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Teaching and learning using a case study: application to a master degree in construction management

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Abstract

The Universidad Politécnica de Valencia (Spain) sponsors a M.Sc. program based on a model (named MAC²), which maps managerial competencies in construction. This program implements dynamic methodologies of teaching and learning; the most singular one is the use of a common project as a case study, which is used as a reference throughout the Master program. Guided interviews with professors and questionnaires to students are used to test the effectiveness and acceptance of this approach. The results confirm not only the success of the methodology, but also corroborate the use of the MAC² model as a tool for syllabus design.

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1. Introduction

For engineers and architects working in the construction industry, the management discipline is critical when acquiring reliable professional competences (Russell & Yao, 1997; Chinowsky, 2002; Russell, Hanna, Bank, & Shapira, 2007). Nevertheless, most university syllabuses in the construction field focus on conventional technology subjects, and do not consider managerial courses (Long, 1997; Galloway, 2007; Arditi & Polat, 2010). Furthermore, the Bologna process encourages the European governments to reform their university systems (Reinalda & Kulesza, 2005) and to organize the degrees in a three-cycle structure, for example, bachelor-master-doctorate (Bologna Secretariat, 2010). Therefore, against this background, in 2006 the School of Civil Engineering at the Universidad Politécnica de Valencia (Spain) decided to offer several postgraduate programs, construction management being one of them.

Consequently, the Master in Civil Engineering Planning and Management was born by the School of Civil Engineering three years ago and the program was fostered by a group of professors belonging to the Department of Construction Engineering. The purpose of this Master degree was to apply a holistic management approach to construction, not only from a production point of view, but also from a business point of view. The Master degree consisted of seven mandatory courses, plus seven elective courses (to be chosen from 12); there was also a Master Thesis. The academic load for each student was 62 ECTS from the courses and 10 ECTS from the Thesis.

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However further regulations by the Spanish government, as well as university rules to comply with this legislation, forced a change in the structure of the syllabus. Modules and subjects were established instead of the traditional courses. The revision and updating of the syllabus was based on a model previously developed by the authors (Pellicer, Yepes, Teixeira, & Catalá, 2009; Pellicer, Yepes, Ortega, & Teixeira, 2010); this model (named MAC2) maps managerial competencies in construction. Moreover, after two years of experience, the faculty thought that something else could be done to improve the teaching and learning methods. The Master's alumni had remarked unofficially that they had to deal with a heavy workload from every course, which was based on diverse case studies. That involved, in addition to solving the topics for each course, becoming familiar with a wide range of different construction projects without having the chance to gain a deeper knowledge of them.

Therefore, the goal of this paper is to give details about the design of the new syllabus based on the MAC2 model along with the implementation of dynamic methodologies of teaching and learning; the most singular one being the use of a single common project as a case study. The accomplishment of this new syllabus is monitored through questionnaires to students and guided interviews to professors. After exploration of the data, results are presented and conclusions drawn.

2. Design of a new syllabus based on the MAC² model

The authors developed a model, which covers the whole field of construction management in several papers (Pellicer et al., 2009, 2010). The model, named MAC2, presents two dimensions: project life cycle and organizational level. The project life cycle is linked to time through four phases: feasibility, design, construction and operation. The second facet considers four organizational levels: construction industry, company, team and individual. Figure 1 in both axes illustrates the two dimensions of the model.

The Master faculty, through its Academic Commission, proposed to the School of Civil Engineering that the syllabus be revised and updated to comply with the MAC2 model. This new syllabus was structured as follows: one year of tuition divided into two semesters, plus an additional semester for developing a Master Thesis. Based on the MAC2 model, the new syllabus in construction management was designed to fill in the most important gaps of knowledge. According to the faculty, its purpose was to cover the mandatory subjects, which were the most important parts of the model. This program comprises four mandatory subjects divided into nine courses with a total workload of 48 ECTS. Regarding the elective subject, only 12 out of 24 ECTS can be chosen throughout some of these courses, namely, real estate, accounting, e-business, artificial neural networks, and lean construction and a seminar in research and professional issues; all of the optional courses are located in the second semester. The elective courses are not shown in Figure 1. However, they should fill in the gaps related to the criteria for each student. Finally, a Master Thesis must be pursued comprising 15 ECTS.

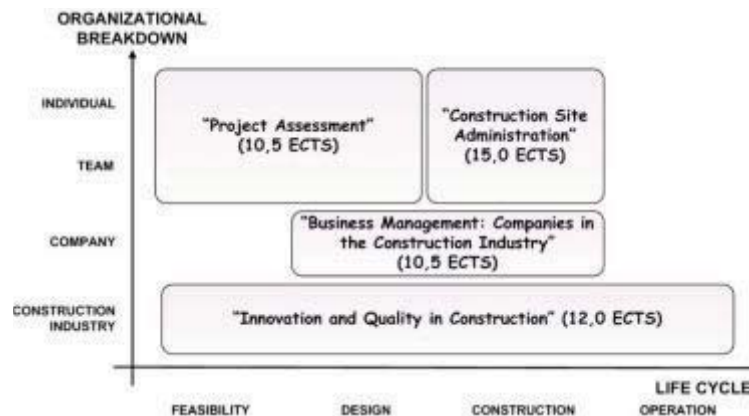


Figure 1. The new syllabus within the model MAC²

3. Implementation of a single common project as a case study

Taking advantage of this situation, the School of Civil Engineering proposed, also, an innovative methodology, which consisted of having a single common project as a reference for all the tasks, demanded by every lecturer. The main idea was that four students from different nationalities and diverse academic and professional backgrounds would come together in multi-cultural groups to develop jointly tasks in a very similar way to those experienced in the professional world.

As a first step to implementing this methodology in the new syllabus, an organizational meeting was arranged between all the professors involved in the mandatory courses; also, some professors, teaching elective courses, attended the meeting. This meeting had two goals: firstly, to explain thoroughly the new methodology to the faculty, resolving doubts and detailing implementation issues; and secondly, to coordinate, not only the contents of each course, but also the tasks demanded by the case study.

This year’s project was based on the design, tendering and execution of an actual construction road project, with a tendering budget of approximately 25 million Euros. The case study was used as a reference throughout the first semester. During the second week of the Master program, there was a specific lecture about the scope of this case study, which described roughly the technical content of the project (characteristics of the road, number and kind of junctions, singular structures, detailed budget, etc.) and pinpointed some recommendations about how students should organize themselves to undertake the start of the project successfully. These recommendations included:

- Setting up the teams, introducing oneself to each other and fitting timetables for work sessions.
- Getting familiar with the documentation of the project and its scope.
- Analyzing construction procedures and methods.
- Awareness of the scope of every different task, which professors demanded.
- Organization of the team including the work breakdown structure.

In the first semester, six mandatory courses of the Master program have a strong link with the common case study. Table 1 shows these courses and the scope of their different tasks.

Table 1. Courses related to the common case study and the scope of their tasks

Subjects	Scope of tasks
Project Management	Team planning and work breakdown structure
Business Management in the Construction Industry	Tendering process
Construction Site Management	Site layout and planning, and cost control at the construction site
Projects Scheduling Techniques	Construction schedule
Health and Safety Management in Construction	Health and safety plan
Strategic Quality Management in Construction	Quality assurance plan

Motivation was another issue, which has to be improved. Often, Master’s students have to cope with their regular jobs and family responsibilities apart from carrying on with the Master’s workload. Even for those who are dedicated full time to the Master program, it means a great personal effort. Therefore, self motivation must be high to succeed in this endeavor.

Students, who do not believe that their efforts are worthwhile, are sluggish, concentrate less, study in a superficial way with less intensity and frequency, and do not try to overcome their difficulties. Consequently, the absence of proper motivation represents a very important problem (Alonso, 2001). Just like students, professors’ motivation is also crucial for student learning; when professors become involved in their work, they feel more predisposed to apply dynamic strategies and innovative methodologies; and promote a participative climate in their classrooms. Professors’ motivation is improved when they feel their efforts are worthwhile through students being positive and responsible for their work (Argente et al., 2008).

4. Survey method

At the end of the first semester (December 2010), professors and students already had perceived how this methodology was working. The effectiveness of implementing this methodology was tested using two complementary tools: a questionnaire to students, and guided interviews with professors.

The students' questionnaire consisted on 23 questions. Seven introductory questions were designed to depict the student's profile: age, sex, academic background, alma mater, labor situation, professional field and years of experience.

Sixteen additional questions were the main body of the questionnaire: the first eight questions were intended to measure how the new syllabus fitted within the MAC² model; the other eight questions assessed to what extent students considered this new methodology positively. For these questions a five-point Likert scale was used to quantify their responses, with five possible choices: strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree (Cohen, Manion, & Morrison, 2000). A score was given to each of the alternative choices, from +2 (strongly agree) to -2 (strongly disagree). Hence the responses to these questions could be analyzed statistically calculating their average score. Only one question of this set was designed to be chosen from different answers.

Furthermore, a short guided interview was developed with each one of the six professors in charge. Five questions were asked regarding: difficulties to adapt to the common case study; impact on the professor's workload; coordination with other colleagues; advantages and disadvantages; and suggestions for the future.

5. Results and discussion

A total sample of 35 students was appraised. The typical student's profile could be characterized as follows: 25 years old or younger (51%), male (89%), former student of Universidad Politécnica de Valencia (66%), with an academic background in different areas of Civil Engineering (66%), from one to three years of experience (49%) in a construction company (37%), and dedicated full time to the Master (71%). Moreover, the answers to the questions regarding the methodology and quantified by the Likert scale, are presented in Table 2, stating each question and its average value (from -2 to +2).

Table 2. Responses to questions quantified with a Likert scale

#	Response	Average
1	Working on a single common project improves my global vision.	0,83
2	I prefer working on a single common project rather than doing unconnected projects.	0,80
3	A single common project is more encouraging than working on multiple partial projects.	0,86
4	The objectives to achieve working with a single common project were clearly explained by the professors.	-0,17
5	Working on the common project involves an excessive workload, even for four members groups.	0,66
6	I think that the extra effort dedicated to the common project is worthwhile.	0,71
7	I support this new methodology based on a single common project for future years.	1,26

Most of the students considered that the single common project was good for their learning process. As shown in Table 2, questions 1 to 3 reveal that, even although not strongly, the students agree with this fact.

Another aim of the study was to find out if professors were performing well concerning the common project. The students' results show a confusing picture regarding this facet (question 4 in Table 2). Most of the students did not understand properly either the scope of the common project or some of the tasks required by the different courses. It seems that, clearly, the students did not comprehend the information even though the faculty made an effort of preparation of the project and coordination of the different tasks.

Two additional questions (5 and 6 in Table 2) were asked in order to understand the students' workload and how they were managing it. Many students believed that the workload was excessive. However, the number of tasks to complete the single project was pretty much the same as in the previous year (without the common project). Maybe,

some of the students were defensive in their responses, and were trying to reduce the workload and, thereby, make it easier to pass the semester.

Another question requested information on which transversal competence was better developed as a consequence of the single common project. Four were suggested: team work, conflict solving, time management, and problem solving, plus a “none of the previous” option. As can be seen in Figure 2, half the students preferred the team work option.

Finally, it was, also, important to know what students thought about this new methodology as a teaching and learning process. Therefore, the questionnaire concluded by asking if, taking everything into account, the student supported or not this new methodology for future editions of the Master program. The vast majority of students, 92% (question 7 in Table 2), approved this teaching innovation, which, obviously, encouraged the faculty to progress in this way.

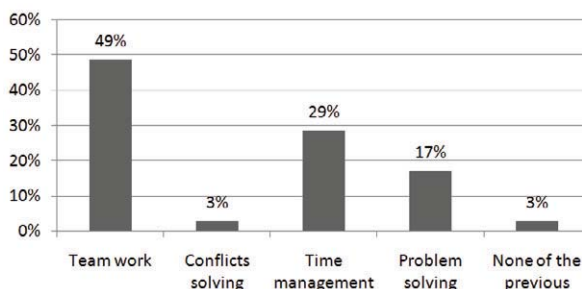


Figure 2. “The transversal competence I’m developing more strongly thanks to the single common project is...”

The overview that students have about a specific syllabus is critical for future word of mouth marketing in order to make the Master more attractive for new candidates in the years to come. Alumni associations, based on the internet, are, also, an excellent forum for this purpose. Therefore, part of the questionnaire was intended to find out how the students would place the Master program according to the MAC² model. They were asked for their agreement or disagreement with eight statements, which corresponded with the four different stages regarding project life cycle and organizational breakdown. The statement was articulated as: “According to the approach of the different tasks based on the common project, my knowledge and competences are intensified in...” (There were differences in project life cycles or applications to different levels of the organizational breakdown.). Their answers varied from totally agree to totally disagree, using again a five-point Likert scale and the same quantifying system used previously. Figure 3 depicts the students’ perception of the new syllabus.

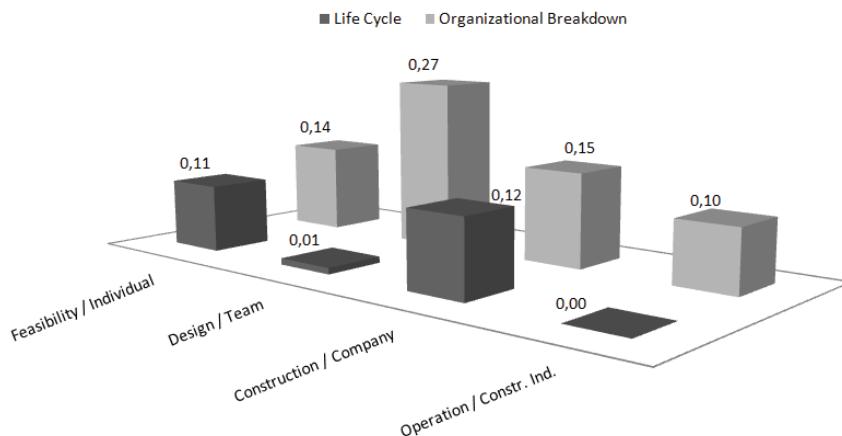


Figure 3. Students’ view of the syllabus according to MAC² parameters

Considering, in the first place, the axis of project life cycle; the Master program is considered intensive in developing students' competences, which are to be applied during both the feasibility and construction phases. On the other hand, it is considered to be very weak for the design and operation phases. At a first glance, it can be deduced that these two are the main gaps in the syllabus. It is important to realize that students were asked for their views, at the end of the first semester of the Master program, when they still have to take and pass several courses (most of them electives). Somehow, this fact distorts the results mainly for the design phase. Furthermore, the new syllabus, intentionally, did not cover the operation phase in-depth, as can be seen in Figure 1. This was the Academic Commission's decision, which was made for two reasons: (a) the operation field was a very wide field because each type of infrastructure had very different features to be taken into consideration; and (b) there was no expert lecturer available at the time.

However, the results for the organizational breakdown axis compensated more, which means that the students think they are better prepared to develop managerial capabilities or better trained to deal with key issues at different organizational levels. It is important to underline that the students perceive that their skills to manage teams increase, probably because of the three months of hard teamwork spent on the common project.

Regarding the guided interviews to professors, these do not give a quantified approach but, certainly, they give a good general view. Moreover, it can be established if this teaching innovation is well accepted by the main agents, who have to promote it to the students. Within that scope, the first concern was to find out the most important difficulties, which each professor had, in order to adapt their subject to the single common project methodology. In general, they found it easy to adjust because, already, they were being asked to carry out the same tasks to the students, but using very different examples. Another worry was the increase to the professor's workload outside the classroom. However, the professors found almost no increase at all because of the same reason, as stated in the previous sentence.

Another aim of the interview was to find out how professors were managing the co-ordination in order to avoid overlaps in the content of the different tasks. They agreed that meetings, held during the weeks before the start of the Master program, were the key to achieving this coordination. Also, this let them know how each colleague was focusing on the different topics of his/her subject and improved their own overview of the Master program. However, three of them suggested that additional follow-up meetings (maybe one per month) would have been very useful in improving the system.

Another important matter for the faculty was the design of the working groups. According to the professors, a key issue was gathering students from different backgrounds, ages, professional experience, and even different countries since their answers to different tasks appeared to be more balanced and accurate than in previous years. Nevertheless, some shortcomings occurred, especially when dealing with part-time students. In this situation, a student, who did not take one of the courses was, somehow, draining his/her group. Two other professors pinpointed that in such small groups, whenever one or two members failed to follow the pace of the rest, the whole group might fail.

Finally, to conclude the interview, it was vital to find out their suggestions and issues for future editions. Two of the professors proposed one step beyond, adapting the Master's syllabus to the logical time-sequence in the project life cycle, and, consequently, changing courses from one semester to another. Another two professors emphasized the importance of follow-up meetings to define, with the highest accuracy, the scope of all the essays and tasks, which the students had to fulfill. All the professors agreed that the students, with previous professional experience, were aware of their work, whereas inexperienced students were often a bit lost about what they were supposed to achieve.

6. Conclusions and recommendations

In this academic year, 2010-2011, a new syllabus, complying with the MAC² model, was implemented in the Master in Civil Engineering Management and Planning at the Universidad Politécnica de Valencia. In addition, there was a teaching innovation consisting of a common project as a reference for all the tasks, demanded by every

compulsory course in the first semester, and gathering students in multi-background groups. 35 students answered questionnaires and guided interviews with 6 professors were tools used to take the pulse after working with the new syllabus and this innovative methodology in the first semester.

The students are finding it difficult to work in heterogeneous groups under time pressure, considering they are working hard, and they are critical about any hint of lack of coordination among professors or courses. The vast majority has a good opinion about the single common project and think it is definitely worthwhile taking for granted that the extra effort, which it represents for them, and they assume that it helps them to improve their teamwork skills. The results of the questionnaire, also, show that the students perceived the new syllabus as well-balanced from the organizational breakdown point of view, according to the MAC² model. However, from the project life cycle standpoint, the syllabus was perceived as very weak for the design and operation phase. There are two main reasons for this: (a) students were asked at the end of the first semester of the Master program when the academic year was not yet over; and (b) the proposed design of the new syllabus did not cover the operation phase in-depth.

With regard to the professors, the adaptation of their previous approach or the increase in the workload did not represent a problem for any of them. Managing students' groups and coordination within the faculty appeared to be the highest difficulties at this stage. Some of the goals for future editions are: working on professors' coordination through regular follow-up meetings; setting a specific subject to conduct all the matters related to the common project; or using this project as the backbone for the whole Master. The authors are now investigating the correlation between the design of the syllabus and the common project as it relates to the development of additional teamwork. There is a willingness, not only to implement some of the suggestions to improve the program, but also to fill in the gaps of the syllabus in relation to the design and operation phase. Feedback from this continuous line of research to the program syllabus and its methodologies will be a source of academic improvement in the forthcoming years.

References

- Alonso, J. (2001). Motivación y estrategias de aprendizaje. Principios para su mejora en alumnos universitarios. In A. García-Valcárcel (Ed.), *Didáctica Universitaria* (pp. 79-111). Madrid, Spain: La Muralla.
- Arditi, D., & Polat, G. (2010). Graduate education in construction management. *Journal of Professional Issues in Engineering Education and Practice*, 136(3), 175-179.
- Argente, E., Castelló, M.L., Colomer, F., Ferrer, M., Jiménez, J., Vilar, S., & Serra, B. (2008). Strategies for promoting motivation. In L. Gómez, D. Martí, & I. Candel (Eds.), *Proceedings of International Technology, Education and Development Conference* (pp. 144-151). Valencia, Spain: IATED.
- Bologna Secretariat (2010). *Towards the European Higher Education Area: Bologna process*. Retrieved from <http://www.ond.vlaanderen.be/hogeronderwijs/bologna/about/>.
- Chinowsky, P. (2002). Integrating management breadth in civil engineering education. *Journal of Professional Issues in Engineering Education and Practice*, 128(3), 138-143.
- Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed). London, England: Routledge.
- Long, R.P. (1997). Preparing engineers for management. *Journal of Management in Engineering*, 13(6), 50-54.
- Pellicer, E., Yepes, V., Ortega, A.J., & Teixeira, J.C. (2010). An academic model for acquiring managerial competences in construction. In P. Barret, D. Amaratunga, R. Haigh, K. Keraminiyage, & C. Pathirage C. (Eds.), *Proceedings of CIB 2010 World Congress* (p. 108). Salford, England: CIB.
- Pellicer, E., Yepes, V., Teixeira, J.C., & Catalá, J. (2009). Developing learning manuals for European construction project managers. In L. Gómez, D. Martí, & I. Candel (Eds.), *Proceedings of International Conference on Education and New Learning Technologies* (pp. 2374-2384). Valencia, Spain: IATED.
- Reinalda, B., & Kulesza, E. (2005). *The Bologna process - harmonizing Europe's higher education*. Farmington Hills, MI: Barbara Budrich Publishers.
- Russell, J., & Yao, J.T.P. (1996). Consensus! Students need more management education. *Journal of Management in Engineering*, 12(6), 17-29.
- Russell, J., Hanna, A., Bank, L., & Shapira, A. (2007). Education in construction engineering and management built on tradition: blueprint for tomorrow. *Journal of Construction Engineering and Management*, 133(9), 661-668.