



Review

Introducing the active learning model: Preparing students for the challenges ahead

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Abstract

This article summarizes the active learning model that is being implemented at the Tecnológico de Monterrey to address the needs of today's students and prepare them for a very different future. The article describes both the old and the new models, what is required to make the shift between them, and some of the results and experiences to date.

Keywords: Active learning, best practices, competences, critical thinking, educational resources.

INTRODUCTION

The future belongs to the Me Generation

Baby Boomers prioritized their professional issues over their personal lives. Generation X struggles to find a balance between their personal and professional lives. The Me Generation, the generation currently in full-time education, believes their personal lives are their first priority and that their professional lives are merely vehicles for making their personal lives more enjoyable. They reject rigid hierarchies, seek personal and professional development in fluid and fun environments, and believe they have the right to shape both their current environment and their future.

Within the Me Generation, there is a sub-group of young people whom we call "digital students." They are challenging the traditional learning process of going to classes, taking notes, reading, and writing, and which, even today, is supported by, as opposed to led by, digital technology. Digital students not only seek a different learning environment from their predecessors - they are the Me Generation after all - but they are also turning the traditional learning process on its head.

These students:

- Do not consider books or the lecture hall to be their main source of knowledge and information
- Do not see the teacher as an expert
- Go online first to find information for and about their courses:
- Scanning publicly available articles, abstracts, and summaries

- Watching videos

- Participating in on-line chats and forums

That goal of an educational model has to be to engage students in a learning process that prepares them for the future - in a way that works for them. It is clear, therefore, that educators must change the way in which we teach students and what we expect them to do while they learn. Simply attending lectures, reading books and writing papers no longer engages students. Furthermore, this type of learning experience does not prepare them for the future they now face. Today's students have to learn to think critically and creatively, engage a wide group of people in the problem solving process, operate across multiple forms of media, and harness the power of technology (Chickering et al., 1987). The digital students of the Me Generation should be brilliantly placed to do just that. However, we need to inspire, guide, and engage them to maximize their potential and prepare them for a very different future.

This article proposes a strategy to engage the digital students of the Me Generation by offering an entirely different educational approach. The model proposed is based on the following four points:

1. We are teaching students whose values are very different from those of the previous generation.
2. Today's students will work with technologies and products that have not yet been invented (Ally M 2009).
3. The rate of advancement of "technical information" is increasing exponentially. In 2006 it was duplicated every

Table1. Competences developed in the MET

Knowledgeable and Professional	Ethical Citizens	Entrepreneurial	Leaders	Citizens of the World
Oral and written expression	Ethics	Innovation	Leadership skills	Languages (English mandatory)
Critical thinking	Citizenship	Entrepreneurship	Self confidence	Global perspective
Planning and organization	Environmental awareness		Team work	
Process improvement			Negotiation	
Self esteem and good health			Decision making	
Self direction			Work culture	

two years. In 2012 it was duplicating every 72 hours.

4. Today's students will have 10 to 14 jobs before they reach the age of 38 (Ally M 2009), many of which do not currently exist.

Within this context, we present an Active Learning Model that is responsive to the characteristics and learning preferences of the Me Generation's digital students, and teaches them in a way that develops the skills and capabilities they will need to work successfully in their futures. This article presents a summary of Monterrey Tech's current educational model (MET), the key aspects of the Active Learning Model, and the changes that are required to make the shift (Christensen and Lundvall 2004). The article also includes a "Q&A" which describes the emerging results, and outlines some of the key learnings we experienced when piloting the new approach within different academic areas of the Mexico City Campus (MCC).

The current educational model (MET)

Monterrey Tech's 2015 Mission is:

To cultivate people with integrity, ethical standards, and a humanistic outlook. Our students will be internationally competitive in their professional fields and, at the same time, they will be good citizens committed to the economic, political, social, and cultural development of their communities, and to the sustainable use of natural resources.

Put simply, the teachers aim to achieve two important objectives. To develop the desired profile of the graduates in accordance with the 2015 Mission and to improve the quality of our graduates' first work experience (Vicerrectoría Académica, 200). We developed the MET to enable the teachers to achieve these objectives. It is a holistic approach that integrates a system of educational philosophies and theories in concordance with international models such as Morin's seven complex lessons in education for the future (Fisch

et al., 2008). and it seeks to develop students who are:

1. Knowledgeable and professional;
2. Ethical citizens with a sense of social responsibility;
3. Entrepreneurial;
4. Leaders;
5. Citizens of the world who understand the global context in which they live.

Table 1 (above) shows some examples of the skills and capabilities we help our students develop to achieve our mission.

Regardless of the area of academic study, MET includes different strategies, didactic techniques, and learning activities - both in and out of the classroom - that allow students to put these competencies into practice. Information and communications technologies (TICs) are used intensively to facilitate learning and to enable students to access the latest and most relevant information. Below are practical examples of how these competencies are developed and evaluated as part of every degree course.

Oral and written expression

As a requirement, all academic programs include workshops on analysis and verbal expression where students develop their written and verbal abilities.

Ethics

Every program has two courses on ethics (Ethics: person and society and Ethics: profession and citizenship). In addition, at least two of the subjects within each academic program include two ethical dilemmas as part of the coursework for that semester.

Citizenship

Every program includes courses taught under the

Learning-Service didactic technique. Additionally, as a requirement for graduation, every student must perform 480 hours of service in his or her community. This experience is captured by students in their Report on Citizen Experiences (REC), in which they reflect on their development as citizens.

Environmental awareness

At least two specific courses in each academic program consider the analysis of situations on environmental matters, particular to each career.

Entrepreneurship

Every program includes a course on entrepreneurship, and students can take addition, optional courses on social entrepreneurship. Further, we offer Entrepreneurial Modality and Investigation residencies. The Mexico City Campus has recently created a degree course in "Creation and Business Development" with a clear emphasis on entrepreneurship.

Leadership skills

Both in and out of the classroom, students are offered a variety of opportunities to lead groups in which they can develop their abilities to plan and execute events. Further, there are lectures on leadership every semester, which provide students with the opportunity to interact with nationally and internationally recognized leaders in many different fields.

Self Confidence

Students are encouraged, throughout their academic experience, to get to know themselves. The Center for Life and Career (CVC) offers services that enable students to express their anxieties and to receive attention, whether personal or academic. They receive support that enables them to present their ideas and projects with confidence. They are given the opportunity to participate in career workshops, conferences, job fairs and other activities that are designed to help them enter their chosen field. Finally, there is a program called 1-4-7, which takes further action in students' lives and career through an online employment bureau.

Languages

Students must take English language courses and courses in English, depending on their level of fluency measured before or during their first semester. As a

graduating requirement, all students must obtain 550 on the TOEFL exam. The 550 score is an internationally recognized result which demonstrates that an individual can successfully manage the course work of a graduate degree or the challenges of a professional life.

Global perspective

We offer a variety of opportunities to obtain international experience, by studying abroad, listening to international speakers, studying with a foreign teacher, and interacting with students from different parts of the world on campus.

In our pedagogical model, teachers generate didactic material, create activities, and design learning environments that aim continually to improve students' knowledge and capabilities in all five areas above. However, MET's distinguishing characteristic is that it assumes students will play a central role in their own development (ITESM, 2002). To that end, they can develop themselves further by actively engaging in a broad range of ideas, and participating in a wide variety of activities - both formal and informal - during which they are encouraged to self-reflect, think critically, and exercise judgment.

In conclusion, Monterrey Tech's MET provides students with an environment in which they can develop the skills and capabilities that are valued by employers (communication skills, critical thinking skills, technology and media skills, the ability to collaborate, and creativity (American Management Association, 2010), become well rounded, responsible global citizens, and take control of their personal and professional development long after their formal studies have ended.

The active learning model

The Monterrey Tech developed its active learning model to take into account the evolving needs of students and the different challenges they will face when they graduate (see the Introduction, above) Figure 1 lays out the main parts of the Active Learning Model.

Learning Objective

One of the most important variables in developing an active learning approach in higher education is the unique profile of students whose learning objectives evolve during their time at university. Following Bloom's taxonomy (Heacox, 2002), the objectives are listed by semester blocks. Scientific and technological thought is characterized as being imaginative and systematic. While science deals with truth and discoveries, technology deals with practice and invention. Together they enable students to become effective and efficient

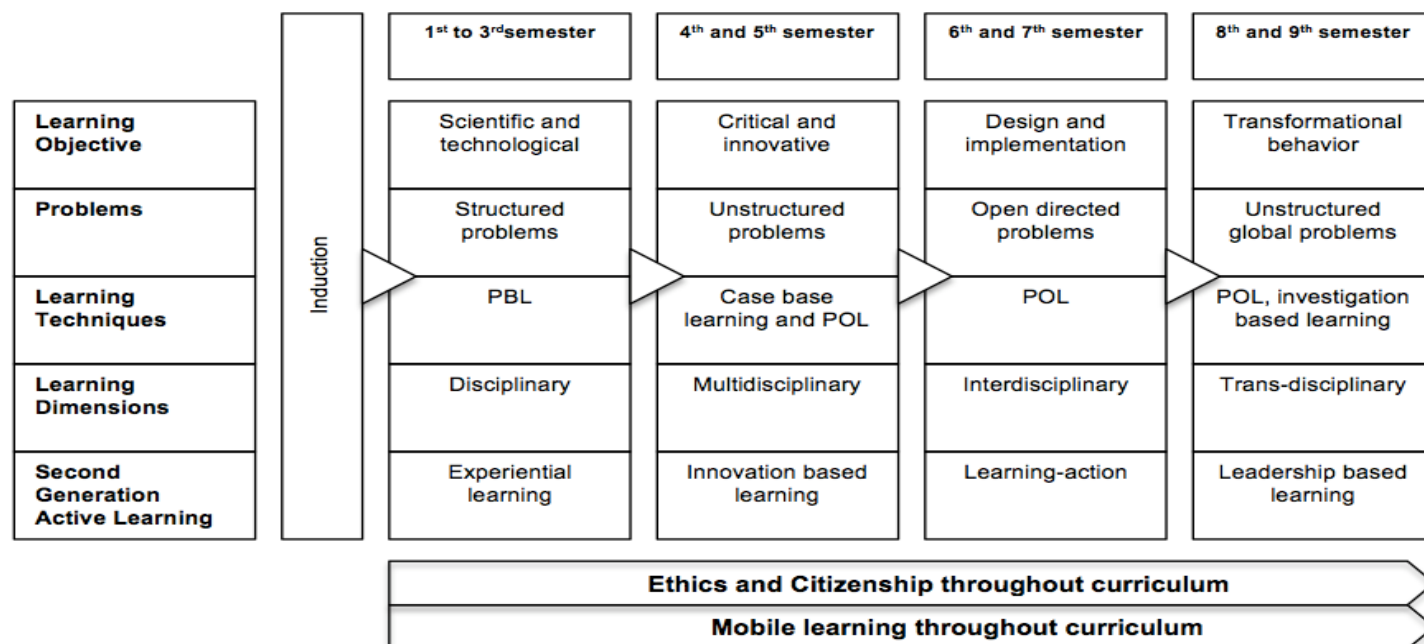


Figure 1. Monterrey Tec's Active Learning Model (acronyms explained above)

when it comes to defining and solving problems. From there students begin to develop critical and innovative thinking, both of which are important as they enable students to redefine problems and question generally accepted solutions (Kirton, 2003). During this phase of their development, students will learn to do things differently in order to do them better.

During the design and implementation students begin to integrate everything they are learning and understand the impact of the different skills and capabilities they are developing. In the final phase, transformational behavior, students have developed the capacity to design and implement sophisticated solutions to complex problems.

The first half of the curriculum, therefore, focuses on analytical and critical intelligence, whereas the second half concentrates on creative and practical intelligence, thereby offering a learning experience that meets the needs of both society and future employers (Oblinger and Verville, 1998).

Problems

It is necessary to challenge students with meaningful problems throughout their time at university to establish learning goals, initiate the learning process, and maximize the learning experience. This is important, not only because individuals learn best when they are motivated and operating within a relevant context, but also because the desired result of the active learning process is to develop students who can resolve complex problems. Throughout their time at university, the type of

problems that will be put to students will become more complicated to challenge and motivate them and to test their thinking skills at the same time as these too are being developed.

In their first semesters, students will face structured problems, which have a clear definition and can normally be solved through standardized procedures and methods (Kirton, 2003). They will then move on to unstructured problems which have no such boundaries and demand that students diagnosis a situation, and develop an approach from several options, none of which have a clear outcome (Kirton, 2003; Llano, 1998)

Toward the end of their career, students will be faced with both open directed problems (limited sub set of possible solutions, clear accountability for results, results that have a measurable impact) and unstructured global problems (no boundaries, unclear impact, complex ownership of problem and resolution) [18].

Increasing the complexity of the problems students will face gradually builds their confidence, gives them opportunities to integrate skills and capabilities they are learning, and keeps them motivated.

Learning Techniques

The Active Learning process requires students to collaborate with teachers and colleagues using a range of technology and media. Active Learning requires a specific approach to organizing, developing, and delivering the learning experience because its main objective is that students assume responsibility for their

development (Morin E 1999), as they will be required to do when they graduate. Therefore, Active Learning does not include all the current pedagogical techniques. Indeed, it includes only the techniques that enable students to master the content of their degree programs and develop the skills and capabilities required by the MET (above) in an interactive, problem-solving approach. Some of the pedagogical techniques that are well suited to meeting the objectives of Active Learning, include:

1. Problem based learning (PBL). PBL requires students to work in small groups to find the best solution to a specific problem, as established by the teacher. Each group has a discussion leader, whose job is to guarantee that the discussion will be oriented towards the meeting the objectives. The members of the group exchange ideas, thoughts and opinions concerning the problem; and the solution will depend on the path that the students choose as a result of this interaction. A tutor, whose goal is to promote the learning and cooperation amongst group members, supervises the group. The performance of the group is the responsibility of each of its members as well as the tutor's.
2. Case based learning (CBL). CBL refers to the process of presenting a group with a complex problem that requires a sophisticated solution. The didactic purpose of learning in a case based method is to develop skills to diagnose and solve problems that occur in the student's professional field. This process is carried out by way of a rigorous analysis of the problem.
3. Project oriented learning (POL). POL consists of the work required to create a service or product through a series of assignments that are clearly sequenced and related. With this technique, students explore a practical problem with an unknown solution. Students are required to apply their knowledge in one or more of their classes to find a solution.
4. The learning-service technique (LST). The LST provides students with the opportunity to apply the knowledge and skills they have acquired in the classroom to face the various needs of their community. Through active participation in service experiences, students take into consideration the realities of their environments and develop an understanding of the responsibilities of particular professions in relation to other members of society.
5. Investigation based learning (IBL). IBL consists of linking investigation to teaching. This allows the partial or total integration of students' knowledge and experience in an investigation based on scientific methods, but always under the teacher's supervision. The goal is to highlight the activities that generate, transfer and apply knowledge.

Learning Dimensions

Active Learning encourages students to collaborate in

many different ways throughout their university career. The process enables students to experience collaboration as well as understand its importance as a means of learning and working (Martín, 2002). As their university career progresses, students will be required to collaborate more frequently and intensively with teachers and colleagues, and in different ways.

During their first few semesters, the level of collaboration is slight as students learn how to manage the level of independence they have at university versus school. During these semesters they are supported to develop self-discipline and self-motivation. Students move on to the multidisciplinary approach in which a relatively simple problem is given to all the students who are allowed to resolve it in the way that works best for them, given what they know. Every student has a different skill set and it is expected that they reach different conclusions. The interest is in both the process of problem solving and in the different conclusions that are reached.

Toward the end of their career, students are required to work in an interdisciplinary fashion, investigating problems as multidisciplinary teams. The team works together and different solutions are reached. Finally, the trans-disciplinary work requires teams to work together for a common goal experiencing not only technical expertise but also interpersonal expertise such as negotiation, leadership, influencing and team working skills. New disciplines may even emerge as a result of this level of convergence (García, 2006).

Second Generation Active Learning

Experiential learning refers to the practice of self-reflection in real time during an assignment whose conditions are real and whose results affect the performance of the participants and their environments. This approach stimulates participants to develop self-knowledge and empathy for others.

Innovation based learning aims to generate, transfer and apply knowledge. It helps students develop their skills by collaborating on the learning objectives of investigation, and evaluation of a problem and the development and planning of its solution.

Learning action refers to the practice of reflecting and studying action to improve performance the next time a problem of a similar nature is faced.

Leadership based learning exposes the student to situations that demand the development of a learning culture (Stavenga et al., 2006).

Throughout the entire curriculum, the Active Learning model emphasizes ethics and citizenship. Teachers are trained to incorporate ethical dilemmas and citizenship dilemmas in their courses so that students can be aware that in most decisions they take in their professions, there are social consequences that must be evaluated

constantly.

Possibly the most critical feature of the Active Learning model is that the learning experience is customized and enriched by the sophisticated use of technology [19]. Mobile, wireless and portable technologies transform the ideas of what is possible in space and time. Thus, the Active Learning model is not constrained by the physical limitations of traditional learning, which mainly takes place in a classroom. On the contrary, students and teachers are connected to each other and to the entire world in real time, any time. Individuals can access information and learning tools, interact and intervene, start and complete projects in the time and space of their choosing - given the boundaries they have agreed with their teachers and colleagues (Ally, 2009).

Implementing the active learning model

This section presents some of the experiences we had implementing the active learning model.

Health Sciences School (ECS)

This school stands out as being the most receptive to the concept of active learning, as it is applied inside the curriculum. This is due to the nature of the knowledge and abilities that the student must acquire throughout the areas of study. The nature of this program requires that active learning be applied each semester.

Active learning is used in two levels. The first uses didactic techniques that involve one scenario that requires one specific solution; whereas the second allows for the full immersion of the students in a real situation. Here they must identify the main problematic through observation. At the first level, the subjects, of Body Systems I and II, and Defense and Homeostasis I and II, are designed around cases. Every week, the teacher assigns a situation or a case that presents specific problems. For this the students must organize themselves into interdisciplinary teams with General Surgeons and Health and Integral Nutrition students and investigate on several bibliographic sources, the possible causes of said symptoms, in order to have sufficient knowledge to offer a diagnosis and a solution to the problem. On the third day, the students discuss the results found from several sources, with which they achieve the purpose of learning. Said purpose does not consist of solving the problem in a rigorous and precise manner; rather it involves covering all themes, thereby simultaneously developing self-learning abilities.

As an academic specialization, General Surgery is fully integrated into the active learning concept. This is due to the fact that the program demands that the students experience a rapid immersion into real problems

that must be solved. The strategy is divided into three stages. These depend on the semester and the subjects the students must take. The first stage involves the first four semesters, and it is called, "basic sciences". The second stage is the four subsequent semesters, called basic clinical sciences, which is subsequently divided into four main branches: surgery, pediatrics, gynecology, and internal medicine. The third and final stage incorporates the last 8 trimesters, the clinical sciences.

The clinical shifts in hospitals after the eighth semester are the axis of clinical formation in the General Surgeon and Health and Integral Nutrition programs, whereas professional internships in health companies or institutions or research centers are the cornerstone for Biotechnologies and Biomedical Engineering.

School of Humanities and Social Sciences (EHCS)

Inside the EHCS, the academic programs of the Humanities and Social Sciences apply active learning from two complementary perspectives. The first one involves working with the student association, "Humanize" (Humanize Yourself) and in the coordination with co-curricular activities that allow students to put their knowledge into practice and to create activities related to their work field. The second perspective is all about the redesign of select curricular courses in which specific active learning activities are realized. Whereas the first perspective is student directed, the latter requires a professor's guidance.

Operating within the structure of the first perspective, in March 2010, the First Entailment of Cultural Managers Day was carried out with the support of a network of cultural managers and the library's administration. Here students learned what happens in the world of cultural management through the knowledge of experts and leaders in the field. In the same month, students collaborated with the library administration in the campus' first book fair where students engaged not only in the logistics, but in the invitation and coordination of guests, artists, writers that participated in the fair. Lastly, students participated in "Tzompantli". This was a workshop whose purpose was to rescue the lost All-Saints day traditions. This workshop was inaugurated with a conference given by the professor Mónica Salcido. Then the students were to work with paper maché skills with the aid of professors from the cultural diffusion department. The second part of the event involved presenting these works in Plaza Loreto, a shopping mall, in conjunction with the work of high school students. An auction was held afterwards, and the earnings were donated to a children's foster home. In sum, students learned how to create value through culture, at the same time helping their community.

As to the second perspective, the freshman semester Logic course, in which theoretical and philosophical

foundations are discussed, the class shifted to the analysis of complex texts through logical reasoning abilities. This was carried out in order to obtain an overview explaining the complexity of the text by means of logic. The fifth semester class, Analysis and Cultural Industries, requires students to visit cultural institutions, specifically museums in Mexico City, where they must learn about the museum's workings and administrative aspects. Each student chooses a different museum, and the results are presented in class, analyzing the museum's administration, its internal roles and as a possible source of employment.

School of Engineering and Architecture (EIA)

In the introductory course for the degree of Administrative Mechanical Engineering, Electrical and Mechanical Engineering and Mechatronics Engineering, 40 freshman students collaborated with Grupo Autofin México, which has 36 automobile agencies in the country. The activity consisted of students visiting the agencies, observing the processes in all of their areas—from the purely administrative to the practical, and thus, more related to their careers, in order to detect problems or areas of opportunity for improvement. By the end of the visit, students were engaged in a process of analysis, and they found themselves contrasting an ideal or theoretical scenario with the reality of what they had seen. The students then presented the results of their experience to their teachers as well as to the company's representatives. This was done in the form of suggestions and consultations, addressing the needs of the company.

One of the principal motivations that led the School of Engineering and Architecture to the application of the active learning educational model was the accreditation processes to which the Monterrey Tech MCC's academic programs are subjected. Within this context, it is fundamental to bear in mind the "Engineering Criteria 2010-2011", as defined by the council of accreditation for Engineering and Technology ABET, or its equivalent in Mexico CACEI, Council of Accreditation of Engineering Learning. The proposed model described in Figure 2 includes said criteria, and the performance is evaluated systematically. Students must demonstrate:

- Abilities to apply knowledge in math, sciences and engineering.
- Abilities to design and develop experiments, as well as analyzing and interpreting data.
- Abilities in systems design, components or processes according to the defined development requirements, taking into account technical, economical, social, political, environmental, ethical, security or health-related restrictions.
- Abilities to interact in multidisciplinary environments.
- Abilities to recognize, formulate, and solve

engineering problems.

- An understanding of professional qualities and ethical responsibilities.
- Abilities to communicate in an efficient manner.
- Abilities to understand the impact of the application on engineering in a global context, taking into consideration economic, environmental and social aspects.
- An awareness of the benefits of maintaining the learning curve on an upward tendency throughout life.
- Knowledge of contemporary aspects and social and cultural trends.
- The implementation of techniques, skills and modern tools for the application of engineering.

Business School

In the Marketing introductory course, 71 students, divided into 11 teams, took part in a project called "McDonald's month". During this project, they visited the company's headquarters where they learned about the company's mission, values, business model and philosophy. At the same time, they were offered a conference by four of the directors: Innovation, Marketing, Human Resources, Communications and Social Responsibility. Each conference concerned the specified area's daily practice. Afterwards, the director of Communications and Social Responsibility posed the challenge of analyzing the market's perception of the service quality, products, nutritional contents, and prime sources of the company. The goal was for the students to develop a mass (and alternative) media marketing campaign proposal, based on the student's and consumer perception. In order to achieve this, students were invited to investigate the internal processes at a McDonald's restaurant, the origin of the products, and the cleaning and standard procedures. Finally, the 11 teams presented their proposals internally, and 4 were chosen. These 4 teams presented their proposals to the directors. McDonald's México would implement the campaign of the overall winner. Thus, the students took the role of consultants and consumers, relating theory with practice, and demonstrating a fair amount of intellectual "rentability". By providing fresh, well-sustained ideas, both the company and the students benefited from the active learning process. Obviously this experience gave the students a great deal of confidence

Q&A Were the goals reached?

In the cases analyzed above, the course's objectives were achieved and even surpassed, through the active learning activities. Having applied the concept of active learning in the bachelor programs (degrees or majors) from Monterrey Tech, MCC, a general pattern, followed

by both teacher and students, has been identified.

1. Students examine, study, and understand the theoretical concepts of the course with the aid of the teacher in the classroom.

2. The purpose of the activity can be identified in three modalities: (1) the teacher establishes and communicates the objective in the classroom; (2) the teacher establishes the objective, along with the business or the institution, and communicates it in the classroom; (3) the business or institution shares its needs, with which an objective is created, shared to the professor, adapted to the course's objectives, and communicated in the classroom.

3. Through two modalities, students meet with the business or institution in conjunction: (1) Visiting the facilities in groups, teams or individually, with the purpose of identifying or observing the situation or problem. Or (2) the business sends representatives to the classroom. These are aided by different methods to present the situation or problem to the group.

3.1 In case 1, students observe and take notes on the situation, the environment, behaviors, and every aspect that they consider to be related to the activity's purpose.

3.2 In case 2, the students take notes on the situation posed by the business representative, thus identifying the relevant aspects for the activity. They investigate and question the supposed requirements and reflect upon the possible and necessary skills.

4. Students take on a process of data analysis with which they identify the knowledge they need to provide a solution to the problem.

5. Students carry out an investigation on the themes they have identified. The student will find relevant information that was not previously considered.

6. The student works individually or collaboratively, the second being more common.

7. Lastly, the results are presented individually or in teams in order to propose a solution to the initial problem.

Were the competences developed?

Students develop both types of competences: the ones necessary to meet the challenge of the activity (first level) and the ones directly concerning the subject's knowledge (second level). The first competences are related to observation, analysis, comparison, relations, documental investigation, discussion and argumentation, rebuttal of ideas, and focusing on results. The second type of competences is aligned with the activity's objectives, and thusly those of the courses.

What are the comments on the students' experience?

Comments made by students vary depending on their degree. Since their professional activities tend to follow the same dynamics, M.D.'s will apply this type of learning

throughout their career. For business students, it's an enriching experience, especially in theoretical courses because it allows them to establish relations and to potentiate and identify their professional competences, as well as to establish business ties (networking). In the engineering school, the comments focus mainly on how the students were able to think outside the box. It also gave them a chance to deviate from their traditional engineering duties in order to observe and work in aspects related to an engineering business. Finally, in the humanities school, students appreciate this type of activities due to the potentially varied oaths that their careers could take. This focus also helps them get a better grasp on what their areas of opportunities might be once they have a professional life.

What learning skills or strategies were achieved?

The type of learning that is mainly identified by the academic program directors is that active learning activities must extend and grow each semester. They agree that the concept of active learning should be integrated into the curricular design, both in theory and in practice.

CONCLUSIONS AND RECOMMENDATIONS

To serve our students and our future society, we believe it is necessary to introduce a learning model that is centered on students, developing and channeling their abilities to work with others, to create, and to innovate using a range of media and technologies.

The learning model we propose enables students to:

Apply their unique skills and abilities from their very first semester in a project-orientated learning environment. Projects provide them with relevant, meaningful, and realistic experiences;

Work in collaborative and competitive environments;

Experience disciplinary, multidisciplinary, interdisciplinary and trans-disciplinary work and understand the importance of each;

Apply what they are learning not only in the resolution of general, transcendental problems but also in the creation and development of practical, commercial products and services that make a positive difference to the world around them.

The objective of the active learning process is not to create experts. On the contrary, it is to help our students develop the broad set of skills and capabilities that enable them to resolve unstructured, complex problems of a kind they are sure to face in their futures.

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