

# Chapter 60

## Teaching of Fluid Mechanics in Engineering Course: A Student–Centered Blended Learning Approach

**Ataur Rahman**

*University of Western Sydney, Australia*

**Md Al-Amin**

*Monash University, Australia*

### ABSTRACT

*In undergraduate engineering courses, fluid mechanics is regarded as a challenging subject. This is particularly the case for students who do not possess a strong mathematical background. This chapter reviews the issues related to the teaching of fluid mechanics with an emphasis on how e-technology can enhance student learning. It uses the data of 462 students studying the second year engineering course at the University of Western Sydney (UWS) in Australia. The UWS fluid mechanics course, in its past ten years, has undergone significant changes in its content and delivery. It has been found that teaching based on a “student-centered approach” is more effective in teaching fluid mechanics than a “lecturer-centered approach.” Further enhancements are proposed in UWS through a blended learning approach involving both e-technology and traditional teaching methods to teach fluid mechanics. The method can also be adapted to other universities.*

### INTRODUCTION

The delivery of engineering education has traditionally been made via face-to-face teaching aided by a significant component of physical laboratory tasks for most of its core subjects. Engineering curricula have focused to equip students with

‘problem-solving skills’. However, it has been reported that lecturing is not a very effective medium to advance problem-solving skills and it does not require much critical thinking, and moreover may not prepare students for the types of problems they face as professional engineers (Johnson, 1999). In recent years, collaborative

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problem-based learning and use of on-line sources have become popular in engineering education similar to many other disciplines.

In engineering courses, problem-based learning has been used for some years at many institutions which employ real-world problems to introduce new concepts of a subject to students. Johnson (1999) presented the use of a combination of problem-based learning and cooperative learning to revise and teach a hydraulic engineering course. The goal of cooperative learning is that students study in teams so that they can learn from the lecturer as well as from each other. The online courses have not been that popular in core engineering subject-delivery till date in most engineering schools in Australia. This may be due to the fact that engineering subjects have a strong laboratory component and due to the lack of interactive responses that can be provided by a lecturer during solving complex design type problems on writing board.

In recent years, the student profiles in many engineering schools have changed significantly from past years. In the past, the engineering student cohorts were represented by top performing high school graduates (often from top 5% of high school students) with strong mathematical backgrounds. Furthermore, in the past, many students were not in paid employment (part-time or near full time) during the semester. In recent years, students in engineering courses in many universities are not from the top 10% of the high school students; rather they are from the top 20% to 30% range. Some of these students have done only general mathematics in high schools, and most often have not done any physics. When these students are enrolled in engineering courses, in particular, with higher commitment to paid work, it presents a challenge to engineering lecturers to equip these students with the necessary problem solving skills in fluid mechanics they would often require in a professional career. For these students, it is argued that a blended learning approach is likely to be more effective where a number of different approaches

are put in place such as face-to-face lectures, tutorial and lab classes, online lecture notes, tutorial solutions, peer mentoring, 'help day' by tutors/lecturers and selection of textbooks having interactive solutions of numerical problems.

This chapter focuses on the teaching of fluid mechanics, which is regarded as one of the most challenging subjects in the engineering curricula. This uses data from fluid mechanics teaching over a three-year period in the University of Western Sydney (UWS) in Australia. This identifies the challenges in the teaching of fluid mechanics generally and then proposes a blended learning approach which might be adopted in the near future to enhance students' learning in this subject in UWS.

## **BACKGROUND**

Catalano et al. (1999) compared aspects of engineering education with several case studies for a variety of subjects from a number of institutions. Comparisons were focused on teacher-centered and student-centered learning methods to identify the effectiveness of learning. They found that the student-centered model is more effective than the teacher-centered one when academic depth is considered. Crouch (2001) reported a ten years' teaching experience with peer instruction in introductory physics courses. Student performance was found to improve in quantitative problem solving skills by this method. They took a number of different approaches such as, the replacement of in-class reading quizzes with a writing report on the topic beforehand and group learning combined with traditional lectures. This paved the way for students developing an increased understanding of the courses.

There have been some previous researches on various aspects of learning and teaching of fluid mechanics and similar subjects. For example, Brohus & Svidt (2004) presented Information and Communication Technology (ICT) for effective

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