

Graduate education must adapt its structures and teaching methods to the new necessities. The objective is to pass from a paradigm based on teaching and the transmission of knowledge to a paradigm based on learning and the development of competences which are transferable to different contexts in time and space.

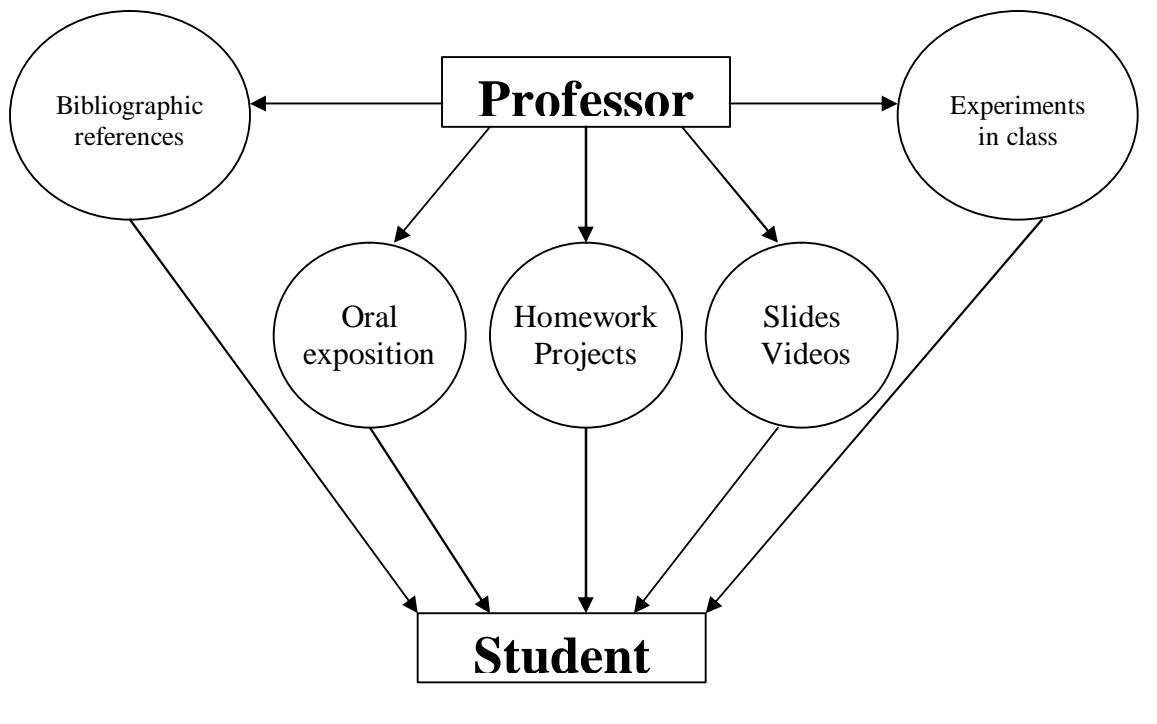
UNESCO, 1998

2. An educational model based on learning.

In order to fulfill the challenging goal of redesigning the teaching and learning processes based on the established guidelines by the mission of Tec, it was necessary to change the traditional method professors used to teach their classes.

It is difficult to include in a single diagram the different elements used by Tec professors in the traditional educational model. The Figure 2.1 presents these elements in a simplified way.

Figure 2.1 Traditional educational model



In a traditional class, the professor teaches his/her class, answers doubts, stimulates students' participation with some questions and requests for homework assignments and projects that students must carry out after class. These assignments can be done individually or in teams. On the other hand, students must take notes, reflect about what the professor said using audiovisual aids such as transparencies and videos which enriches the class and makes it more interesting and attractive.

This model has been effective if it is used by good professors and for a long time, it was also the one that better adapted to the availability of didactic resources and society needs. Many professors have been able to incorporate learning activities to this model as case studies, projects or simulations which help the students acquire attitudes and values such as responsibility, honesty and team work. They also develop the ability to analyze, synthesize and evaluate. However, if they are not explicit in the teaching-learning process, students will not acquire them in a structured and programmed way. Sometimes, students are not able to develop these skills, since professors rarely specify which are the activities or mechanisms students can carry out to acquire them. In addition, professors do not evaluate how much students have developed these skills.

The traditional educational model strengthens the diagram in which the professor is the core of the teaching-learning process. The professor is the one who decides how and what students should learn. He/she is also the only one who evaluates how much students have learned, whereas students only participate in the performance of the activities chosen by the professor, depending on decisions which are taken without taking him into account.

In the traditional model, the main objective of the teaching-learning process is to acquire knowledge and professor's exposition is very important. Professors only evaluate the level of knowledge acquired by students. It is obvious that students have also developed abilities, attitudes and values, however, this is not explicit intention, but it is part of the hidden *curriculum*.

In the educational model which has emerged from the mission, the core of the teaching-learning process moves from the professor to the student. Learning in teams is combined with the individual work, students' ability to explore replaces professor's exposition and efficient teaching strategies are incorporated. On the other hand, the teaching and learning processes are enriched by data processing technology and telecommunications. (See Table 2.1)

Learning process based on the student

In Tec's educational model, the student is the core; all the process moves around students' learning. This orientation is based on two learning principles; the constructivist and experiential.

The constructivist learning principle is based on the premise that knowledge cannot be transferred from one person to another, but it is constructed by the individual. When a professor bases his/her teaching on exposition, he/she imposes his/her own structure to students and does not give them the opportunity to generate their own knowledge and comprehension. In the learning process based on the student, the professor does not transmit knowledge he/she becomes a facilitator of knowledge. The professor will design the environment in which the learning process is the core of the whole activity. The constructivist learning principle changes the traditional perspective of how students' learn. The main objective in this diagram is the construction of meaning through the following types of experiences: detection, comprehension and knowledge application.

Table 2.1 Characteristics of the traditional model in contrast to the Tec's educational model.

<p>Traditional educational model:</p> <ul style="list-style-type: none"> ? It is centered on the professor. ? It is centered on teaching. ? It applies the individual learning. ? It develops abilities, as well as attitudes and values in both directions ? It uses professors' exposition as a prevalent teaching method. ? It uses technology as an additional tool. 	<p>Tec's educational model:</p> <ul style="list-style-type: none"> ? It is centered on the student. ? It is centered in the learning process. ? It applies collaborative and individual learning. ? It develops abilities, attitudes and values in a planned and programmed way, and students' achievement are evaluated. ? It uses a variety of teaching techniques. ? It uses technological resources to enrich and make the learning process more effective.
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The constructivist learning principle changes the traditional perspective of how students' learn. The main objective in this diagram is the construction of meaning through two types of experiences: detection, comprehension and knowledge application. Students also construct meaning through the interaction with the other members of the process with whom they share the knowledge acquired through spoken or written language. This process helps students make a careful study of that knowledge, master it and improve it. In this way, the group of students which has not been relevant in the traditional educational model, occupy a fundamental place in this process.

The other principle in which this educational philosophy is based, is *experiential learning* which states that we learn from our own experiences and from the reflection of these experiences.

Students are influenced by experiential knowledge in two ways: improving their cognitive structure and modifying their attitudes, values, perceptions and behavioral patterns. These two elements are always shown and interconnected in a person. Students' learning process is not the isolated development of the cognitive ability, but a change in all the cognitive-affective-social system.

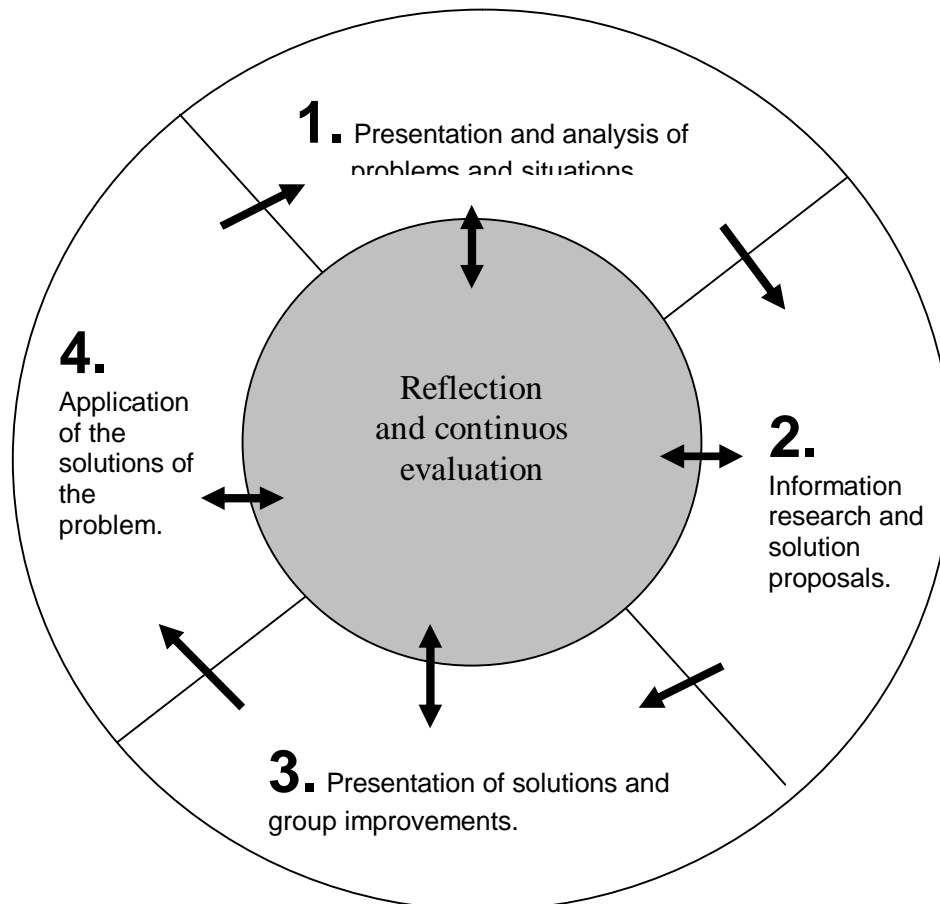
The experiential and constructivist learning can be considered a four-stage-composed cycle as indicated in Figure 2.2.

It is through active, meaningful and experiential participation how students acquire relevant and new knowledge. This knowledge will influence their education and will encourage them to be responsible of their learning process, as it is said by Ausubel (1976): *When learning is relevant appears a deliberated intention to learn.*

Role changes

A learning process based on the student affects not only the way the process is organized but also the way professors and students are related to each other.

Figure 2.2. Learning cycle of an educational model based on the student.



Students' role

In this process students participate in different activities which change their role radically. Some of these activities are:

- ? Analyze real, challenging and complex situations presented by the professor.
- ? Search for, study and apply information in different sources (Internet, Tec's Digital Library, Campus library, texts, articles, opinions of organization and company experts) to offer fundamental solutions.
- ? Discuss solutions with the other members of the group in a collaborative way in order to find the most appropriate solution.
- ? Use information technology to learn, investigate, and give presentations and interact with the professor and classmates.
- ? Consult the professor and other experts whenever it is necessary.
- ? Participate in the organization and administration of the process sharing responsibilities with their partners.
- ? Participate in group sessions to reflect about the process, the results obtained and propose improving solutions with professor's guide.

Professor's role

In order to have students play their roles, professors must adapt their way of being related to students and assume varied and complex functions:

1. *Continue being the expert* of the subject they master. They are expected to share their experience and knowledge in order to orient, widen, enrich and clarify the knowledge thought, students learn through the different activities in the course.
2. *Explore and investigate* real-life situations related to the course content and give them to the students as cases, problems or projects to be solved.
3. *Plan, design and administrate* the learning process. They also use an appropriate technological platform to document the course and have it available for the student. The technological platform helps students know beforehand what is expected in the course and how he/ she will be evaluated.
4. *Arrange spaces* in order to help students develop the required behavior. For instance, the furniture is set in a way to encourage students to talk and reach an effective discussion.

In a redesigned course, you learn to be more responsible, to investigate and work by yourself; in other subjects the professor explains everything and you record it as if you were a tape recorder.

Student comment, Student's comment.. Investigation of the Educational Impact in the Technology Institute of Monterrey, 2001.

5. *Create* a working atmosphere which can let students be open, motivated and out-spoken and at the same time, feel secure and respected when they make contributions to the group.
6. *Facilitate* the learning process providing the appropriate conditions: professors choose the best experiences, stimulates students' thought with key questions in order to extend their knowledge and orient them to overcome difficulties and reach the learning objectives.
7. *Use* technological tool so that the student can have access to updated information through internet and Tec's Digital Library: Use the e-mail to have an open communication with the students, regardless to the place where they are. Offer tutoring and keep the group of students in constant interaction through virtual communication.
8. *Evaluate* permanently the students' performance. Observe their behavior and analyze their participation and assignments. Compare the data with the previously established standards or criteria and identify where those problems are and offer the required support.
9. *Perform* as the group leader, motivating the students through out the process. Professors know that a motivated student works easily, resists fatigue and overcomes difficulties.
10. *Create* and authentic learning community where students feel part of the group in which everyone works together and help each other. In this learning community students are the main characters and the professor is an aid but does not invade or substitute the students' performance.
11. *Investigates* in the classroom, improves and readjust the established plan if necessary and keeps a record of the results. This process keeps the professor in a permanent improvement and lets him/her identify the most appropriate experiences and activities, and share them with their colleges.
12. *The professor is a rol model for the students.* The professor must always show values and behaviors that he would like to develop in his/her students, and should live and act according to the principles established in the mission. His/her influence will help students model their behavior.

Other courses are not so open. These courses are open in all aspects, in the professor-student relation and in the academic area. You learn much more than in a "common" group where all you do is to go to class, listen to the professor, take notes and get nervous before the exam. Student's comment. Investigation of the Educational Impact in Monterrey Institute of Technology, 2001.

Table 2.2. Change of the professor's role.

The professor in the traditional educational model	The professor of the present educational model
? Acts in an isolated way; his/her reference to be a professor is him/her self.	? Works in teams and learns from other colleges.
? Does not incorporate a great variety of activities, therefore repeats them often.	? Incorporates a variety of activities.
? His/her teaching process is a routine.	? Uses an active teaching process.
? Uses an inflexible structure.	? Uses a flexible structure.
? Reflects a little in his/her teaching process.	? Reflects and investigates about the teaching-learning process and improves it.
? Assumes a teaching role.	? Takes a facilitator role.
? Maintains an impersonal relation with the student.	? Offers a constant orientation and establishes a personal relationship with the student.
? Gives students the answer they have been looking for.	? Encourages students to look for the answer.
? Gives his own opinions.	? Listens to students opinions.
? Bases his/her teaching on theory.	? Bases his/her teaching on students' experiences.

Table 2.2 shows how professors have changed the way they teach.

Challenges a professor must face.

It is not easy for a professor to assimilate all these changes. The traditional model is rooted in his/her performance and often teaches the same way he/she was taught, using the same method throughout generations. On the other hand, it has just a few variables and it is less demanding. The professor's performance is automatic and without any problem; he/she knows how to solve any situation and feels secure. This security is due to the fact that he/she teaches the knowledge he/she masters and does not leave enough time for students' contributions. For this reason, whatever happens is predictable and it is almost impossible to have surprises. Students' questions are usually related to the course content; he/she is the one who masters the course so he knows the answer. Students show respect to their professor because of his/her experience and knowledge. In addition, he/she is the only evaluator. Due to these aspects, it is not common to have situations professors cannot control.

Table 2.3 Professor's testimony

The educational model from my experience

The first change I have noticed is a professor performing a role with a much more responsibility in the learning process. Behind these courses there is planning, designing, reflection, evaluation, investigation and documentation. These processes were not used before and if they were used, it was not often nor frequent.

Probably in the past it was much more important to give a good exposition. The professor was an artist expressing his/her ideas and transmitting knowledge. At present, he/she must be able to make knowledge attractive to the students, promote and guide the learning process. The professor should always master the topic; however, in this new process he/she should motivate students to learn.

Another important change in the professor's role is that he/she now has to work in a more intelligent and efficient way. He/she must use all the resources available including technology, evolve with these changes and constantly analyze these processes and his/her role in them.

On the other hand, students have developed a great capacity to learn by themselves, to use and to adapt themselves to the new technology. They have been able to organize and administer their time better, work in teams, develop specific abilities, criticize positively based on evidence, investigate and search for information, elaborate reports and presentations. They should also be able to read technical language since in the engineering area they must be able to understand the problem to be able to solve it. In other words, students' formation is more integral and superior.

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In an educational model based on the student the situation is different. The whole process is centered in the students' activities and their performance. Professors must face difficult situations; students can give answers not expected by the professor and might not be prepared to give meaningful contributions to the class. They might also use information professors do not know and sometimes among students there are different level of participation or might not reach the objective. It is difficult to manage a group where students are free to express their own opinions. In the traditional model, professors used to have the only answer and many students would like to continue in the same way. These new process requires time and professors feel under pressure to finish the contents of the program. In order to stop being the main actor in the classroom,

change from being the one that controls the audience to one who does not know how it will react, and delegate a leadership based on this knowledge to one based on his/her personal qualities, professors must have an open attitude, be flexible and humble. They should also show a strong commitment to the change and a determined will to face it.

(See Table 2.4) These are the qualities which characterize professors who are working and contributing to install the educational change in the classroom.

Table 2.3. Behaviors that Define a Motivating Professor.

A motivating professor:

- ? Encourages the student to think and test their own ideas.
- ? Shows real interest in students' work.
- ? Delays his/her opinions so that students' work and evaluation would not be conditioned.
- ? Works with students' opinions.
- ? Takes advantage of student's mistakes to help them learn.
- ? Stimulates students' collaboration and participation in the classroom.
- ? Guarantees that each student will be shown respect, listened and appreciated by their classmates.
- ? Appreciates creative ideas and accepts students' decisions.
- ? Stimulates students to work and share risks.
- ? Clarifies doubts and enriches student's vision.

Jurjo Torres, 1996.

Group's role

In the traditional educational model students do homework in teams, however, it is not as relevant and fundamental as it is in a model based on the students' learning process. (See Table 2.5)

Table 2.5. Contribution of the Group Members to the Students' Learning Process.

When group members:

- ? Contribute with ideas.

- ? Argue against and opinion.
- ? Ask

- ? Criticize
- ? Accept opinions

- ? Have problems

- ? Work with effort

- ? Learn through their partner's explanation

The student:

- ? Enriches his/her points of view
- ? Lays the foundations of his/her proposals
- ? Structures and extends his/her thoughts to reach the answer.
- ? Develop tolerance.
- ? Fortifies his/her self-esteem and confidence in him/her self.
- ? Shows solidarity to the group.
- ? Is motivated to offer his/her best contribution
- ? Consolidates his/her knowledge when he performs a presentation.

In order to get the group to work efficiently, the professor must distribute the functions using roles. These roles will help students' learning process and will help observation and evaluation. It is also necessary plan an assignment that integrates all the members and motivates them to participate, for example, solve a problem or carry out a project; the assignment is the core of all the individual and group activities and at the same time it is meaningful and arouses students' interest to carry it out.

Conclusions

The complexity and radical difference in the way teaching is practiced and the way students learn makes the transition to the new model difficult. (See Table 2.6)

These new roles have emerged prejudices such as:

- ? *In the new teaching model the professor does not teach anymore.* In an educational model based on the student does not mean that the professor will stop teaching. The professor can teach whenever he/she considers his/her comments are necessary to complete or clarify concepts which have not been correctly understood, to introduce an abstract and difficult concept and to amplify student's point of view. All this related to students' needs and as supporting activities.

? *In the teaching model students do not attend to class.* An educational model based on learning does not mean that there will be no classes. It is true that the activities carried out in the classroom have changed and the classroom has a different function. The classroom has changed from a place where the professor was in the scenery and the students were distributed in rows as a passive audience observant of his/her exposition to a space or forum where all students participate to clarify, reinforce and discuss aspects related to their individual learning process. They also share experiences and reflect about the process they followed and the results they have reached. In this process, the professor is a guide and monitors the activities.

Table 2.4 Critical matters in the application of the educational model.

<p>From professors' experience it is important to;</p> <ul style="list-style-type: none"> ? Know when the most appropriate time is to contribute, how and to what extent, without interrupting the students' process. ? Administer the time in class to complete all the activities and respect the students' rhythm. ? Incorporate to the working routine the time required to write a case or describe a real problem. ? Manage a situation without knowing previously the information students will contribute and avoiding the fear and insecurity this situation can cause. ? Quit exposition and ask students for readings, and request them to memorize specific information for the test. ? Assume a much more open attitude towards the way things are done and avoid expecting everything done the way he/she wants it. ? Manage a discussion when students are not well prepared, without expecting that the professor has to give the correct answer. ? Stop taking a directive role when the student has an egocentric position and only looks for his own benefit without taking the rest of the group into account. ? Do not feel tempted to contribute with exposition or explanations of specific concepts when students discuss in groups, it will difficult the flow of the participations. ? Be aware of students' emotional states and reactions when the group is against his/her arguments or proposals. 	<p>From the student's experience:</p> <ul style="list-style-type: none"> ? Be interested in working with his/her partners and accept his/her responsibility in the other's learning process. Students tend to think that collaboration means working less in more time and prefer the individual work. ? Understand the importance of their personal responsibility in their learning process. They should prepare themselves individually to make important contributions to the group and do not expect all the answers from the professor. ? Feel secure of being accepted by the others when they have to ask questions, argue against someone's opinion and express his/her own opinions to others. ? Accept that they have to invest more time in homework assignment than the time spent in the traditional method. ? Accept that answers can come from other students and not only from the professor. ? Stop being afraid of taking his/her own decisions. They need time to interiorize the changes, since they do not have enough practice in directing his/her own learning process. ? Accept that professor's exposition is not the best way to learn. <p>Results from the Exchange of Experiences of Professors who are Facilitators of Teaching Techniques, 2001.</p>
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