

Effectiveness of Studio based learning in collaboration with companies in Design&Engineering Master Course at Politecnico di Milano

Matteo O. Ingaramo, Roberta Gorno

Politecnico di Milano, Dept.INDACO, Milano, 20158, Italia

KEYWORDS:

Studio based learning, Design&Engineering Master Degree Course, company collaboration, design studio, Politecnico di Milano

ABSTRACT

At the Design Faculty at Politecnico di Milano, design studio activities hold a central role in the didactical structure, basing on the idea of “learning by doing”. [2] [7] Design studios lead in terms of time and effort the formative career of the students. All theoretical modules support and complement design studios, following the parallelism between “knowing” and “knowing how to do”. [4] [6] In particular, in Design&Engineering Master Course this parallelism is always reinforced by the presence of both teachers mainly conveying the “knowing” part and professionals/technicians conveying the “knowing how to do” part.

Design&Engineering Master Course is an inter-faculty course where contributions from industrial design and engineering field are present in both theoretical classes and in design studios. The design studio projects usually evolve following steps from idea generation, to concept and to design definition [10], which are continuously supervised by professors and professionals from different design and engineering disciplines and by technicians from companies.

It is thought that involving companies in the didactical activity can reinforce the “knowing how to do” portion of education, making students aware of the professional routine in design projects where creative and technical skills blend and the ability of working in a multidisciplinary context is therefore necessary.

A case study is presented to show a typical studio learning experience in collaboration with a company in Design&Engineering MC, and feedbacks from students are summarized.

INTRODUCTION

Design&Engineering is a Master Course offered by the Faculty of Industrial Design at Politecnico di Milano. It was

born in 2004/2005 with the intention to exploit and to valorise the discipline variety inside Politecnico di Milano. Design&Engineering Master Course integrates contributions from different faculties of Politecnico di Milano such as Design, Industrial Process Engineering, Industrial Engineering. It aims at training future designers to face both research, concept phase of the project and engineering, production phases with their limitations. (Facoltà del Design 2009).

Since Design&Engineering Master Course is an interfaculty course, both students from Industrial Design and from Engineering disciplines can apply to attend it. Indeed every year within a new group of students both designers and engineers from the Bachelor Degree apply for this course eager to study and to train in an interdisciplinary context.

Beside students, also professors have interdisciplinary backgrounds. Indeed within the entire teaching board there are Architects, Industrial Designers, Mechanical Engineers, Material Engineers, Industrial Process Engineers.

Professors divide into those teaching theoretical classes and those teaching practical classes (design studios), but in few cases some professors teach in both theoretical and practical classes. In theoretical classes, technical subjects as Mechanics principles, Materials, Production Technologies are being taught to students coming from Industrial Design, while humanities subjects as Design History and Design Studio are being taught to students coming from Engineering disciplines (Facoltà del Design 2009).

The formative goal of Design&Engineering Master Course is therefore to educate professional figures able to manage every phase of the industrial product development process, from concept phase (Design) to engineering phase (Engineering), through the ability of relating themselves with different area of expertise (Selva, Carulli 2007).

I. STUDIO LEARNING IN DESIGN&ENGINEERING MASTER COURSE

“Learning by doing” is the idea on which all studio activities in Design&Engineering Master Course base their theoretical foundation. In design studios indeed, students face practical issues, through the development of realistic design projects. They learn how to get through common troubles in design practice while they are facing them (Boud 1993). Professors supervise this process of learning by doing giving advices to the students and sharing with them their knowledge and their experience. As in theoretical classes also in studios professors are both from Industrial Design and Engineering disciplines, allowing to make contributions to the project development more heterogeneous and therefore useful for the students’ complete education. In this “learning by doing” strategy the “knowing” portion of education is conveyed by theoretical classes while the “knowing how to do” portion is conveyed by design studios. In Design&Engineering Master Course companies are usually involved in design studios to give to the students a more realistic experience of the product development process. (Bertola, Penati, Seassaro 2001).

Inside each design studio, students are grouped and each group is composed both by designers and engineers. Since their way of working and background is basically different, in the first semester they all attend some grounding courses which have the aim, not to eliminate students’ specific characteristics, but to provide them with supplement knowledge. Indeed their distinctive traits are fundamental to create a multidisciplinary context inside a team (Selva, Carulli 2007). While designers, working in the conceptual phase, usually focus on “system architecture” and “core concept” that is “developed during conceptual design and fundamentally differentiate one product from other competitive products”, engineers’ mind is usually focused on product behaviour and features, and for this reason their work is closer to the product development phase. (Ulman 2003)

A. Company Collaboration

Involving companies in the educational activity can reinforce the “knowing how to do” portion of education, making students aware of the professional routine in design projects, where creative and technical skills blend and the ability of working in a multidisciplinary context is therefore necessary. (Facoltà del Design 2009)

The collaboration with companies in education activities brings to the students the experience of a real product development process. Therefore the problems and the questions which emerge are real and require real solutions. Since the product to be developed by the students is supposed to follow a typical product development process, then emerges the common question about aesthetic and functionality, which is evaluated throughout the entire process. The students have to face the trouble of deciding what solution is best for the functionalities of the product but at the same time how to make it aesthetically pleasurable and also meaningful for the consumer. Indeed the aesthetic issue is not only about shape but also about meaning and symbols connected to specific shape, material, geometry, details

(Norman, 2004). Each ‘aesthetic’ choice will influence not only the concept phase but also the definition phase of the product development since each choice made at the beginning of the process reflects its consequences on technical matters connected to materials and to production technologies.

The presence of the company, the professionals and the professors inside the studio is valuable to teach to the students how to face this matter.

In Design&Engineering Master Course at least one company is involved in every design studio. The company is asked to collaborate in the design studio activity providing knowledge and experience about the product typology to be developed. Usually a technician from the company is present at some critical points of review, such as final concept review and design definition review, or sometimes in everyday reviews with students to follow the development of the projects. What is asked to the company is therefore to be present providing its expertise in some critical development phases and also to provide the students with a sample of the product to be redesigned. This sample is always disassembled and measured by the students in order to understand principal components, their connections and functions.

B. Studio Project Development

The students arriving at the design studio are in the first year of their master degree; during the first semester they already attended the grounding courses, in which Engineering students took humanities courses and Industrial Design students took technical courses. This design studio is the first they face inside Design&Engineering Master Course and therefore it is the first occasion they have to put down into practice the knowledge they acquired during the previous semester.

The design studio projects usually evolve following steps from idea generation, to concept and to design definition (Ulrich, Eppinger 2003). Professors from Industrial design Faculty provide the students with their knowledge and experience in the product development field, giving advices both in the concept definition phase and in the product development phase, relying on professors from engineering disciplines for specific and complex issues connected to the engineering phase of the product.

The strategy developed during the years by the professors of the studio is that of following the phases of a typical product development process (Ulrich, Eppinger 2003), starting from macro concept reasoning to micro detail’s definition. Once the first concept idea is settled, the students are required to start designing the parts of their idea, proposing basic solutions to be then developed in the following phases. While designing each part and their assembly they have to keep in mind that every shape and detail they add, will need then to be virtually produced and therefore will face restrictions connected to production technologies and materials.

What is usually taught to be kept in mind is that every choice made in each stage of the process reflects its consequences on later stages and needs therefore to be deeply evaluated before accepting it.

The students face a complex product development simulating the typical professional process, in which designers are required to interact with different stakeholders throughout the process, from mechanical engineers, to material engineers, to production technicians. These distinctive skills and knowledge are carried inside the design studio by professors from engineering faculties and by technicians from the company. This didactical structure provides the students with the skills necessary to manage high-medium complexity projects and allows them to easily integrate themselves into companies' typical structure (Selva, Carulli 2007).

The interaction between the students and the professors is addressed, in every stage of the process, at solving the aesthetic-functional issue. The students are taught to think previously at the consequences of their choices and to always foresee the implementation of technical solutions also at beginning stages.

In design studios students are divided into mixed teams of 3-4 people composed both by designers and engineers. This mixed team strategy provide the students with a rich design experience, since designers contribution is mainly focused on addressing experience and usability problems, therefore they put the user in the centre of their thinking; while engineers tendency is to find technical solutions to produce the concept proposed, therefore focusing on production technologies matters. Students also learn from each other a different approach to the project development: designers learn how to find out problems and how to propose technical solutions, and engineers learn how to consider the users' experience point of view before starting the problem solving phase.

Usually the company provides the students with one or more samples of the product to be redesigned to allow the students to get acquainted with its functionalities. In order to understand not only the functionalities of the product but also its components and connections, the students are required to disassemble the product and to take measurements of its parts.

The design studio then proceeds with the concept definition phase in which the students hand in different concepts which are evaluated by both professors and technicians from the company in order to choose the most promising idea.

Then begins the so called "product definition phase" in which most of the product characteristics, features, materials and production technologies are defined. In this phase the contribution from engineering professors and technician becomes fundamental in order to solve specific problems connected to the product definition. A further step is the engineering phase where students detail their choices, clearly defining parts' features to make them respect the production technologies' restrictions and limits.

Inside the design studio this process, with the above defined steps of review, really gives to the students a simulation of a typical design process, preparing them, among others, to the interaction with the different stakeholders dealing with the design project.

The involvement of the company with technicians participating in most important reviews, gives an important impulse to the work of the students and a significant contribution to the students education. Technicians' input is strongly valuable since they provide a deep knowledge of the topic and a realistic simulation of ordinary design processes inside the company.

A successful example of collaboration between a design studio and a company is the one proposed hereafter, dating back to 2008. Its success is measurable in terms of both students' knowledge acquisition and satisfaction and company's appreciation of the projects.

II. EXAMPLE OF A DESIGN STUDIO IN COLLABORATION WITH A COMPANY

The company involved in this design studio was chosen basing on the complexity of the product it produces. It was a medium complex product which was ideal to be developed by first year master students. It was complicated enough to make them reason on its components, their functions and connections, but not too complicated to make them loose too much time in understanding it. The product was a professional slicing machine from a leading Italian company.

As described above, the company was asked to give a presentation at the start of the design studio explaining to the students the field in which it works. In this case the presentation was about the professional slicing machine market comprehending a brief bench market with competitors' products. The company also explained the process through which their slicing machine is produced from the main components to the surface finishing.

In the same presentation the company gave the brief of the project to the students: they were all supposed to design a new way of driving away from the blade the slice of alimentary product. It is basically what a human hand does when cutting an alimentary product: one hand is used to push the trunk while the other is used to take the slice and to put it into the package. In the professional field the slices are being cut at a very high frequency, for this reason it is usually used a mechanical system to move the slice. The traditional mechanical system produces some damages to the slice since, in order to size the slice, it uses some hooks which make holes in the slice itself lowering therefore its quality. The company wanted to find a way to move the slice without damaging it.

Moreover the students had to face some restrictions due to the alimentary field norms, which give rules about shapes (eg. Rounds radius), materials (eg. Alimentary compatible materials like Aluminium), fasteners (eg. Only some types of screws are allowed).

Since the beginning students started to understand the context in which these machines work, that is connected to megastores or production plants. In parallel they disassembled a sample machine measuring and understanding each component.

Once the measurement work ended (it took one week) they started to think of a new way to size the slices without using hooks. They thought about different ways of carrying the

slice from the blade to the plate and tested some of them by making prototypes. The test phase was helpful to understand which ways of ‘transportation’ were valuable and which instead entered new problems in the process. This phase took two months during which they met teachers and technicians from the company twice a week to collect advices and new directions of development. At the end of the two months each group of students had a defined concept representing a new way of ‘transporting’ the slices from the blade to the plate. Some groups also thought of new ways to automatically lay the slices into the packaging avoiding the use of multiple motors or adding functionalities to the current solution.

The next phase was then the engineering phase which took the last month of the design studio. During this month the students were required to technically define their solution choosing appropriate materials and production technologies and, if necessary, to optimize their design in order to adapt the components to the chosen production technology. At the end of this phase they produced all technical drawings of their ‘slice seizing device’.

In this kind of design studio experience, though it is stated that design and engineering students use to proceed in a different way when designing a product, they virtuously worked together throughout the entire design process. Designers learned how to keep in mind, since the beginning of the design process, production technologies limits, and engineers learned how to consider user’s experience matters and how to solve them.

A. Students Feedback

The students feedback on this design studio experience was highly positive both in terms of overall satisfaction and of knowledge gained. The overall satisfaction based on the organization of the design studio and the kind of support given to the students by teachers, professionals and technicians. The knowledge gained derived from all the figures involved, each with its field of expertise. In particular they learned and experienced a typical product development process, learning to confront themselves with different stakeholders of the company and therefore people with different backgrounds. The presence of technicians from the company gave to the students further insights on the company typical process and know-how.

The students feedback was measured with the usual form given by the Faculty of Industrial Design at Politecnico di Milano.

In these evaluation forms there are some issues of particular interest such as the overall satisfaction about the course and the amount of interest towards the subject of the course. In both indexes this course resulted in a high position: for 45% of the students the overall satisfaction was “very high” and for another 45% it was “high”, while the 58% of the students had a “very high” level of interest and 37% of them had a “high level” of interest in the subject of the course.

Moreover, in order to prove that the knowledge gained by the students is valuable and highly appreciated by design companies, a statistical count of placement after graduation is usually performed by Design&Engineering Master Course board. From the last survey it resulted that nearly 87% of the students found a good position in the job market in the first two years after their graduation.

III. CONCLUSIONS

This paper discusses what occurs in a typical design studio in Design&Engineering Master Course at Politecnico di Milano. In detail the author aim was to prove that a design studio which involves a company, can result in a deeper knowledge of the subject by the students and can provide a realistic experience of a typical design process inside a company.

As a result, the students gain not only a valuable education through learning by doing inside a design studio but also a deeper insight on a typical design process inside a company. This provides them with a complete and rich education about project development processes and moreover helps them in placing themselves on the job market after their graduation, since they already know the dynamics occurring in a design company and can easily confront with the typical stakeholders.

This research opens to further studies and surveys about the knowledge gained in a design studio in collaboration with companies and its effectiveness compared to previous approaches.

REFERENCES

- Bertola, P., Penati, A., Seassaro, A., *La didattica del design. L'innovazione delle strutture didattiche e dell'organizzazione*, Rivista del Politecnico di Milano, Milano (2001)
- Boud, D *Using Experience for Learning* Open University Press, Bristol (1993)
- Bruno, D., *Learning design by design experience*, Edizioni POLI.Design, Milano (2002)
- Cross, N *Engineering design methods: strategies for product design* Wiley, Chichester (1994)
- Facoltà del Design, *Guida dello Studente*, Politecnico di Milano (2009)
- Jones, J C *Design Methods* Wiley, Chichester (1970)
- Lawson, B *How designers think* Architectural Press, London (1980)
- Norman, D. A., *Emotional design: Why we love (or hate) everyday things*, Basic Books (2004)
- Selva, S., Carulli, M., *Multidisciplinary approach within Design&Engineering at Politecnico di Milano*, Proceedings Connected 2007
- Ulman, D.G., *The mechanical design process*, McGraw-Hill, New York (2003)
- Ulrich, K.T., Eppinger, SD. *Product design and development* Irvin McGrawHill, International Edition (2003)
- Marco Zanuso in Sinopoli, N., *Design Italiano: quale scuola?*, Milano (1990)