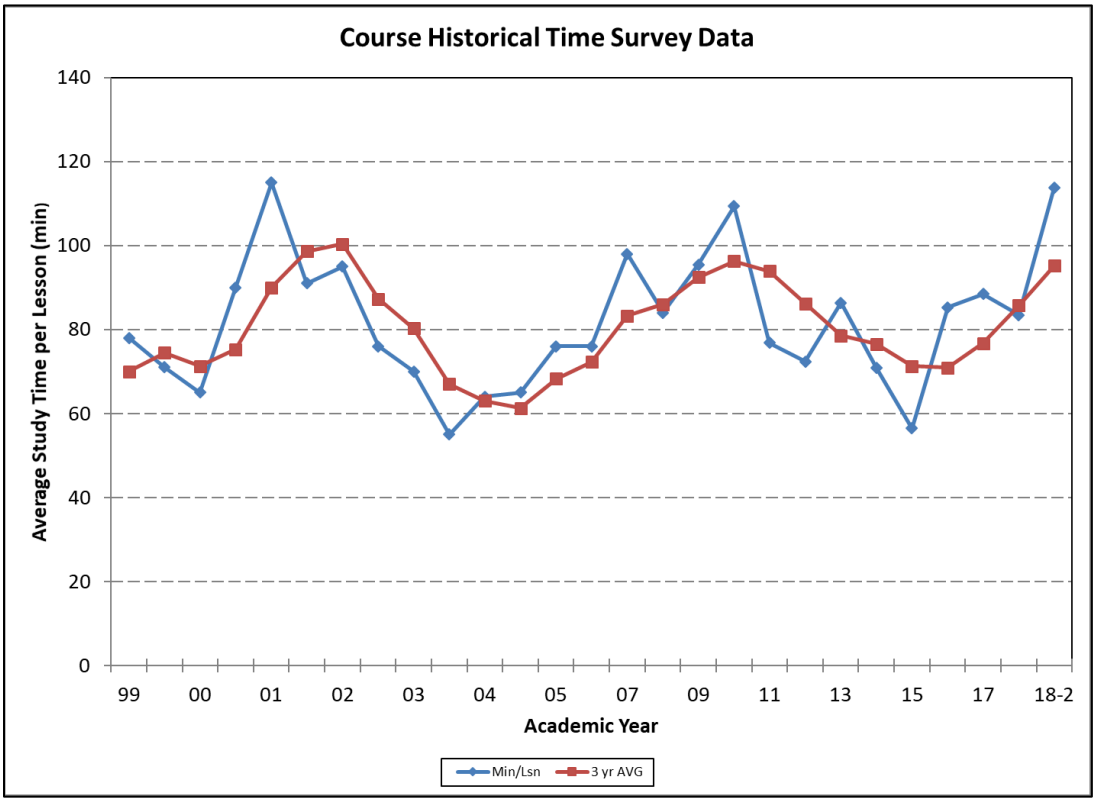

Figure 1: Course Historical Time Survey Data

The 45 students were anonymously asked after the semester was complete to estimate their class preparation over the semester. The results, shown in Table 2, reveal "In-Class Assessment" led to greater student preparation. While nearly 50% of the students prepared for class at least 50% of the time when "In-Class Assessment" was implemented, less than 0.1% of the students prepared for class 50% of the time for lessons in the same course when "In-Class Assessment" was not implement. Across all other engineering courses, only 17.7% of this cohort prepared for class at least 50% of the time.

Table 2: "In -Class Assessment" Class Preparation Numeric Feedback

	Prepared for Class (% of the time)			
	75 - 100	50 - 75	25 - 50	< 25
"In-Class Assessment Lessons" – Steel Design	22.2	24.4	33.3	20.0
Non "In-Class Assessment Lessons" – Steel Design	0.02	0.07	20	71.1
Other Engineer Courses this semester	2.2	15.5	22.2	60

Instructors also assessed the effectiveness of the "In-Class Assessment" by reviewing student performance of course objectives. The assessment of student performance of course objectives was in accordance with the following criteria:

1 = Objective Not Met. Objective clearly not met, most (75%) of the students did not achieve it.

2 = Objective Marginally Met. Objective met by roughly half the students or minimally by most of them.

3 = Objective Satisfactorily Met. Objective clearly met by a solid majority (70%) of the students.

4 = Objective Solidly Met. Objective clearly met by the vast majority (90%) of students.

5 = Objective Clearly Met. All students have achieved the objective and can be expected to demonstrate it.

The definition of "meeting a course objective" was achieving a "C" level (70%) on the task. Comparison of student performance is shown in Table 3. Students in the semester with "In-Class Assessment" (annotated in red) largely matched the student level of performance of students that took the course without the "In-Class Assessment". While student performance was largely unchanged, student ability to recall information beyond the current semester may be a better indicator of the students' understanding of the course material and is a potential topic for follow-on research.

The authors also compared arguably relevant Academy-wide anonymous survey questions. These survey questions were asked to students using a 5-point scale (5-Always, 4-Frequently, 3-Sometimes, 2-Rarely, 1-Never). In response to "Students are responsible for their own learning", students assessed the "In-Class Assessment" course at a 4.67 (45 responses) versus 4.50 (12,466 responses) for all other courses. In response to "My motivation to learn and continue to learn increased due to this course", students assessed the "In-Class Assessment" course at a 4.40 (45 responses) versus 4.03 (12,466 responses) for all other courses. While these survey results are data points from just one semester, they suggest "In-Class Assessment" may help students take responsibility for their learning and motivate them towards lifelong learning.

Understanding these results could be influenced by several factors other than the "In-Class Assessment", the authors surveyed students to get their thoughts on the assessment technique. A representative sample of the student freeform comments of their likes and dislikes are provided in Appendix A and Appendix B, respectively. Overall, students liked the fact that the "In-Class Assessment" served as a forcing function to prepare for class and that the light-hearted nature of it kept the assessment from becoming an undue burden. Students also seemed to enjoy the cohesiveness it built not only amongst their project group but within the class as a whole. On the other hand, not every student fully bought into the concept. A few students felt it was impossible to understand the textbook or complete the reading assignment prior to class. Others did not like the fact that some questions were easier than others. They felt that some teams were lucky and ended up with questions that could potentially be answered without reading at all while others ended up with "tough" or "nit-picky" questions.

CONCLUSIONS AND WAY FORWARD

The Accreditation Board for Engineering and Technology, Inc., (ABET) provides student outcomes that describe what students are expected to know and be able to do upon graduation. A few of the outcomes pertinent to "In-Class Assessment" include a student's ability to engage in life-long learning, a student's ability to communicate effectively, and a student's ability to solve

engineering problems. “In-Class Assessment” motivated students with a little bit of positive peer pressure and fun to get in the habit of what experts in a profession are supposed to do: prepare for work! It also encouraged them to think critically, solve problems under reasonable pressure, and articulate answers in front of their peers. In short, “In-Class Assessment” has the potential to not only contribute to student learning and the formulation of good professional habits, it can also serve as a contributor for programs to attain their educational objectives.

Table 3: Course Director Course Assessment of Course Objectives

Course Objective	Assessment 2018-1/2018-2 (Previous AT)	How Evaluated and Remarks
Design and analyze the members and connections of low-rise structural steel and wood structures using LRFD methodology, given a set of functional requirements and an architectural concept.	5/5 (5)	Overall course average 86.4% in 2018-1 and 87.2% in 2018-2 (previous year 85%). All students both terms met objective.
Describe the advantages and disadvantages of using structural steel and wood as building materials.	5/4.5 (4)	Average of two homework assignments. 2018-1: All students met objective. 2018-2: 44/45 met objective. Previous year, 94% met objective.
Describe and model the path of gravity and lateral loads through common structural systems.	4/4 (4)	Average of Engineering Design Problem Submissions and a portion of one exam. 2018-1: 94% met objective. 2018-2: 91% met objective. Previously, 94% met objective.
Use modern engineering software to analyze load effects and communicate structural plans in 2D and 3D.	4/5 (3.5)	Average of Engineering Design Problem Submissions and portions of several homework assignments. 2018-1: 94% met objective. 2018-2: 100% met objective. Previously, 86% met objective.
Describe and predict structural stability concerns in members locally, in compression members, in flexural members, and in frames.	4.5/4.5 (3.5)	Average of portions of homework, Engineering Design Problem Submissions and the Term End Exam. 2018-1: 98%. 2018-2: 98%. Previously, 88% met objective.

The authors are encouraged by the 30-minutes per lesson increase in student preparation in comparison to the previous term and the percentage of students that prepared for most of the classes in comparison to other courses. Further investigation with additional iterations is warranted and will be done by the authors for additional data points. During the next iteration,

the authors will eliminate the bonus point opportunities geared towards softening the already low impact of missing the answer to a question. In doing so, more emphasis will be placed on correct answers to the "In-Class Assessment" questions. The authors will also seek more balance with respect to the questions' difficulty in an effort to eliminate large perceived disparities with respect to level of difficulty. Convinced that "In-Class Assessment" is an effective tool to increase class preparation and student learning, the data from multiple iterations will be consolidated and evaluated.

APPENDIX A: FREEFORM STUDENT FEEDBACK: WHAT DID YOU LIKE MOST ABOUT THE "IN-CLASS ASSESSMENT?"

**The group component and the component of standing up and not wanting to embarrass yourself in front of the class. It motivated me to prepare for class.*
**I thought it was a good bonding experience for the class and it promoted good discussion.*
**That it was in front of everyone and your team relied on you. You felt bad if you couldn't answer the question, so we all came prepared.*
**The questions were only one point so if we got them wrong it wasn't too bad.*
**The questions were relevant to the day's topic and rewarded good preparation.*
**Held me accountable without jeopardizing my grade if I messed up.*
**It forced everyone to read so that they didn't let their teammates down.*
**It always hit the key elements of what we needed to know.*
**They were fair and straightforward from the assigned reading and preparation.*
**It got excitement in the room and people talking.*
**It gave me incentive to prepare. It got us in the right frame of mind for the class.*
**It forced us to somehow prepare for class. It helped with concept questions.*
**I liked that our class embraced the assessments and made them fun.*
**It made me much more likely to prepare for class, and it was still presented in a light and fun manner. It didn't ruin your grade if you got one or two wrong.*
**I liked that it got me thinking about the course material and kind of prepared me for the lesson.*
**Being held accountable for my out of class prep.*
**It forced me to read the material beforehand and arrive to class with questions.*
**It makes you get used to pressure and feel comfortable sharing what you think.*
**They forced me to at least skim over the readings to prepare for class.*
**Got me to open the textbook prior to class and read.*

APPENDIX B: FREEFORM STUDENT FEEDBACK: WHAT DID YOU DISLIKE MOST ABOUT THE "IN-CLASS ASSESSMENT?"

**I wish we had a little more guidance / general idea of what the questions would be on.*
**Didn't like the getting called on but it was good for us.*
**I think that having the same groups all semester lost the chance for us to reach out to more people.*
**Some groups with struggling students are now not on good terms with each other.*
**Random selection of the group member to answer the question.*
**It made us answer questions on a reading that most people probably didn't do and if they did do the reading, didn't understand. There is no way someone could do the assigned reading and know what they should know for class.*

**Sometimes even if I read the material, the questions from the learning objectives weren't asked or clear.*
**Questions varied in difficulty. Luck of the draw often gave some people very easy questions. Grading was often not harsh enough, giving students the benefit of the doubt and free points.*
**Being put on the spot in front of the class.*
**It was too frequent at times.*
**Some of the readings were very dense, and I found myself just not doing the rest of the reading.*
**It did not always pertain to the reading material, so despite having done the reading, there could be questions that I would miss because they were really questions from two lessons ago. That can make it difficult to retrieve the answer, not because I could not come up with the right answer, but because I was searching in the wrong place for the information in my brain because of initial context given (that it was something I should have read last night in the reading, so I'm going through the reading in my head and can't find it because it wasn't from that reading).*
**Some numbers were called more frequently than others.*
**Each assessment added stress to the class and a number of them were minute details that I did not entirely understand coming into class.*

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A Roadmap to the Implementation of the ASCE Policy Statement 465: First Professional Degree

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ABSTRACT

In October 1998, ASCE's Board of Direction adopted Policy Statement 465: First Professional Degree (FPD), which supports the concept that the master's degree or an equivalent would be required for a graduate engineer to practice civil engineering at the professional level. In this author's opinion, this requirement has not been implemented because there is no clear vision of how to put together a curriculum and a mechanism to bridge the gap between the existing curriculum and requirements to satisfy the first professional degree. A model curriculum is presented for the development of a process that will lead to the entry-level degree of professional civil engineer or a master degree in civil engineering. This degree will carry with it not only a pure academic component, but also requires a full summer of professional experience which exposes the student to the practice in the field whether it being a site experience and/or an office experience. The duration of both degrees would normally be five academic years with an obligatory summer semester for the professional experience requirement. The deciding factor whether a student could pursuit a graduate degree or the professional degree would be the cumulative and/or the major GPA at the end of their junior year. Students pursuing the graduate degree would be awarded a BS at the end of their senior year and an MS in a minimum of one year after their senior year. Meanwhile students in the professional track would be awarded a professional degree at the end of the fifth year.

INTRODUCTION

In October of 1998, the American Society of Civil Engineers (ASCE) Board of Direction adopted Policy Statement 465 (PS465) supporting the concept of the master's degree or equivalent education as the First Professional Degree (FPD) for the practice of civil engineering. Citing globalization, social diversity, new engineering and information technologies, enriched public awareness of technical concerns, and a complex and intricate infrastructure, the Board declared current Bachelor of Science degrees in Civil Engineering (BSCE) insufficient training for professional practice in the future. In October of 2001, the Board voted unanimously to proceed with requiring additional education for civil engineering. Once again, in 2008, ASCE has conveyed concerns that a BSCE degree is not adequate training for professionally licensed civil engineering practice (ASCE 2008). ASCE has formed committees to evaluate existing requirements to decide what is deficient and to classify the suggested academic requirements modifications.

ASCE PS465 has addressed this concern and it has evolved to its present form over the past couple of decades. The suggested fulfillment of these educational requirements could consist of a combination of:

- A baccalaureate degree (BS),
- A master's degree, or approximately 30 coordinated graduate or upper level undergraduate credits or the equivalent agency/organization/professional society courses

providing equal quality and rigor, and

- Suitable experience based upon broad technical and professional practice course of action that afford adequate flexibility for a wide range of roles in engineering practice.

In this paper, the concept of a professional undergraduate degree would be introduced and would be called Bachelor of Engineering (BE). This BE degree would require a minimum of five academic years of undergraduate education. The BE option would not normally be given to students who have the required academic qualifications at the end of the fourth year to pursuit a track leading to the traditional BS and MS degrees in Engineering. Whereas those students who have a lacking academic record (not acceptable for admission to graduate schools) would continue on to pursuit a professional degree BE.

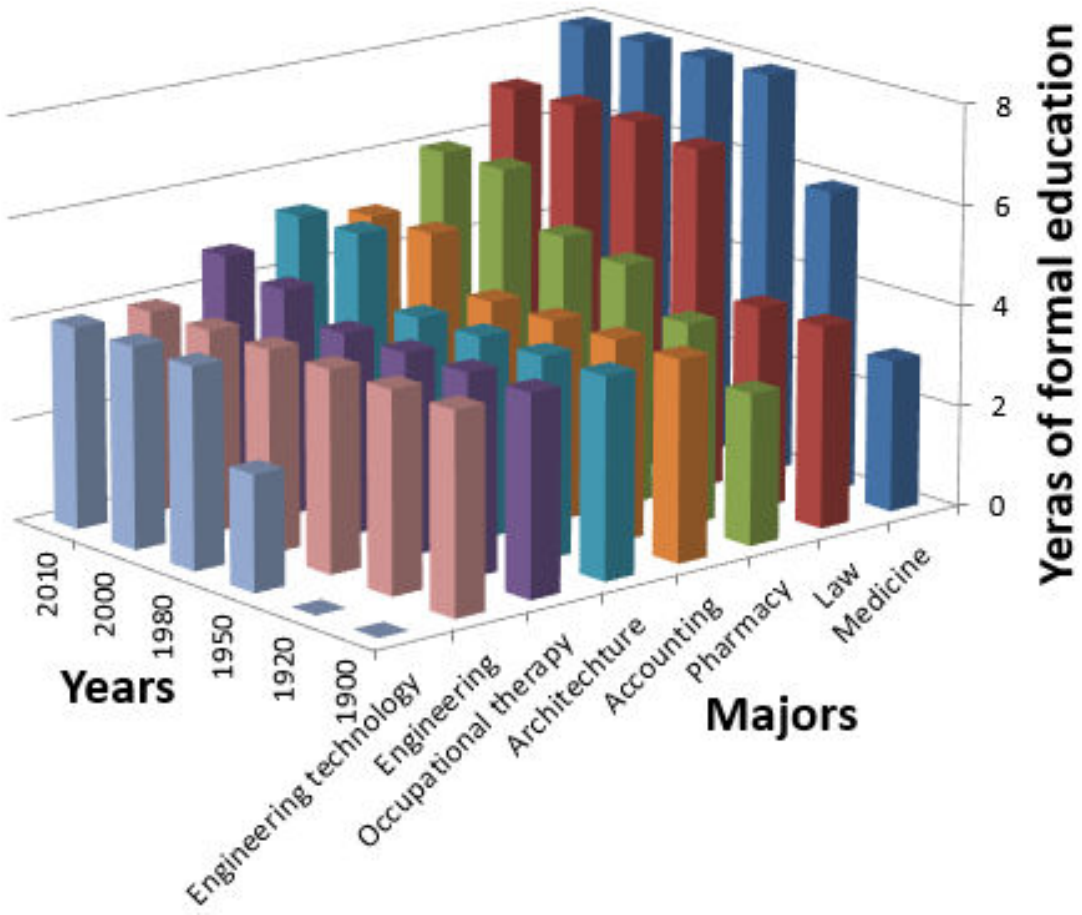

Figure 1: Evolution of years of formal educational requirements for different professions

ISSUES

Existing US baccalaureate programs, while constantly undergoing modifications preserve a minimal traditional four years of educational route. This limited period restrains the capacity of these programs to deliver a proper education commensurate with the growing burdens of the professional civil engineering practice. There are entirely conflicting constraints trying to embrace more content into the baccalaureate curriculum while at the same time decreasing the credit hours that are crucial for the BS degree. The outcome is a BSCE adequate for an entry level position while meeting ABET (ABET 2018) accreditation requirements, but inadequate for