Enhancing Team Performance at Chemical Engineering Curriculum

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Introduction

As a consequence of the Bologna Declaration, the European Union is establishing a common high education space that gives a greater compatibility and comparability between the education systems of the European countries in a 10-years horizon. Among the objectives of this leading change, the inclusion of personal abilities and social capabilities in the core of the curriculum of all domains is foreseen as a critical factor.

The School of Chemical Engineering at the University Rovira i Virgili (Tarragona, Spain) pioneered a decade ago the incorporation of topics such as teamwork, leadership, critical thinking, decision making or problem-solving to the chemical engineering curricula [1]. To stress the integration of concepts and increase the retention of knowledge, integrated design projects are developed during each course [2,3]. In this way, students run through problem based learning to solve *open-ended* problems. Consequently, hands-on teamwork training is extensively experienced. In this work, we present the specific and complementary training on teamwork provided to students to fulfil the programme objectives.

Organisation

The training activities are arranged in seminars consisting in modules of 10 hours, which are offered every year. The educational material used is similar to that furnished by professional training packages [4]. The activities are organised with an optional attendance; nevertheless over 80% of students follow these seminars, which account for a free election course. Each module is carried out in two 3 h workshops (25-30 students per session), and a set of additional extra time activities to discuss within the group. These activities are usually developed during the completion of the integrated design project proposed for each academic year, which horizontally and vertically integrates subjects given in different courses [5].

The modules deal with different teamwork-related issues, and are driven in an easygoing atmosphere, with students highly motivated and involved. Activities are supported by a number of practical examples, which are designed to point out the critical factors that contribute to teamwork succeeding. The activities are distributed across the curricula considering a long-term deployment (Table 1). The arrangement aims to provide students with just-in-time training, because the team performance evolves throughout different internal organisation, going from a leader directed situation to a self-managed team. Thus, in each academic year, the team members request different abilities that are furnished through the modules.

In each session two instructors are available. They alternatively play different roles: one leads the session while the other acts as facilitator. In particular, the task of the facilitator is to point out the topics revealed in the hands-on activity and to generalise the conclusions to their day-to-day work. For instance, in one of the cases developed in the third module (3rd year in the Chemical Engineering curriculum), an assignment is raised to the team. Its completion needs to discuss the procedures, to allot tasks, to control time, etc. Then, the team performance and dynamics is evaluated. Typically, group performance is reasonably good, but the team operating procedures are not clear: roles are not assigned, some of the team members are not involved in the common objective of the group, some of the natural team-leaders are not able/interested in include all members in the tasks and so on. This evaluation allows going deep in the need to reinforce these concepts as a key for improving teamwork performance.

One of the aspects that is included in the seminars is conflict resolution, as experience indicates that this situation arises in a few groups every year. This topic is faced by means of a classic activity: the prisoner's dilemma. Typically, the different members do not analyse the problems from the point of view of the others, and therefore, they fail to find a win-win scenario. Also, group members often do not provide their team mates with a second opportunity. Overall,

students always feel that time constraints stress their performance, as they have to arrive to an agreement in a short period of time.

In particular, the first year module is of great importance as the fundamentals of teamwork are introduced being a tool of motivation for the new students and the starting point for the rest of modules. In this seminar, the three columns of the succeeding teamwork, i.e. methods, relationships and leadership, are subjected to open discussion in order to drive the team to achievements in an environment of confidence between the members. Many practical experiences are carried out to reinforce the need for teamwork as a way to get a whole that is more than the mere summation of the parts.

Conclusions

As main conclusion, it is worth to note that training in professional capabilities helps the students to improve their performance as chemical engineers because the individual capabilities are magnified inside the teamwork. Also, the development of integrated design projects across the curricula has been proved to be a useful tool to force students to use as a whole all their individual abilities. The distribution of the training in these social capabilities across the Chemical Engineering curriculum models the just-in-time approach, as students are not involved in long-time horizon activities. Finally, it must also be pointed out that the academic staff need to improve their own performance as a teamwork to function as a model role for students.

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References

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Table 1. Distribution of seminars throughout the Chemical Engineering curriculum at the School of Chemical Engineering of the University Rovira i Virgili.

1st course	2nd course	3rd course	4th course
Fundamentals	Communication	Team norms	Leadership
Common purpose	Conflict resolution	Team capabilities	Recognition and reward
Confidence	Member integration	Team operating procedures	Team evaluation