The Importance of the Final Year Project as a way of Completing an Education in Engineering

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Abstract — In all engineering degrees, students are obliged to carry out a ‘Final Year Project’. This activity has many objectives that are going to be discussed in the first part of the paper. In short, it can be stated that it is a way of increasing the student’s maturity and preparing him/her for their future career. In a second step, several ‘theoretical’ ways of accomplishing the previously mentioned objectives are going to be presented and discussed. It will be shown that guaranteeing student motivation is a key factor in obtaining a successful result. In fact, motivation will provide the student with the necessary strength to deal with the unavoidable difficulties derived from the learning process. In the third part of the paper, the experience at the Thermal Machines and Engines Department at the UPV with respect to this subject will be presented, and how we have tried to implement all the previously discussed ideas. At the end of the paper, a valuation and discussion of our method will be presented, trying to underline its strong and weak points.

Index Terms — Final year project, motivation, new learning environments.

INTRODUCTION

Present society is increasingly asking for people with higher education in order to cover its needs. For this reason, these kind of studies are becoming more popular, resulting in some cases in university overcrowding. In parallel to this demand, students live immersed in a world in which information is more and more at anyone’s reach and this ‘excess’ of information may distract them in their formative process.

The key to success in higher education lies in knowing how to provide the student with incentives that counteract all these distractions, and this is why the ‘new learning environments’ are often talked about, since new things offer great possibilities of attracting the student’s attention. However, it must be underlined that the newest is not always the most suitable. In fact, traditional methods, if well used, may often lead to successful educational processes. This article pays attention precisely to a traditional activity in engineering high schools that may become a powerful tool to attract the student’s attention and help him or her in the formative process.

Helping students mature in their knowledge is one of the objectives of higher education, and this task entails much more than the mere transmission of knowledge. In particular, in the field of engineering, the future engineer is supposed to have assimilated the basic specific concepts in his particular field and have a well-formed intuition to be able to face all the problems that will come up during his future professional career. To attain this maturity and exercise this capability of facing problems, it is a common rule in all engineering that the students carry out a ‘Final Year Project’. This activity is, in some ways, a synthesis of all the information the student has been receiving along the successive stages of his educational life, and it is a key element of successfully finishing university education.

This publication deals with the topic of the Final Year Project. First, the main goals to be achieved will be analyzed, to consider secondly how it should be proposed from a theoretical perspective. Next, the way this activity is approached at the Thermal Machines and Engines Department (DMMT) at the Universidad Politécnica de Valencia (UPV) will be presented, and lastly, both the strong and weak points of the considered approach will be discussed.
AIMS OF THE FINAL YEAR PROJECT

The targets of the Final Year Project are diverse. On the one hand, since it is the student’s last activity at the university, it fulfills a purpose of synthesis of all the knowledge they have acquired throughout the different years. Besides, this knowledge must be used in a particular way, in order to solve a specific problem. Thus, students are able to demonstrate their aptitudes by applying this knowledge. On the other hand, it helps the student to mature as an engineer, giving him/her the chance of finding the solution to a similar problem as he/she might do in his/her future profession. Therefore, it also constitutes a preparation for starting work. Summing up, the final year project targets are the following:

• Synthesis of knowledge.
• To demonstrate the aptitude of applying the own knowledge to solve a specific problem.
• To mature the knowledge.
• Preparation for joining the working world.

The last aim imposes some determining factors that must be taken into account. First of all, engineers must assume both material and human responsibilities. In the same way, and due to the complexity of nowadays’ challenges, it is necessary both to work in multidisciplinary groups and to be able to adapt to the different scientific and technological advances. For this reason, engineers must be capable of learning and looking for information in order to solve the new problems they face in a practical, efficient and fast way. Summarizing, the current working world demands that the engineer is able to:

• Assume responsibilities.
• Work in a multidisciplinary group.
• Adjust to the different scientific and technological advances:
  o Auto learning capacity.
  o Search of information.
  o Pragmatism.

In the following section, and taking into account all such aims and the different circumstances, we are trying to show, in a theoretical way, how a Final Year Project should be planned.

THEORETICAL WAY TO PROCEED

As in any activity inside an educational process, the Final Year Project has to be oriented under a perspective that considers the student as the protagonist, the one that has to assume the responsibility of his/her own education. In this sense, the teacher/tutor has to play a role of guidance and advice throughout this educative ‘journey’, providing the student with any tools that he/she may need. By such means, the teacher contributes to facilitate the learning process, and at the same time stimulates the student to progress little by little in this activity.

As the Final Year Project is last educational activity to be fulfilled before getting the degree, and also due to its specific characteristics of both synthesis and particular application, the fact that the teacher helps the student displays a high degree of importance. In fact, it should allow the former to progress more firmly towards his/her goal, and to overcome uncertainties that will undoubtedly arise.

On the other hand, any learning process demands an effort. This must be kept in mind by the tutor, who should not give in to the temptation of sparing all difficulties to the student. For this reason, there should be a demand, mainly from the student’s side, who has to face the challenge entailed by learning, but also from the teacher’s side, who knows from his maturity and experience that effort is at the base of learning.

Nevertheless, and without forgetting about the relationship between effort and learning, there is another element left that leads the way towards learning at a more lively pace, and that is motivation. In fact, when a student is persuaded by the interests, benefits and, even, joy that learning can bring, most efforts are no longer a barrier. In some way, it can be stated that motivation is a key-factor for the future engineer to be willing to undertake all the necessary steps, demanding though they may be, in order to train him/herself and to learn until reaching the maturity in his/her knowledge. Accordingly, we think that both an adequate level of demand (indispensable to learn) and motivation (indispensable to assume the fore-mentioned demand) should be combined at the Final Year Project development in order to succeed in the goals and objectives that are aimed at through this activity.
DMMT EXPERIENCE

The DMMT is the main part of the CMT-Motores Térmicos research institute at UPV, developing thus, an important task in two parallel ways: education and research. As for the latter, there is a close relationship between CMT – Motores Térmicos and automotive companies, other universities and public institutions in order to develop both basic and applied research programs. Knowledge generated by research represents an additional value for educational purposes because the updating of knowledge occurs in a natural and continuous way. Allowing students to carry out a Final Year Project related to one of the institute research lines and institutional projects is another way of taking advantage of this effort made in research. Experiences lived by students during their Final Year Project are going to be presented, in order to analyze later the advantages and disadvantages of this type of methodology as a complementary educational tool.

A student that joins DMMT for his Final Year Project is given a topic in the frame of a research program. In this way, the student knows which work he/she will have to develop during his/her stay. A tutor is assigned to each student, who directs and guides him/her during his/her stay. All project topics are related to reciprocating internal combustion engines involving theoretical or basic subjects, and also practical or applied subjects. Due to the complexity of this type of work, the student will join a multidisciplinary group, perhaps for the first time in his/her life, resulting in a very valuable experience from the fact that he/she will have to make his/her personal contribution to the group. As a result, the student assumes a high level of responsibility in the work such as he/she will do in his/her future professional career. In order to compensate such an effort to a certain extent, the student enjoys a grant for this work.

Finally, we want to remark that the Department experience on this methodology is over 20 year-old, with an average of 40-50 Final Year Project students per year in the last 8-10 years. This data shows a certain success in this type of methodology, at least from the student’s perception.

VALUATION AND DISCUSSION

Bearing in mind all the ideas mentioned along the preceding points, i.e., what the objectives of the Final Year Project are and which theoretical way should be proposed, and comparing them to the actual way the process is carried out, it should be possible to valuate this procedure.

From the most fundamental, basic point of view, the DMMT approach to the Final Year Project considers the student as the protagonist, in concordance with the already presented idea that ‘he who learns is who must hold the reins’ in his own learning process. This leading role is made evident through the responsibility conferred to the student, entrusting him/her some of the work the team develops. In a sense we can claim, then, that the basis we start from is a good one.

The student, apart from accepting responsibility for his/her own learning, also has the supplementary demand of looking for the necessary information to face the new situations he/she meets, acquiring some practical sense that may be helpful when facing problems that need an efficient solution. Throughout this work the student is helped by the academic tutor, who provides him/her with guidance and advises on the different decisions he/she has to take. This is both a security and a guarantee that the apprenticeship is going to be done correctly, since the possible errors can be corrected properly.

Taking a closer look at the way the Final Year Project is approached at the DMMT, we think that it represents a proper preparation for the student’s future insertion in the working world, as the student is placed in an environment similar to the one he/she might find at a hypothetical workplace. In this sense, he/she learns different experiences such as those of working in a multidisciplinary group, assuming a responsibility, facing a real problem with a certain complexity and becoming capable of finding information to solve specific problems and situations. All of these characteristics are demanded by the current working world, so another of the Final Year Project objectives is fulfilled in this way.

Another characteristic to be underlined from the DMMT approach is the level of demand, which is made clear through different aspects. As mentioned above, learning is entailed with an unavoidable effort, and the level of demand, in some way, makes it compulsory going through that effort. Nevertheless, motivation is another important point that can help cope with all this exigency and sacrifice. In general, the topic of internal combustion engines is usually very appealing to students (especially to those joining the DMMT for their Final Year Project, since they do it through choice). This fact results in a high level of motivation towards the subject itself. A supplementary motivation is the financial benefit the student receives through the grant, which in most cases represents his/her first salary.

From the different elements commented above, it could be stated that such an approach towards the Final Year Project also contributes to the aim of maturing in knowledge. Indeed, the dedication to solve a specific, real problem, to look for information that can be needed to overcome new situations, the advice by a tutor but with a personal responsibility contributes to this maturing in knowledge.

A second but also important benefit that can be obtained from this approach is that the teacher, who has close contact with the student, can receive feedback about the suitability of the training-formation which has been received by the student
during the different years of the university course. Detecting weak points or lacks in the training might provide clues to reconsider the different subjects a department is teaching on the various courses. This check of the suitability of the educational process is a very important issue, and can only be carried out through a careful analysis of the final product, that is, the student as a professional, for which spending time together with him/her is a necessity.

After reviewing all the positive items of this approach to the Final Year Project, we are going to analyze which are the ‘troublesome’ or darkest aspects. Basically there are two possible risks:

• Firstly, it must be borne in mind that applied research, that is usually entailed to projects with firms, is very demanding in terms of time and resources, and in the end, it is the actual project and not the student that might be important. This results in two possible dangers: on the one hand the teacher might not give the student enough attention, being negligent in his/her training job; and on the other hand, the student may just perform a routine work without really understanding what he/she is doing (as the important outcome of the project is the result, without paying much attention to the learning and apprenticeship of the student).

• Secondly, under some circumstances the responsibility placed on the student may be excessive. This respect might be negative if the student becomes unmotivated, while, on the other hand, it could represent an advantage for the future engineer since he/she is involved in real situations of pressure and stress, which are more and more frequent in today’s working world.

Looking at all these risks, it is vital that the teacher does not overlook the objectives of the Final Year Project, in order to prevent these negative circumstances from arising, and to take advantage of all the positive points mentioned.

CONCLUSIONS

Finally, conclusions can be summarized as follows:

• As for the Final Year Project goals, this is an important activity in the educational program of engineering students and it is important to pay proper attention to it.

• All learning processes involve personal effort. Motivation is an essential element in helping to maintain the effort required for learning process. Thus, the Final Year Project has to be approached with a certain level of demand, but also relying on motivation.

• Final Year Project tasks developed inside a research program in the Department offers the possibility of bringing together responsibility and motivation in order to assist the learning process.

• Additional advantages can be obtained using this methodology, as the future engineer is prepared for skills demanded by the working world: responsibility assumption, capability of working in groups, capability of facing new situations, etc.

• Supervision of student’s work by teachers offers additional guarantee and security over the learning process developed by the student. Using this methodology, additional information can be obtained such as success or failure obtained by the student in different subjects studied during the previous years, thus helping teachers to improve subject structure. This information is difficult to obtain in any other way.

• Methodology presented contributes to the student maturity in knowledge, as the student has to carry out particular tasks where he/she has to use a great quantity of concepts that he/she has in a conscious or unconscious way. Tutoring from the teacher may help in this respect.

• Finally, it is important to bear in mind that this method presents two different risks. Firstly, the fact that priority may be given to the research project, and the educational goal of the Final Year Project may be thus forgotten. Secondly, if too much responsibility is put on the student, this can lead to a loss of motivation. In order to avoid these risks, teachers must take into account that the student’s formation is the main aim of this process.