Entrepreneurship-based Learning: A New Teaching Technique for Active-Learning Oriented to Multi-disciplinary Groups

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ABSTRACT

This paper describes the implementation of a new teaching technique called: "Entrepreneurship-based Learning (ABE)" within the framework of an Educational Model of Active Learning. The ABE is an enriched didactic technique, both for students and for society, to focus their efforts on solving a real problem, and serve as a starting point for a group of students to understand and practice all that entails for becoming an entrepreneur . The ABE is without a doubt a transcendental teaching technique, since it develops new forms of capitalizing knowledge and experience, and in turn generates transferable knowledge that can be replicated in other educational settings.

Keywords: Teaching Strategies, Teaching Techniques, Active Learning, Entrepreneurship-based Learning

RESUMEN

En el presente artículo se describe la aplicación de una nueva técnica didáctica denominada: "Aprendizaje Basado en el Emprendimiento (ABE)" dentro del marco de un Modelo Educativo de Aprendizaje Activo. El ABE resulta una técnica didáctica enriquecedora, tanto para los estudiantes como para la sociedad, al enfocar sus esfuerzos en resolver un problema real, y servir como punto de partida para que un grupo de estudiantes comprendan y practiquen todo lo que conlleva convertirse en un emprendedor. El ABE es sin lugar a duda una técnica didáctica trascendental, ya que desarrollada formas de capitalización del conocimiento y la experiencia, y genera a su vez conocimiento transferible que puede replicarse en otros entornos educativos.

Palabras claves: Estrategias de Enseñanza, Técnicas de Enseñanza, Aprendizaje Activivo, Aprendizaje basado en el Emprendimiento

1. INTRODUCTION

Today we witness a revolution in the technological, social and economic strata which requires a rethinking of the present educational system and its *teaching strategies and techniques.* Dryden and Vos (2005) argue that universities initially concentrated their efforts on students memorize and understand theories and abstract or academic principles which from the beginning created a barrier between knowledge and the student because they did not understand its utility or real-world application. Seymour Papert (1991), professor at the Massachusetts Institute of Technology, says it is much more effective to move the student from work (experience and/or practice) to the abstract or academic thinking, by solving real problems, than if it is done in the opposite direction. Thus, based on this need, it arises in the current educational institutions the concept of *Active Learning* which represents a paradigm shift in teaching strategies and techniques of traditional education.

This paper describes the implementation of a *new teaching technique* called: *Entrepreneurship-based Learning* (ABE for its acronym in Spanish) - within the framework of an *Active Learning Educational Model* (see Figure 1 - Molina et al., 2011). First it is discussed the concept and implications of the *Active Learning* as a *teaching strategy* by the educational model proposed which in turn provides the conceptual basis to the *new ABE* (for its acronym in Spanish) *teaching technique,* and finally it is presented a case study that describes the process application of the proposed *teaching technique* within the academic course of "Design and Development of New Products", and the results of its implementation.

2. TEACHING STRATEGIES AND TECHNIQUES

Within the design of an academic course, there are two concepts that define how the learning will be guided through it: the *teaching strategy* and the *teaching technique.* According to the Virtual Teaching Techniques Center (2010) of the Tecnológico de Monterrey, the *teaching strategy* involves an organized, formalized and focused on obtaining a teaching aim process, and must be based on a method, this being flexibly according to the learning needs. To implement a *teaching strategy* defined by a teacher, it is necessary to establish, design and refine the teaching techniques that will allow achieving the learning objectives defined in the strategy. Thus, a *teaching technique,* defined as the logical procedure, and with psychological foundation oriented to guide the student learning, will determine how the learning objectives of an academic course will be achieved through a sequence of steps or behaviors, obtaining results or products previously established in the *teaching strategy* in an effectively and efficiently manner. This procedure consists of activities, in a greater level of specificity than the *teaching technique* which vary depending on the context in which they are applied, e.g. type of academic course or learning needs. In this respect, the *Active Learning* represents a *teaching strategy* and the *Entrepreneurship-based Learning* (ABE for its acronym in Spanish) a *teaching technique* which together support the achievement of the learning objectives of an academic course oriented to creativity, innovation and/or entrepreneurship. The ABE intends as well to be a *teaching technique* that Molina et al. (2011) call of second degree because of its more inclusive or integrative nature of *teaching techniques* (*meta-teaching technique*):

Experiential Learning + Innovation Based Learning = Entrepreneurship Based Learning

3. ACTIVE LEARNING

According to Bonwell and Eison (1991), there is no common definition for the concept of *Active Learning*, however there is general awareness of what *Active Learning* implies: "Students must do more than just listen in the classroom, must read, write, discuss and implement the knowledge learned in the classroom in order to propose solutions to the problems in the world outside the school grounds".

Active Learning arises from the need of the society and the organizations to have graduates with the knowledge and skills necessary to meet the challenges of the workplace and of the current social situation in an analytically, creatively and practical manner (Oblinger and Verville, 1998). What has led teachers to develop new *teaching strategies* and *techniques* (of teaching and learning) that prepare the new generations of professionals not only with a number of theoretical knowledge, but with skills to putting this knowledge into practice, in order to improve their environment through the generation of creative and also pragmatic solutions to solve problems more effectively and efficiently. *Active Learning* is aimed to develop the student's analytical skills, creativity and practicality in designing solutions to problems through reasoning exercises, and offers great advantages over other *teaching strategies,* due to the order in which knowledge is processed and assimilated by the student where the understanding of a topic, does not originate in memorizing theoretical concepts, but in the access to some basis of knowledge that the student is able to use and/or apply to solve a problem.

3.1 ACTIVE LEARNING EDUCATIONAL MODEL

Within the framework of *Active Learning,* Molina et al. (2011) propose an *Active Learning Educational Model* (see Figure 1) which describes the dynamics of *Active Learning* taking this *teaching strategy* to practice within the context of the curriculum of professional careers of the Tecnológico de Monterrey. This model is based on

the concept of *Research - Action,* so part of the direct observation of the teaching practices was done through all the professional schools of the Tecnológico de Monterrey, Campus Mexico City, within a specific time period, starting in January 2009. The *Research - Action* process was selected because of its progressive and oriented nature at solving problems from practice, so it considers as the basis the implementation of the teaching techniques as conducted in each major.

Within this model of *Active Learning,* built based on the concept of *Research - Action,* Molina et al. (2011) have identified at least five dimensions associated with the practical application of the concept of *Active Learning* which have been identified to require a precise management to allow their proper integration to achieve the development of analytical and creative skills of the student, along with the theoretical knowledge of the academic course (see Figure 1): (1) The focus of learning that identifies the outcome or extent of the learning depending on the stage on which the implementation of the concept of *Active Learning* is: [1.1] science and technology for change, [1.2] creative and innovative thinking, [1.3] design and implementation, [1.4.] transformational behavior. (2) The problem to be solved which describes the nature of the problem to be solved: [2.1] structured, [2.2] unstructured, [2.3] open, [2.4] global - unstructured. (3) *Learning techniques,* representing the teaching techniques that are applied at each stage of learning, depending on the learning objective and the results that are willing to be obtained: [3.1] Problem-based Learning (PBL), [3.2] case method + PBL, [3.3] Project-oriented Learning (POL), [3.4] POL + learning - service + learning - research. (4) The *learning dimension* which is the diversity of scientific disciplines involved in the learning process, and how these disciplines interact, represented by students of one or more academic programs: [4.1] disciplinary, [4.2] multidisciplinary, [4.3] interdisciplinary, [4.4] transdisciplinary. (5) *Active Learning* of second generation, that indicates the type of *teaching technique* with the intrinsic approach of the *Active Learning:* [5.1] experiential learning, [5.2] innovation based learning, [5.3] entrepreneurship based learning, [5.4] leadership based learning. (6) The *technological resources* which identify the technologies used by the student to support his learning process.

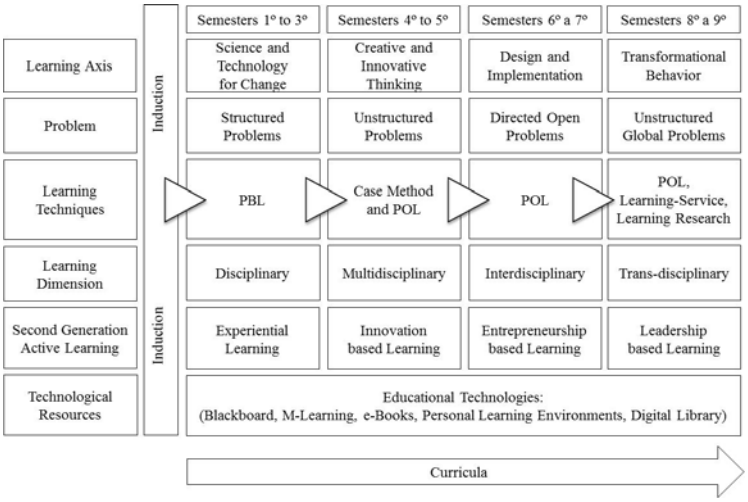

Figure 1: Active Learning Educational Model (Molina et al., 2011)

The *Active Learning Educational Model* identifies four periods within the student's academic program in which the five dimensions mentioned above must be adapted according to the learning progress throughout the curriculum or student's major. The first period runs from 1st to 3rd semester, the second from 4th to 5th semester, the third from 6th to 7th semester, and the fourth from 8th to 9th semester. Each of these periods represents a stage of maturity in the student learning process, and, therefore an evolution in each dimension of the model. The teaching-learning process evolves in its goal or approach, on the *teaching techniques* used and on the way students collaborate and the scientific disciplines that they represent according to their academic programs. Therefore in this way it is integrated an evolving teaching-learning process in which the objectives of the later stages are based on the achievement of the objectives of the previous stages.

The following section presents a case study and/or application of the *Entrepreneurship-based Learning* (ABE) in an academic course within the Tecnológico de Monterrey, Campus Mexico City as a new *teaching technique* that is part of an *Active Learning* strategy oriented to interdisciplinary groups.

4. CASE STUDY

The academic course of "Design and Development of New Products" is offered at the Tecnológico de Monterrey, Campus Mexico City from the semester January to May 2009 by professors Arturo Molina and David Romero, in the format of 'seminar', having every semester different guests such as teachers, businessmen, entrepreneurs, researchers and outstanding students - from previous semesters who have studied the major - to share their expertise and experience in the implementation of the theoretical foundations surrounding the administration of the innovation, the technological development, and the marketing of new products (goods and/or services).

The guests accompany the students during the process in several ways:

- the associate professors, during 16 weeks, provide their expertise and knowledge on product development methodologies, and allow the students to understand and apply them directly to their projects;
- the businessmen invited are directors of innovation areas of transnational companies which during the 16 weeks bring their experience in the process of innovation and new product development within their companies;
- the entrepreneurs share with the students in week 14 or 15, their experience in the further processing of product development: development of a plan and business model;
- the researchers, at week 4, present their progress in developing technologies in order to provide technology platforms that will be the basis for the development of the students, also they are they are available to the students to advise them throughout the process;
- finally the outstanding students from previous semesters, at week 12, present their functional prototypes and the process they followed to achieve them in order to sensitize the students to understand that the work done through the semester will provide them the basis for developing a functional prototype for Week 16.

This exchange of experiences dynamic has allowed the course to obtain an enriching feedback that has allowed it to evolve semester by semester. The course is aimed at students of four majors or disciplines that are: mechatronics engineering, bachelor in industrial design, bachelor in creation and development of enterprises and bachelor in marketing (see Table 1).

Table 1: Academic Programs (Majors - Bachelors)

Major (Bachelor)	Plan	Subject matter that validates	Semester
Mechatronics Engineering	IMT04	Mechatronic design methodologies	7th
	IMT07 & 11	Mechatronic design	8th
Industrial Design	LDI04	Technological innovation	8th
	LDI07	Product development process	5th
Creation and Development of Enterprises	LCDE05	Innovation and technological development	5th
	LCDE11	Innovation, markets and technological development	4th
Marketing	LEM06	Trademarks and new products development	7th
	LEM11	Innovation, markets and technological development	5th

The academic course is located on the 3rd. stage of the Active Learning Educational Model (see Figure 1) which has the following characteristics: (1) *Period:* Between 6th and 7th semester, although in practice the enrolled students are between the 5th and 8th semester due to the different majors Involved and their curricula. (2) *Learning Objective:* design and implementation, with what it is expected from the student its ability to analyze complex problems, design solutions and bring these to implementation, developing both a creative and innovative thinking. (3) *Problem:* open and focused, which seeks that the student make a diagnosis of the problem and propose concrete solutions. At this stage of maturity, the problem is open which means it does not have a known solution, and focused because the teacher is responsible for providing the problems or guide the overall direction of the same. (4) *Learning technique:* learning oriented to projects, whose approach is aimed at facing the students

to the challenge of designing and developing a functional prototype of a new product (good and/or service) in a collaboratively manner using the tools and/or methodologies learned during the course, carrying everything learned into practice in an innovation project. (5) *Learning dimension:* interdisciplinary, aimed to promote the development of skills for collaborative work between several scientific disciplines. To work interdisciplinarily means addressing issues through the participation and contribution of different scientific disciplines seeking an integrative and innovative solution. (6) *Active Learning* of second-generation: entrepreneurship based learning as teaching technique aimed at bringing innovation to the marketplace through technology transfer or the creation of an enterprise.

4.1 OBJECTIVE OF THE COURSE

The course objective is to understand the process of innovation and technological development, as well as the necessary skills from different disciplines such as marketing, industrial design and manufacturing, for the design and development of new products. All under a comprehensive approach with various scientific methodologies that facilitate problem solving and decision making to innovate and develop a new product attractive and competitive for a target market.

The course of Design and Development of New Products is aimed at developing a "Plan for a New Product Development" which serves as a guide for a new product to meet the following characteristics: be required by a market or to obey an megatrend (demand), have a sustainable and differentiated value based on high technology, provide a robust offering, for which in a later course of Entrepreneur it will be generated Model and Business Plan that allows its commercialization through its presentation to investor clubs, entrepreneurs fairs or high-tech or intermediate technology incubators.

4.2 TEAM BUILDING

Team building in the course follows the principle of 'interdisciplinarity' so a team consists of three (or more) different but complementary profiles: (a) A bachelor in industrial design, which has the ability to change its environment, extract and transform raw materials to build objects (products) by identifying the problem, setting project requirements, understanding the user's profile, development of concepts and prototypes, and selection of production methods. (b) A mechatronic engineer who brings knowledge of mechanical engineering, electronics, computer and control systems aimed at creating products, processes and automated production systems by identifying appropriate technologies to create innovative mechanisms for a wide variety of products. (c) A bachelor in creation and development of enterprises, with the knowledge to analyze the market, identify a business opportunity (innovation) and justify a project (of innovation), from the marketing, operational and financial point of view by developing a business plan for the marketing of a new product.

Thus through ABE, students of different majors work together guiding their skills toward developing an innovative solution with commercial potential, that at the same time allows them to work interdisciplinarily and apply the knowledge and skills acquired throughout studying their curricula in a real situation.

4.3 DEVELOPMENT OF THE INNOVATION PROJECT

The design and development process of a new product that students follow from identifying the opportunity for innovation up to generate a functional prototype that proves the technological feasibility and market attractiveness of their product concept, is planned to be achieved in 16 weeks, during which they work interdisciplinarily in the following activities. It is noteworthy to say that the IDEO methodology is integrated in this process because it allows students to approach people who will be the users and customers of their product also it offers several techniques to test if the team's idea is related to the needs of their market: (1) Identification of the characteristics of interdisciplinary work and team building with this feature (see Figure 2). (2) Identification of the innovation opportunity through the use of megatrends (see Figure 2). (3) Generation of a portfolio of problems/needs that the product should be able to solve, led by one or two megatrends (see Figure 2). (4) Identification of available technology platforms for the rapid development of a prototype of their product (see Figure 2). (5) Use of the IDEO cards 'Learn' and 'Look', for the field research and direct validation with customers/potential users on

the opportunity for innovation identified (see Figure 3). (6) Product Description (good and/or service) through tangible and intangible attributes (see Figure 3). (7) Generation of a product use scenario (Storyboard) which graphically identifies the user at the time the product or service is being used (see Figure 3). (8) Market analysis on which by the use of IDEO cards 'Ask', it is asked to the users and potential customers about their needs, preferences and interests, in order to validate the attractiveness of the market in which it is intended to venture, it may be included researches in statistical databases (see Figure 3). (9) Analysis of technologies, on which it is used primary and secondary sources: the IDEO cards 'Ask' as primary source of research with technology experts, and documentary research as a secondary source, on which it is investigated characteristics of the available technologies as well as their current state of intellectual property protection (see Figure 3). (10). Implementation of the AHP technique (analytical hierarchical process), in which it is established a target, identified alternative solutions which are evaluated with a set of predetermined criteria. This technique is applied to evaluate two objectives of the project (see Figure 3): [10.1] The attractiveness of the market, that aims to find the most appropriate market segment to start marketing the product, and [10.2] The technological feasibility, that seeks to identify the most suitable technology to serve as an axis in the technology development process, based on the information gathered during the 'Analysis of technologies'. (11) Implementation of QFD tool, to hear the voice of the customer and translate it into engineering requirements, and to compare the shape and extent on which the competition meets the same functions (see Figure 3). [12] Implementation of the IDEF0 tool to understand the inputs, outputs, mechanisms and controls required to implement the product features (good and/or service) (see Figure 3). (13) Implementation of the Morphological Matrix tool to select the best set of technologies or technical solutions to meet each product function (see Figure 3). (14) Structuration of the value-added network of the company, which identifies the work team as an entity that interacts with external actors such as technology providers, economic development institutions, NGOs, government agencies, clients, customers, alliances among others, in order to identify which value exchanges, tangible and intangible are made between each of them and the team (see Figure 4). (15) Business Model Generation, based on the perspective given by the Osterwalder canvas (2009) (see Figure 4). (16) Introduction of a functional prototype, which validates the product idea, showing that it is possible to achieve the planned functionality (see Figure 4).

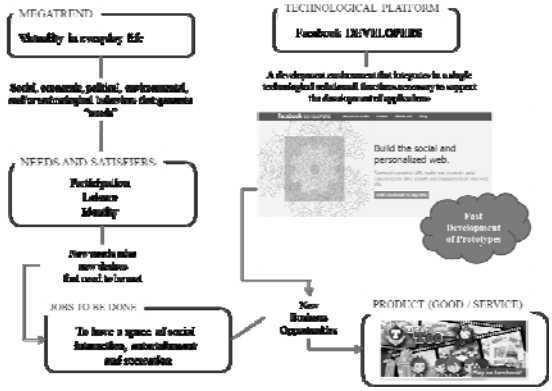

Figure 2: Integration of Megatrends, JTBD, Technology Platform, Product and Competitors

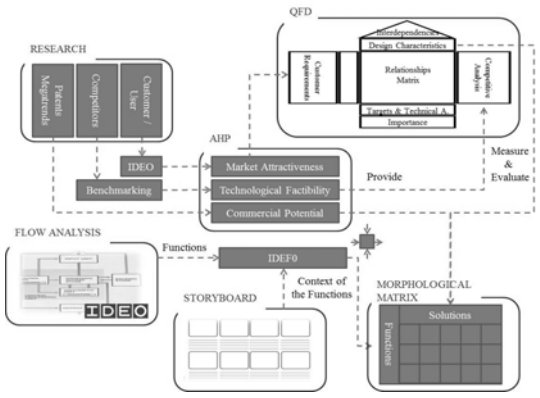

Figure 3: Integration of the R&D Product Design Tools (IDEO, AHP, QFD, Flow Analysis, Storyboard, IDEF0 and Morphological Matrix)

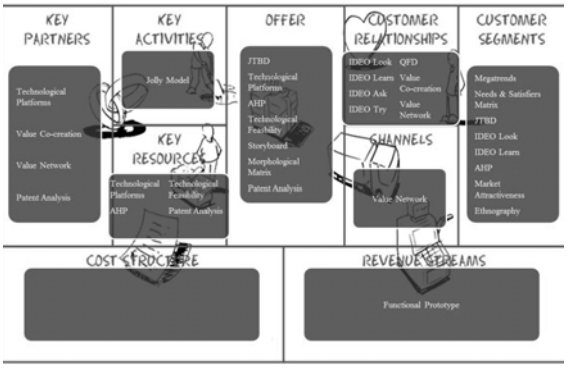

Figure 4: Integration of the Course Tools in the Osterwalder's (2009) Business Model Canvas

4.4 SUCCESS STORY

One goal of the course "Design and Development of New Products" is to pick the best projects to provide continuity through the business incubator of the Campus where they will have the opportunity to finish developing their product idea hand in hand with a business model and its functional prototype as the basis or starting point for starting a business.

Currently there are three companies: (1) Med Tag, (2) SinCC, (3) Sugar Band, that have already undertaken and obtained financial support from the Ministry of Economy and the National Council for Science and Technology (CONACyT) for the development of its technology. The most relevant case for its advancement and technological development is the Med Tag, a company formed by students who completed the class during the semester from January to May 2009, from the majors LDI and LCDE, who continued with the process in the High Technology incubator of the Campus Mexico City. Med Tag innovation into the market is to provide cards with the RFID technology mainly to insurance companies for their beneficiaries to carry them at all times, and so instantly locate their general medical data in case of an accident.

The success in the creation and initial development of this company lies in the strong foundation on two fronts: (1) to have a plan to develop new products, which is fully based on an opportunity arose from a need or problem, and (2) to have a technological development that made the value offer tangible. Both bases originate in the solid training of professionals that guided and applied their knowledge and skills to the generation of a new product.

5 CAPITALIZATION: LESSONS LEARNED

The experience gained through the development and continuous improvement of the course "Design and Development of New Products" generates two lines of capitalization: (1) From tacit to explicit, consistent in generating teaching materials that allow to replicate the course in other campuses through the generation of a manual for the course planning and a textbook as a guide for the students, in which it is described the methodology of the course weeks to week, as well as the *teaching techniques* that include dynamics and learning activities that are currently used in the teaching of the academic course. (2) Also the reproduction of the strategy and teaching technique of the course involves the coordination of the professional career directors and the department heads, to support the creation of balanced teams of different disciplines (majors), as well as a strong link with the public relations and business departments, who can provide the contact with businessmen and entrepreneurs invited to share their experiences with the students of the course. (3) Extrapolation of the methodology, consisting in the identification process of academic courses that for their teaching objective can be redesigned based on the *ABE teaching technique.* Thus, the focus of the search will be towards the courses located in the third stage of the *Active Learning Educational Model* because as it has already been mentioned above, at this stage the collaboration is no longer disciplinary, besides being oriented to solving a common goal, reason why the multidisciplinary dimension could not be accommodated, since the aim can be satisfied by integrating courses with members from various disciplines.

6 CONCLUSIONS

The use of the concept *Research - Action* as a basis for the development of this work, allows us to get the facts straight from the environment in which they occur, with which we can propose models that reflect what is actually working and being applied in the teaching-learning process in the classroom. With this study it was observed that when the theory of the *teaching techniques* is put into practice in the educational context, it fits the needs of the curriculum and each subject matter, in order to achieve the learning objectives. Thus, for example, the theory states that the case method should be used mostly in the last semester of the undergraduate courses or in postgraduate courses, however this method can be and has been used since the first semesters in many academic courses at the Tecnológico de Monterrey, Campus Mexico City, in order to achieve the direct immersion of the student into a real situation and motivate him/her to the self-observation and research aimed at solving a problem.

Innovation in the design of *teaching techniques* that is up to the challenges offered by the modern society is imminent, and it requires changes in the paradigms and scope of the teaching-learning process in the classroom. This process should be done gradually and methodically, respecting the stages of maturity of the student's learning. Based on this premise, the integration of the concepts of experience, innovation and entrepreneurship within the design of a *teaching technique* as the *Entrepreneurship-based Learning*, is enriching because it changes the objective of a *teaching technique* in a transcendental product for both students and society by focusing the efforts on solving a real problem, and serve as a starting point for a group of students to understand and practice all that entails becoming an inventor and entrepreneur. However, in order for innovation to be transcendental within teaching techniques, it must be developed ways of capitalizing such knowledge and experience in order to generate transferable knowledge that can be replicated in other settings.

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