

Practical teaching and its importance in teaching civil engineering

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Abstract

Students pursuing their civil engineering degree usually learn the theory part in class but may struggle to relate theory to practice if the instructor has no industry experience. Engineering graduates can benefit more when civil engineering courses are taught by instructors that have both academic and practical experience. An instructor with industry experience can motivate students, enable them to relate what was learned in the class with the real world, and allow them to start developing their own engineering judgment, which is essential for the successful practice of civil engineering. The paper discusses the importance of practical experience in civil engineering education, problems facing practical teaching, and successful practices in practical teaching.

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Introduction

Numerous studies have attempted to identify the different qualities of an engineering graduate in terms of key technical and practical skills. Some studies identified technical knowledge and skills as the area of greatest strength of an engineering graduate in the United States (1, 2). Other studies found that many students graduate with a lack of problem recognition and solution skills (3, 4). These studies recommended open-ended design problems to improve a student's ability in the practice of engineering. To teach these skills to the students, the instructors need to have some practical experience.

Practical experience helps instructors to relate theory to practice, improve their hands-on abilities, and train the students' ability of analyzing and solving problems. This paper presents suggestions on some practices for practical teaching to improve the skills of the engineering graduates. These skills are skills needed to qualify for a job in a competitive world of industry firms. The paper emphasizes the significance of the real-world experience of engineering faculty members to prepare students for transition from university to the 'real world'.

The engineering graduates should learn that civil engineering problems cannot be solved by mathematical analysis alone. They need to understand that in engineering, judgment and perception are crucial. Civil engineering students should be taught how to develop engineering judgment for the size of elements, expected dimensions, quantities, values and the sense of proportion which help her/him to judge the results of calculation against reasonableness. Students can develop these skills with the help of instructors having academic and practical experience, through illustrating examples, real-life examples, field work, and simple cases of design projects.

Problems facing practical teaching

The purpose of engineering teaching is to develop the students' ability of analysis, design, management, and engineering judgment - in addition to verifying their understanding of engineering fundamentals. Currently, the practical teaching of civil engineering has the following problems in many universities.

- Many of the engineering students find some courses, including design courses, difficult for several reasons. Among them, most of the instructors lack the necessary practical experience to relate fundamentals to practice and to give real life examples. As a result, the students cannot relate theory with practice and apply their knowledge to solve practical problems.
- Lack of separate computers and latest engineering software used in the industry is a significant problem when trying to integrate practical teaching to a specific course. The cost of hardware and software is usually high, especially in the case of large class sizes. Some universities cannot set up laboratories because of the shortage of funding and the lack of specialized technicians. These conditions ensure that the students' understanding of engineering fundamentals remains only in theory.
- In most of the traditional teaching methods, students study fundamentals according to certain steps to acquire certain results. Students rarely think independently, or even ask why - which makes it difficult to nurture their innovation and creativity.

Therefore, it is necessary to reform the current teaching methods to find better practical teaching practices that meet the needs of social development, lay a solid basis for trained, qualified, and talented engineers with innovation capabilities, and motivate the interest of students as much as possible.

Successful practical teaching

In my opinion, real-life examples, case studies, and projects should be a major part of the teaching process. They should be prepared so that students can study based on the characteristics of the course. Once applied, these practical teaching methods will improve the attitude of the students for the course, will guide the students to participate in active course study, and will maximize

their development. In the section below, different practical teaching methods are listed. These methods can be used depending on the specific content of the courses taught.

Case study teaching

In the case of civil engineering, which is a practical field, every case study is a good teaching case. In case study teaching, instructors demonstrate and explain the specific practical case, and enable students to practice the fundamentals learned in the class by working on the analysis and design of this case study. This approach can enhance student perceptions and improve the effectiveness of teaching. Currently, case study teaching is adopted in the practical teaching of transportation engineering courses. Group discussions can also be adopted in most case studies. The developed case studies need to adapt to the students with different characteristics, fully stimulate the study enthusiasm of the students, help as many students as possible to understand the classroom knowledge deeply, and develop their engineering quality and innovation ability.

Analysis tools

Choosing a practical tool is a key factor to implement the practical teaching concepts. In order to benefit from the case studies, they should be completed using a practical analysis tool or software used in industry, so that students can benefit from the process. The analysis tool or software should be carefully chosen. For example, the two main software packages used in highway engineering are Geopack and AutoCAD Civil3D. Both packages have all the required features to complete the tasks assigned to the students and can design and produce construction plans for a highway. The latter is heavily used in Qatar by the public agencies and consultant firms. Customer support is available to provide the instructors and sometimes the students with the proper training and detailed tutorial. It is one of the most powerful highway design software available in the market. The software is easy to manage and upgrade and to combine with other hardware and software available at the university (AutoCAD). By equipping the labs with the software, it will be easy for students to practice after class as needed.

Group assignments

This approach can be used for the lab exercises that require a variety of laboratory equipment, software, and repetitive operation. The instructor sets the topic for the lab, students form their own groups freely, and each group elects a leader, who is responsible for team management. This approach will also solve the problem of shortage in lab equipment and software. In addition, it also improves the ability of adapting to work in teams in the future.

Real-life projects

The use of real-life projects is a practical method for students to apply what they learned in the class. First, the project tasks are given to the students and the instructor provides the students with the basic needs of the project according to the teaching purposes and teaching contents. Second, instructors organize the students to meet and discuss the different tasks in the project and to find ways to complete each task. In this case, the students apply their knowledge to find different solutions. Third, students introduce their proposed solutions to the instructor for discussion and approval. Finally, the instructor reviews the issues presented by the students then provide guidance to the students on how to proceed.

Practical training

Practical training should be considered as an essential part of the engineering students education. It is currently a mandatory course in many universities. Some institutions prefer offering this course during the summer only. The practical training has many benefits to the students including familiarizing the students with practical engineering work, improving the performance of the students by connecting theory to practice, and equipping them with the necessary skills so that they would be ready for the job when they graduate. After completing the practical training, the industry can also provide feedback, which can reveal the strengths and

weaknesses of the students and can lead to improving the material taught in the future. Finally, this type of collaboration can play a major role in reinforcing the relation between the industry and the academic institutions.

Conclusion

The author believes that the students can benefit more when engineering courses are taught by instructors that have both academic and practical experience. It was noticed that the techniques listed in this paper interests and motivates students. Using case studies and real life projects enable students to relate what was learned in the class with the real world. It will also allow them to start developing their own engineering judgment, which is essential for the successful practice of civil engineering.

The idea is to make the learning experience a memorable time for the students so that what and how they learned will be adopted into their memory and practice in the future. When discussing the impact of the courses taught with engineering graduates, they mention that they remember the content of the courses that I taught them and how it was a great help after graduation. I believe that these methods met the students learning needs and provided them with hands-on experiences that set them up for their future as transportation engineers.

Comprehensive application of the teaching methods listed in this paper will stimulate the enthusiasm of students, improve their hands-on abilities, and increase the students' ability in analyzing and solving problems. It should be noted that these methods have different effects on students due to the differences between individual students. Finally, It is necessary to adopt different techniques and keep learning and exploring in order to stay up to date with the new methods, techniques, and software used in the civil engineering field and to train more practical engineers for society.

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