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Managing the Transition of First-Year Students to a Competency-Based Educational Model

by

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Summary

An educational module has been developed and implemented at the ETSEQ (University Rovira i Virgili, Spain) to facilitate the transition of first-year ChE students into a comprehensive project-based learning environment. All first-year subjects participate in the first-year integrated design project and fourth-year ChE students act as project managers for first-year project teams. The eight-hour module is taught during the first two weeks of the first term and is structured according to factors necessary for a person to understand and commit to change. The first-year students' evaluation shows that the module helps them to: 1) identify what they should accomplish in order to find future employment as chemical engineers, 2) understand what an integrated design project consists of and what the benefits of teamwork are, and 3) realise that the integrated project and the related teamwork are great opportunities to acquire competencies essential for today's workplace.

Keywords: Change management, first-year students, project-based learning.

1. Introduction

Since 1995, the School of Chemical Engineering (ETSEQ) at the University Rovira i Virgili (URV) has been experimenting with Project Based Learning (PBL) and Cooperative Learning (CL) methodologies within the so-called Integrated Design Projects (IDP) [1]. With time, the IDP has evolved into the foundation of a competency-based educational model of the Chemical Engineering (ChE) programme of the ETSEQ [2].

First-year ChE students, apart from the usual changes experienced by all students beginning their university studies [3], suddenly find themselves immersed in a teaching and learning environment very different from the one they have been accustomed to. In the second week of the first term, they already find themselves forming part of a team led by a fourth-year ChE student. These teams aimed to carry out an IDP. All first-year subjects are involved in the IDP and teams have an average of five hours of classes per week during two terms to work on the project. When first-year ChE students compare their situation to that of other engineering students, it is natural and inevitable that they ask themselves: “What on earth was I thinking of when I decided to take this course?” Some authors [4] have observed that students, when forced to take responsibility for their own learning, undergo some or most of the stages that psychologists associate with traumatic change [5].

In spring 2003, the ETSEQ selected and launched a project to facilitate the first-year Ch.E. students’ transition into the student-centred learning environment that the IDP entails. As a result of that project, an educational module entitled “Change Management” was designed. The purpose of this article is to describe the structure and activities of this module. Although the module is designed specifically for a chemical engineering programme, it can be easily adapted for any other programme based on extensive use of student-centred learning methodologies.

2. Description

The “Change Management” module consists of eight hours of teaching and is held during the first two weeks of the first year of the ChE programme. The module has been divided into three stages, according to the three factors necessary for a person to understand and manage change successfully [6]:

1. A convincing reason to change.
2. A clear and compelling vision of the desired state.
3. An understanding of the steps needed to progress towards this vision.

Figure 1 illustrates these three stages and the different sessions into which the module is divided. The purpose of the first stage is to make students aware of the competency profile required in order to find employment (4 hours). In the second stage, students reflect on the discoveries from the first stage and decide what knowledge, skills, and behaviours they should acquire within the next five years (1 hour). In the third stage, students receive detailed information about the ‘*why*’, the ‘*what*’, and the ‘*how*’ of the first-year IDP (2 hours). To conclude the module, students are taught about the human response to change, including both positive and negative predisposition towards changes (1 hour). A teacher trained in facilitation techniques leads the module.

2.1 Compelling reasons to change

Upon the end of the first stage, students should be aware of what their future employers will expect from them once they have graduated. The most effective way to understand these expectations is to interact with industry representatives. However, as a prerequisite to this meeting, students should first consider:

- ♣ How changes in industry and society are affecting their future professional careers.
- ♣ How they can prepare themselves to cope with these challenges.

This preparatory work is necessary so that the students can later validate their perceptions and assumptions to industry representatives. The first two hours of this preparation are devoted to this reflection. In this session, first-year students start collaborating in teams aided by fourth-year students who act as project managers in the IDP. This way, they begin to experience the educational environment of the IDP and have an opportunity to get to know each other.

The other two hours are dedicated to a session with industry representatives themselves. Five or six people are chosen based on the following criteria:

- ♣ Representation of small and medium companies as well as large corporations.
- ♣ Diversity of the country of origin of the large corporations.
- ♣ Balanced representation of engineers and human resource professionals.

It is important to highlight the fact that there has always been a complete agreement amongst industry representatives for the recruiting competencies. As an example, Figure 2 contains the summary of these expectations for one of the Spanish petrochemical companies. A university degree and a good student's academic record are the basic requirements for applying to the job. Once these basic requirements are met, the selection is made dependant on the candidate's generic competencies and is carried out using the Assessment Centres' method [7].

The session with the industry representatives never leaves any student feeling indifferent. After the session, the facilitator begins to take note of the students' emotional response. Many of them feel the need to share their emotions with the facilitator, often in the form of emails. The following quote from a student is an example: "Once you realise what the companies demand, at first you feel frustration. I'm not sure if I'll be able to do all that I should. Nevertheless, the feeling of frustration is quickly replaced by an imperative need to get yourself together and make the effort to achieve these objectives." Figure 3 contains more verbatim comments received from students. Some of these comments, which show discouragement, distress, and denial, are characteristic of the human response to major change [4, 5].

Another common issue in students' responses is the fact that they often discuss the session amongst themselves. Although change is a personal journey, it is helpful to share this experience with colleagues [6]. So a positive side effect of the interaction with the industry representatives is the building of a support group, a key enabler in developing social competencies [8].

2.2 A clear and compelling vision of the desired future state

After arriving at this point, students need to reflect on what they have experienced in the first stage and structure their thoughts to finally prepare a list of competencies (knowledge, skills, and behaviours) they should possess when entering the professional world. The Kano model is an excellent tool for managing this task [9].

Before introducing the Kano model, the facilitator shares information with the students, reinforcing the message given by industry representatives. Some of the emails sent by ETSEQ graduates expressing their appreciation of the benefits of the IDP approach to their careers, prove to be effective. Moreover, prestigious references are used, such as conferences held by the representatives of both industry and universities from all over the world [10], as well as works by renowned education experts [11].

The Kano model is used to understand the importance of the characteristics of a product (in this case it would be a new engineer) for the customer (in this case the future employer). Figure 4 shows the application of the Kano model by a first-year student. The model classifies the characteristics of a product as:

1) Basic: These characteristics are so obvious that they do not normally need to be requested by the customer. However, given that they are so important, they must be identified. The best performance of any basic characteristic will only assure that the customer is not dissatisfied. An example of such characteristics could be the diploma of a chemical engineer. It is assumed that a chemical engineer already knows how to design a distillation column or write a technical report correctly.
2) Performance related: These characteristics are requested by the customer. A better performance in this kind of characteristic leads to better customer satisfaction. Contrarily, a lower performance reduces customer satisfaction. The price that the customer is prepared to pay for a product is closely related to these characteristics. The vast majority of characteristics explicitly demanded by industry representatives in the first stage, such as some social competencies can be included here (see Figure 2).
3) Delighting: These characteristics cause an immediate positive effect on the customer. An increase in their performance translates into higher satisfaction. However, their absence does not cause dissatisfaction. The customer does not tend to request this kind of characteristics either. In this case, competencies such as team leadership and project management delight the future employer, as new graduate engineers do not typically possess them.

When the basic characteristics are introduced to the students, the facilitator provokes them by asking, for example, if they believe that an engineer has to know how to write reports correctly and effectively. One student's response: "If the content is fine, what difference do twenty spelling mistakes on one page make?" very clearly indicates the level of detachment of some students from the real world. At this point, the facilitator should emphasise that the fact that this characteristic is not mentioned by any of the industry representatives is not because it is not critical, but because it is taken for granted that an engineer knows how to write correctly. This type of example opens the students' eyes and lays the groundwork for the students to reflect and actively seek information to construct their own Kano models. It is also emphasised that ETSEQ is not the only resource at their disposal where they can acquire some of these characteristics.

The students find the Kano model educational and useful and importantly, they find that this exercise helps them change their mindset from "degree orientated" to "customer orientated" and even into "self orientation". This mental change is demonstrated by the following student comment: "This diagram has opened our eyes. We shouldn't study in order to obtain a degree or pass an exam. We have to study in order to be competent and be satisfied not only on a professional level, but also on a personal one." Unfortunately, we have also observed how many students quickly forget these ideas as they progress through the ChE programme. Hence, it is essential to remind and reinforce them throughout the corresponding IDP of the second, third and fourth academic years of the programme.

2.3 Path forward

During the initial session of the third stage, the first-year IDP coordinators give a detailed explanation of the reasons behind the IDP and its function. Here, it is very important to highlight the 'why' of the IDP and its connection with the discoveries of the first stage. The students learn that the IDP is based on a combination of two teaching methodologies: project-based learning and cooperative learning [1]. The objectives to be achieved are:

- To learn how to learn.
- To apply and integrate the knowledge from all the first-year subjects in order to solve an open problem.
- To develop social competencies.
- To begin to practice what a chemical engineer has to do.

All of these objectives are in line with the employers' requirements.

During the second session of this stage the facilitator presents the human response to change [5, 6]. In particular, the negative pre-disposition towards change [5] is worked on in depth, presenting cases that illustrate the different stages indicated on Figure 5. This last interaction turns out to be a great discovery for the students, as many of them can correlate and empathise with the change curve. The following comment made by a student is revealing: "I'm really impressed by the graphs you've shown us because they are similar to situations I have witnessed." Some students become quite anxious when they realise how predictable this human pattern is.

First-year students are comforted by the fact that their project managers (fourth-year students) are educated in change management and can therefore receive coaching on a daily basis when working on their IDP. In addition, support is available through a number of professors.

Assessment and conclusions

The "Change Management" module has been in operation at the ETSEQ since the academic year 2003-04 i. e., for three consecutive years. At the end of the module, students have to complete an evaluation questionnaire that consists of three multiple-choice questions and a blank space where they can also provide any comments (improvement suggestions, feelings, complaints, etc.). By analysing the responses, the following conclusions can be drawn:

1. The module helps students to identify what to work on in order to secure future employment as chemical engineers (between 35% and 72 %). In addition, a significant number of students (between 8% and 31%) indicate that the module has helped them to set priorities and begin to draft an action plan for their future development.

2. The vast majority of the students (between 80% and 93%) have understood what the IDP consists of and the benefits of working in a team. A very significant number (between 42% and 83%) consider the integrated project, and the related teamwork, as a great development opportunity to build a professional career in the industry.

3. The students' response towards the IDP is in line with the pattern of human response towards change. Therefore, some students can be identified as "change pioneers" (between 17% and 27%), with the majority of students being more passive towards change (between 60% and 83%).

Students typically take the opportunity to freely write whatever they think of the module in the blank space of the questionnaire. Figure 6 presents a sample of these comments. The analysis of these comments has led to improvements in the module design, such as a reduction in the number of hours, the participation of second-year students' in the third stage in order to present their experiences in the first-year IDP, or the introduction of more relevant case studies.

It can be concluded that the "Change Management" module is valuable and overall, positively received by the target group. This conclusion has been confirmed by a study carried out by the URV vice-chancellorship in 2005, as a result of group interviews of first-year students.

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Figure Captions

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