

# Chapter 12

## Team Teaching in PBL: A Literature Review in Engineering Education

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### ABSTRACT

*Project-based learning (PBL) is a challenging learning methodology, also for teachers, questioning common assumptions of teachers, like control over the classroom and reliance on expert knowledge. Most challenging is teamwork. Team teaching has been explored in many disciplinary areas, both in traditional as well as in PBL curricula. Teachers may feel uncomfortable with sharing knowledge and being assessed by students and peers. This chapter explores characteristics of team teaching in a PBL context through two consecutive literature reviews. The first seeks to characterise team teaching and its meaning to teachers, zooming in from team teaching in general to team teaching in a PBL context in engineering education. The second connects this characterization to the experiences of a specific PBL teaching team in an engineering context, resulting in insights in experiences at practitioners' level. The authors argue that successful team teaching is crucial for the success of PBL in engineering education and is important as an example for students to engage in collaboration.*

### INTRODUCTION

The challenges that engineering education is facing according to Hadgraft and Kolmos (2020) - sustainability, the fourth industrial revolution and employability - have led to four different types of changes in

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engineering curricula: 1) student-centred learning, 2) contextual and practice based learning, 3) digital learning and 4) professional competencies. Student-centred learning is described as “ways of thinking about teaching and learning that emphasize student responsibility and activity in learning rather than content or what the teachers are doing” (Cannon & Newble, 2000, pp. 16-17) and is based on constructivist learning theory (Hannafin et al., 1997). This means that learning environments are created that “enable and support individual construction by engaging in design and invention tasks. The design task is to create an environment where knowledge building tool (affordances) and the means to create and manipulate artefacts of understanding are provided, not one in which concepts are explicitly taught” (Hannafin et al., 1997). According to Baeten et al. (2010) student-centred learning activities are characterized as 1) an activity and independence of the teacher, 2) a coaching role of the teacher, and 3), knowledge which is regarded as a tool instead of an aim.

Problem and Project-Based Learning (PBL) involve students actively in their own learning and are commonly regarded as a way to make education more student centred (Bagheri et al., 2013), and, especially in the engineering context, to contribute to professional development of students (Johnson et al., 2015; Lattuca et al., 2017). In project-based learning, students work in teams and carry out a project to solve a large-scale complex open-ended problem, through a long period of time (Powell & Weenk, 2003). They are supported by their teachers and the knowledge and skills from supporting courses. Supporting student teams throughout a multi-disciplinary project semester implies strong teacher collaboration. Planning the project theme, defining requirements, establishing supporting knowledge and organizing tutoring demands from teachers to work closely together and discuss about educational issues across boundaries to help teams in this endeavor. It requires teamwork for tutors, teachers, administrators and integration over the traditional subject boundaries, what could be considered a disadvantage of PBL (Powell, 2000).

Teaching in higher education has traditionally been a rather individual activity, autonomous, often monodisciplinary, and sometimes isolated from other parts of the curriculum (Flinders, 1988; Vangrieken & Kindt, 2019). A stronger focus on the role of the student in the learning process and the importance of active learning has changed the role of the teacher and has shifted the focus in higher education from teacher to student (Gaebel & Zhang, 2018). The growing interest in student-centered approaches to learning, including multidisciplinary project approaches, questions the role of the teacher and the position of teachers within the teaching staff of a degree program. In engineering education, the opportunity for more intensive teacher collaboration also increases (Guerra et al., 2017).

Teacher collaboration is described in different ways varying from, for example, team teaching, co-teaching and collaborative teaching (Vesikivi et al., 2019). It can be defined as two or more teachers planning, instructing, and evaluating the learning of a single group of students; co-teaching refers to two or more teachers instructing a multidisciplinary student team in the same classroom and collaborative teaching emphasizing teacher collaboration and co-operative teaching is used. However, despite the number of teachers involved and their role in the teaching and learning process, these authors argue that “the definition of team teaching should be based on the pedagogical approach and grounded in learning theory” (Vesikivi et al., 2019).

No single definition of team teaching is agreed upon, but characteristics of team teaching are identified, like by Minett-Smith and Davis (2020) who refer to the involvement of two or more teachers, the degree of interaction between the teachers, the resources they share and the interdependence between the teachers. Interdisciplinarity is highlighted by Walsh and Davis (2017), Salonen and Savander-Ranne (2015) and Li (2020), the latter explaining team teaching as a specific form of interdisciplinary teacher collaboration.

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