

*The education taught must encourage the formation of creative and innovative persons who are committed to their community improvement. In order to reach this, it is necessary to organize the education to recall the interest and curiosity of students, relating what is studied with real and practical situations and stimulating the analysis of problems to find solutions.*

Hans Aebli, 1991.

## 6. The didactic techniques of the Tec educational model

The following text is a dialog between two University professors taken from the movie: *The mirror has two faces* directed by Barbara Streisand. A professor asked his colleague to attend one of his classes for her to give him some feedback.

The class observed goes like this:

*(The professor is in front of the board, writing and having his back to his students. His colleague is sitting like any other student, observing).*

*Professor:* If  $X$  squared plus  $Y$  squared equals 16, how do we find  $D-Y-D-X$  as an implicit function of  $X$  so we differentiate both sides. The right-hand side is trivially zero. What is the left-hand side?

*(His colleague gives him feedback after the observation and they reflect on it)*

*Colleague:* You're like, walking across the room, and you're into your own thing...the body language...it's very detached...it's very alienating...You see what I'm saying? I just think that you have to relate more to the kids...engage them...You're up there with your back to the room having a great time solving your own problems, it's like you're having a party and you only invited yourself. So relax...have some fun with it.

*Professor: (taking notes)* Relax...have fun...What was the other thing you said?...

*Colleague:* Put the pen down! I'm not going to test you on this stuff!...Come on... teach me something, anything...

*(Again the professor turns back to write something on the board)*

*Professor:* If a ball is thrown into the air and its height  $h$  equals  $100t$ ...

*Colleague:* What are you doing? Turn around! Turn around! Talk to me!

*Professor:* " $t$ " is time in seconds...at what limit is the speed?

*Colleague:* You lost me...You have to put it in some context...make up a story...jazz it up a little...maybe find some humor in it...

*Professor:* Humor in calculus?

*Colleague:* Try telling me a story.

*Professor:* A story...once upon a time...there was...a ball...and...it was thrown into the air...its height...I don't know...maybe I should just write books.

*Colleague:* No one understands those either...just kidding...don't give up...do it again... try it again.

*Professor:* Tell you another story?

This excerpt shows some of the difficulties that professors face when trying to break the traditional paradigm. They manifest their need to *know how*, in this

case for example, how to give a context for a theory to rise students' interest. How to make students participate; in short, how to move from a teacher-centered process to a student-centered process.

The purpose of this chapter is to know strategies, methods and didactic processes that professors use to install the Tec's Educational Model in the real practice.

Some of these processes are the following: professors in class can clarify doubts, structure concepts or make brief expositions for students to deepen their knowledge. Professors can connect content to reality through a presentation of experiences, cases studies or having guest speakers. They can also incorporate processes that mix learning with socialization such as discussions and group exercises which are very valuable to develop social attitudes, such as participation and contribution to the group; respect and value others. Professors can also incorporate activities like individual study, the search and analysis of information in digital or printed documents, use simulators and virtual or physical labs.

These processes can be valued according to the number of participants and the coverage. According to the number of participants there are activities in which students can work individually and others where students work with other classmates varying the number which goes from two to six or the whole group in a plenary session. Regarding the coverage, it can cover a class session, a week or a whole semester, for example, when doing a project.

Professors can build a didactic process incorporating some activities making use of their experience and creativity while planning. This process can easily become a sum of activities without any connection that implies a lot of control by the professor during the implementation to be able to coordinate them and a lot of effort from students to perform them.

To avoid these risks, the leader universities on educational innovation have structured methodologies and didactic techniques used from a long time ago. They have been incorporated to previous schemes several processes that go according to the current requirements and learning necessities; that is to say, collaborative work, the use of technology, the emphasis on the students' building their own knowledge and learn how to learn. The techniques that have been more efficient and that are used the most are: Problem Based Learning, Project Oriented Learning, Case Studies, and the variety of techniques oriented to develop abilities and attitudes specific to collaborative learning. These didactic techniques are the ones being promoted at Tec.

We can, therefore, define didactic techniques as the guidelines or methods that the professor follows to incorporate the characteristics of the education model to the learning process. These techniques develop from an education vision in which students have a greater responsibility of their own process. These techniques are also based in collaborative learning, constructivism, and life experiences, which give them support. (See Fig. 6.1)

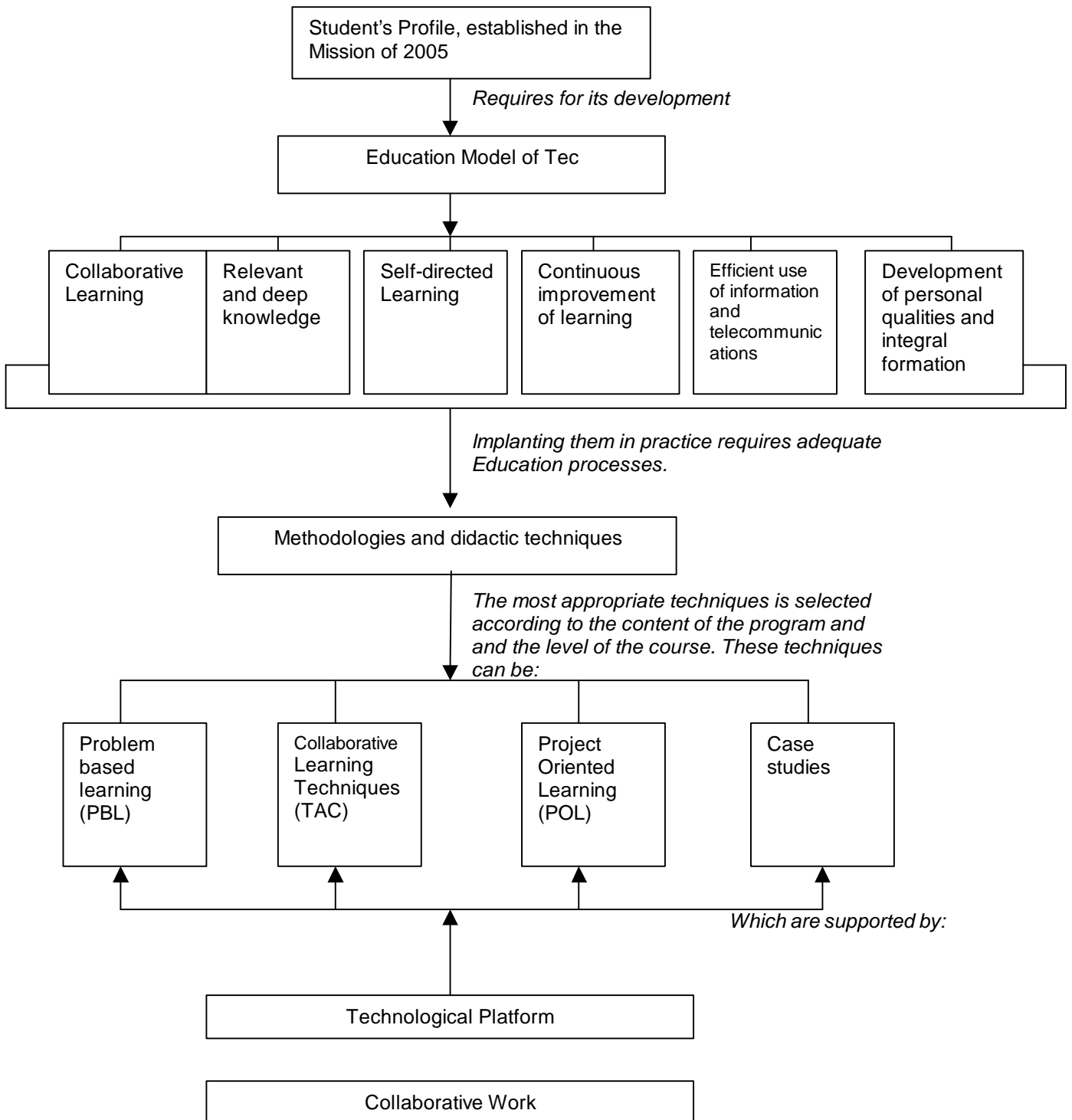
This education approach is not new in the history of pedagogy. Already in the first part of last century, John Dewey (1915), whose pedagogical thinking is greatly influencing today's education approaches, considered that adults as well

as children are active beings whose learning takes place when they face, through their own activity, situations that are problematic. For this pedagogue, school should not be a place to prepare for future life but of life in itself where students have the opportunity to have new experiences in situations that imply *a simplified presentation of social complexity*. These new experiences that are carried out when students face problematic situations, which Dewey refers to, are related to the experiences he/she will face in his/her social and professional life. The reality which will be under study is informed to students through the so called *scenarios*, which are described by the professor in the form of cases, problems, or projects. Starting with these, a series of varied and connected activities are presented in which students actively participate to carry out tasks through which they reach the programmed learning in the course.

The didactic value that is part of the techniques can be summarized in the following points:

- ?? They are valuable didactic resources to support the professor in the organization of the learning process.
- ?? Each technique is a teaching and learning methodology structured and organized in steps, directed to reach goals, and integrates a variety of didactic processes previously established by the professor.

Figure 6.1 Didactic techniques as supporting methodologies to the education model of Tec.



- ?? The steps describe the experiences in which students participate and which have been proved to be adequate to acquire the expected knowledge.
- ?? At the same time, these steps are formed by activities ordered in such a way, that each one is a requirement for the next one. This gives sense and meaning to all the process.
- ?? They are efficient strategies to introduce students in the depth knowledge of the contents of the subjects. Simultaneously, this helps develop abilities and generate attitudes and values included in the profile of graduate students.
- ?? The steps are flexible in relation to difficulty, scope and the expected education objectives. They also allow the professor to make the necessary adaptations to the specific situation in which they are applied.
- ?? They permanently keep the content of the program up-dated.

These advantages explain why didactic techniques have come to play a leading role in the implementation process of the education model.

### **Characteristics common to all the didactic techniques**

Although each didactic technique has a particular structure, the Institute, loyal to its principles and with the goal of achieving the graduate's profile, included in the mission, has defined that all the didactic techniques that are used in the Institute, should have the following characteristics:

- ?? Work like a global didactic process within which all the learning activities are developed and connected to activities that are part of the professional practice.
- ?? Allow students to work with the contents of the program, beginning with a problematic situation and continuing with the study of the knowledge required to offer a well based answer.
- ?? Give emphasis to the understanding of reality and the commitment with the environment working on solutions to situations that will contribute to its development or improvement.
- ?? Have a collaborative working system through which students share within a group, planning, process, and results, alternating this with individual activities.
- ?? Include students' active and responsible participation in the decision making process of how to carry out the task.
- ?? Allow the professor to take a role of learning-facilitator with which he/she will guide, support, give feedback, and evaluate students during all the process.
- ?? Motivate students to reflect about what they do, how they do it, and the results they achieve. This will help make students responsible for their own learning.
- ?? Include information and telecommunication systems technology as a support to teaching and learning.

- ?? Make students reflect about a problematic situation in real life from an ethical and social perspective in order to present practical solutions which will contribute to the improvement and development of the environment.

*The contribution of teachers is to prepare youth to face the future with confidence and to construct it in a well decided and responsible way; it is also to awaken curiosity in students, develop autonomy and create the necessary conditions in order for education to face the new challenges; contribute to the development of society and help each individual understand and dominate, to a certain extent, the phenomenon of globalization.*

*Unesco, 1996*

The use of didactic techniques has risks, which we have to consider, in its application. Some of these risks are the following:

- ?? They are used like an *activity of the course* in which the student previously acquired knowledge. This working structure is more related to the traditional education model.
- ?? The technique is carried out parallel to the content of the course. This situation makes it difficult to fulfill the contents of the course. Also, it doesn't adjust to the education model that the technique is expected to support.
- ?? Didactic techniques are used as the goal of the teaching process and as a means to achieve learning. That is, the technique is used in a mechanical way without subordinating its use to the learning that is expected to be acquired.

All the didactic techniques follow a learning cycle which can be summarized in four basic phases: presentation and analysis of a problematic situation; research of information and knowledge in order to offer a scientific solution; group discussion to improve the proposals, and finally, applying the solution (see Chapter 2, Figure 2.2.). In a structure with these characteristics, students find value and meaning to what they are learning and they are motivated to work. This structure also fosters autonomy through which students develop the capacity of learning to learn.

### **The education model of Tec, internationalization of the Institute and didactic techniques**

Since the last quarter of the past century, some foreign universities, leaders in education innovation, have worked with learning methodologies based in problems, cases, projects, and other collaborative techniques. These years have helped them acquire experience and produce knowledge about the conditions that are required to work with the techniques so that the knowledge demanded by today's society is given.

Considering the complexity of the education model of Tec, the professors requested to know about experiences validated in other universities. It was

considered that this was a good option to join the effort of training professors in didactic techniques with another strategy established in the mission and that is also very important: *fortify the international character of the Institute through academic experiences that its students have abroad, the international experience of its managers, have foreign professors, the promotion of academic, research, and extension programs, carried out in association with foreign universities in areas that are relevant to the needs of the country.*

A first step in this process was forming alliances with foreign universities which successfully use didactic techniques and with which Tec. would have interest in creating long term bonds to exchange experiences, develop programs, promote joint activities and fortify the innovative nature of the Institute. The selected universities fulfill the following criteria:

- ?? Share an education philosophy and principles similar to those of Tec.
- ?? Are academically strong universities in similar fields and disciplines as Tec.
- ?? Develop innovative ways for teaching, learning, and research and have a validated experience.
- ?? Have worldwide prestige and recognition.

One of these universities is Aalborg Universitet in Denmark, with which Tec has established very strong collaboration agreements. This university is leader in applying the methodology of *project oriented learning* and counts with wide national and international recognition because of the contributions it has made during more than twenty years in the fields of Engineering and Natural Sciences. This university has also been evaluated and compared with other universities from the country that follow the traditional method and the results show significant differences in the graduates' profile. The following are some of the outstanding differences that their graduates have (Kjersdam and Enemark, 1997):

- ?? They are very strong in problem solving, communication, cooperation, and technical knowledge.
- ?? They easily find a job and feel confident in the assigned positions.
- ?? They easily adapt to the requirements of the working world.
- ?? They have ability to work and handle groups.

Figure 6.2 presents the universities with which Tec has formed agreements to train professors in didactic techniques.

The relation with these universities considers three phases:

1. A first phase in which experts from the foreign university visit Tec and offer basic training in the technique to professors from all the System. This training is carried out through the Virtual University and is followed by a summer stay abroad so professors from Tec know *in situ* how the technique is applied in a real university context and at the same time receive advanced training and



use their laptop to design the course in which they will apply the technique. During this process, they receive feedback from expert professors.

Figure 6.2 Universities in which professors from Tec are trained in didactic techniques.



#### **Collaborative learning**

1. The University of British Columbia, Canada
2. The University of Minnesota, U.S.A.
3. The University of Texas at Austin, U.S.A.

#### **Project oriented learning**

4. Aalborg Universited, Denmark
5. Universitet Twente, Holland

#### **Case studies**

6. Harvard University, U.S.A.
7. The University of North Carolina at Chapel Hill, U.S.A.
8. The University of Western Ontario, Canada

#### **Problem based learning**

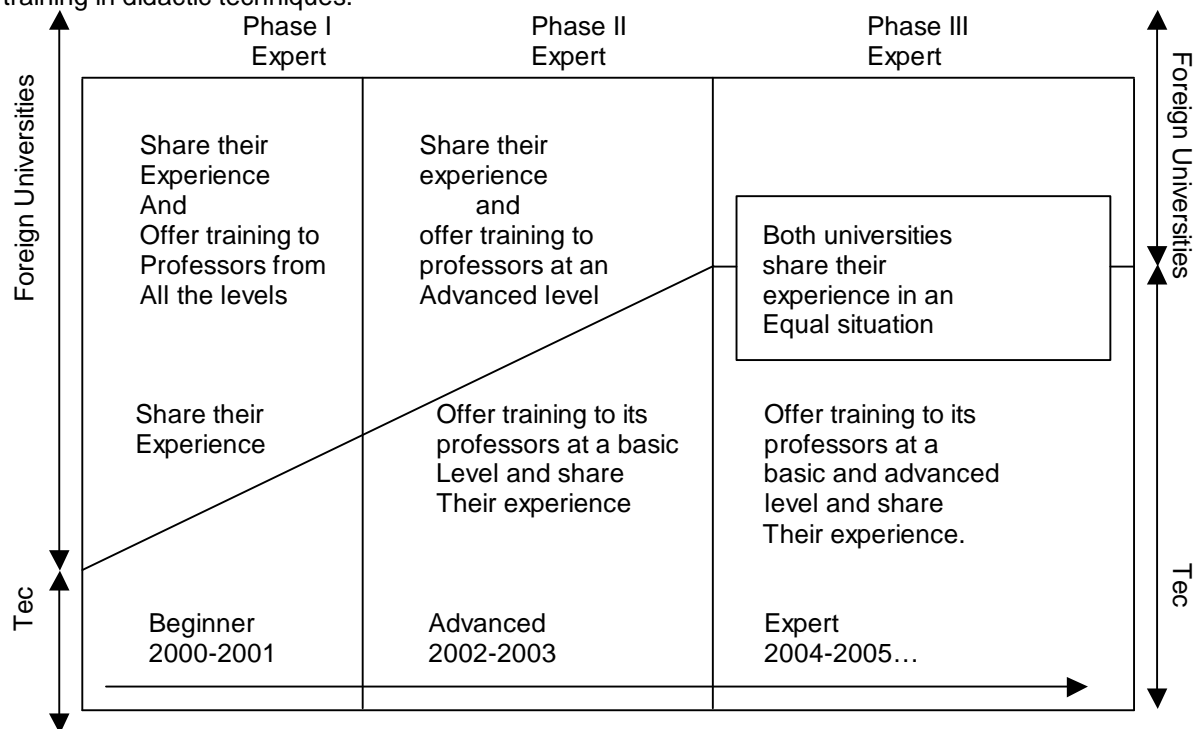
9. Universitet Maastricht, Holland
10. Wheeling Jesuit University, U.S.A.

2. A second phase in which new groups of professors are initiated in the technique receiving basic training by colleagues who have already participated in the previous phase. After this, they continue with the advanced training in the foreign university, where they also exchange experiences with expert professors.
3. In the third phase, both Tec and the expert university, under an equal situation, sign agreements to have exchange programs for professors and students, promote research of common interest, carry out joint publications,

share databases, form societies in common projects, and work together to develop education innovation. (See Figure 6.3)

The professors who have participated in the summer workshops in foreign universities state that this has been a very rich experience not only to thoroughly know the technique but also in other aspects, as shown in Table 6.1.

Figure 6.3 Relation between Tec of Monterrey and foreign universities in different phases of training in didactic techniques.



Didactic techniques at Tec have gone through a process of adaptation and adjustment according to the education needs of the institution; this gives them certain elements which are different from those of the universities in which professors are being trained. (See Table 6.2.)

### Description of didactic techniques

Within the framework that defines all the techniques as having certain common elements, each one presents its own characteristics. In the following sections, we will define these characteristics, its organization for learning and the results of its application, according to the experiences presented by the professors in the exchange sessions that are periodically carried out in the Institute through the Virtual University.

## Didactic techniques for collaborative learning

Collaborative learning, as seen in previous chapters, is not a didactic technique, but a working philosophy that constitutes the platform of the education model and of all the didactic techniques and methodologies that are being used.

Table 6.1 Testimony of a Professor

Benefits of my experience abroad
<p>Having the opportunity to be in a foreign university has allowed me not only to receive training to know and use a variety of methods and didactic resources, so I can promote in my students the acquisition of knowledge, values, attitudes, and abilities, but also to receive other benefits which are also very important like:</p> <ul style="list-style-type: none"> <li>?? Know a group of professors from Tec and establish relations for distance team-work.</li> <li>?? Have the opportunity to interact with foreign professors to know about their experiences.</li> <li>?? Value and reaffirm my commitment in the process of implementing the education model.</li> <li>?? Appreciate and know other cultures and have the opportunity to experience diversity.</li> <li>?? Understand the need of internationalization for my students and its importance in learning.</li> <li>?? Improve my English.</li> </ul> <p style="text-align: right;">Patricia Díaz Director of the Division of High School Aguascalientes Campus</p>

Table 6.2. Didactic techniques in Tec in contrast to foreign universities

Foreign universities	Tec of Monterrey
<ul style="list-style-type: none"> <li>?? Are specialized in one technique</li> <li>?? Emphasize knowledge, abilities and processes.</li> </ul>	<ul style="list-style-type: none"> <li>?? Uses a variety of techniques according to the disciplines.</li> <li>?? Emphasizes knowledge, abilities, processes, attitudes, and values.</li> </ul>
<ul style="list-style-type: none"> <li>?? Use technology in an additional way</li> </ul>	<ul style="list-style-type: none"> <li>?? Incorporates technology in an essential way, offering support, both in the application of the technique as well as in its documentation.</li> </ul>
<ul style="list-style-type: none"> <li>?? Do not use, the majority, a design model.</li> </ul>	<ul style="list-style-type: none"> <li>?? Documents the course in a technological platform, following a design model.</li> </ul>
<ul style="list-style-type: none"> <li>?? Have more risk that the technique will be a goal in itself.</li> </ul>	<ul style="list-style-type: none"> <li>?? Allows a more reflexive and adapted application according to the situation of each campus and to the experience of the professor.</li> </ul>

Because of the importance that this way of learning has gained in the present times, a variety of techniques have been developed that even though they are guided towards a task, they emphasize the development of abilities and attitudes for effective group work. This is different from other techniques, like problem based learning, case studies, and project oriented learning, which nevertheless using collaboration as a form of work, they focus towards a task for the achievement of a goal.

The professors who use these last techniques consider that students need to know how to work in team in order to perform efficiently. For this reason, it is proposed that the techniques of collaborative learning be applied in an intensive way in the first semesters of senior high school and first semester of their professional studies.

### **Characteristics of collaborative learning**

In an efficient collaborative group there is shared authority and the acceptance, from all the members, of the responsibility of the actions and decisions of the group. The basic premise of collaborative learning is based in the consensus constructed under equal situations.

All the collaborative learning techniques, according to the theory of the brothers Roger and David Johnson, incorporate five basic elements in order for the process to be carried out successfully. These elements are:

- ?? *Positive interdependence.*
- ?? *Individual responsibility.*
- ?? *Social abilities.*
- ?? *Interaction among group members.*
- ?? *Group processing, that is, the reflection the group makes about the process.*

To assure that these elements are always present, the professor, in an explicit way, plans activities with the objective of being achieved; for example, for positive interdependence the professor assigns different roles to each member of the group and with this he/she is able to:

- ?? Reduce the possibility that some students adopt a passive or dominant role when interacting with the group.
- ?? Allow that all members learn the abilities and activities that incorporate the elements.
- ?? Be aware of the importance of individual responsibility in the process.

### **Examples of techniques for collaborative learning**

The techniques for collaborative learning are varied and they differentiate from each other in the degree of complexity and scope of the task. The following are some of the most common:

1. *Three-phase interview:* It used so the members of the group know each other and break the ice.
2. *Focused list:* It is used as a brainstorm technique or as a technique to produce descriptions of concepts.
3. *Pair note-taking:* Students get together in pairs and review and learn the same article, chapter or content area. Students exchange the notes they took about the text and their reflections about it. They discuss the most important points and look for similar and opposed ideas.

4. *Controversy for effective decision-making.* Students get together in pairs and pair groups, and analyze a situation in which a decision has to be made. The members of the group take different roles that are rotated so everyone can live the experience in different situations and analyze it from different perspectives. At the end of the process, a decision is made with the best proposals from each group.

### **Student and Professor's Role in Collaborative Learning**

In collaborative learning, the professor takes the role of facilitator and the student has a more participating and active role in the process. The following are the activities carried out by each one.

#### **Professor's activities**

- ?? Helps in the formation and functioning of the group.
- ?? Clarifies concepts and shares his/her experience.
- ?? Promotes interaction and the development of social abilities among the participants.
- ?? Stimulates development of individual responsibility.
- ?? Encourages and motivates students' thinking.
- ?? Promotes student and group reflection in relation to their performance in the learning activities.
- ?? Evaluates the process and the results.

#### **Student's activities**

- ?? Collaborates in the development of the group's activities.
- ?? Promotes and respects the participation and collaboration of all the members of the group.
- ?? Maintains a willing attitude towards collaboration.
- ?? Accepts feedback from partners.
- ?? Contributes to the achievement of the group's goal.
- ?? Prepares to offer a valuable contribution to the group.
- ?? Improves the group's learning process through reflection.
- ?? Studies and investigates individually to make contributions to the group.

### **Organization of a collaborative learning process**

The essence of collaborative work is group work which can be of different types according to the function it carries out: the base group, the formal group, the informal group, and the plenary group.

#### **The base group**

This group is used to fortify long-term relationships of the participants and to promote a support structure for each member. Its duration is of about one semester and in this group students develop social abilities. Each participant contributes with his/her support to the rest of the members of the group; at the

same time, he/she requests and accepts help from others. All of this is done in an environment of solidarity and respect.

**The formal group**

The difference between this group and the base group is that here work is organized according to a specific task. The duration of this task can be from a complete class session to several sessions, weeks, or all the semester. In the formal group students develop abilities related to time administration, project administration, co-responsibility and peer evaluation, as well as research, negotiation, solution of conflicts, respecting different ideas and opinions, tolerance, and critical thinking, among others.

**The informal group**

This group is used for students to get prepared to work in the last mentioned groups. Here students carry out very specific activities like how to clarify concepts in pair groups, introduce a topic, and understand homework. It can last a few minutes and up to a class session.

**Plenary group**

This group is formed by all the participants of the course and includes the professor. It generally takes place at the beginning of a task in order to introduce it, give instructions, verify that all the students understand it, and at the end of the task to make conclusions, clarify, and reflect as a group.

Figure 6.4 presents an example of the typical organization of a class session based on collaborative learning.

**Learning that is promoted in collaborative learning**

In a course based in collaborative learning, students develop different types of abilities, like those listed in Table 6.3.

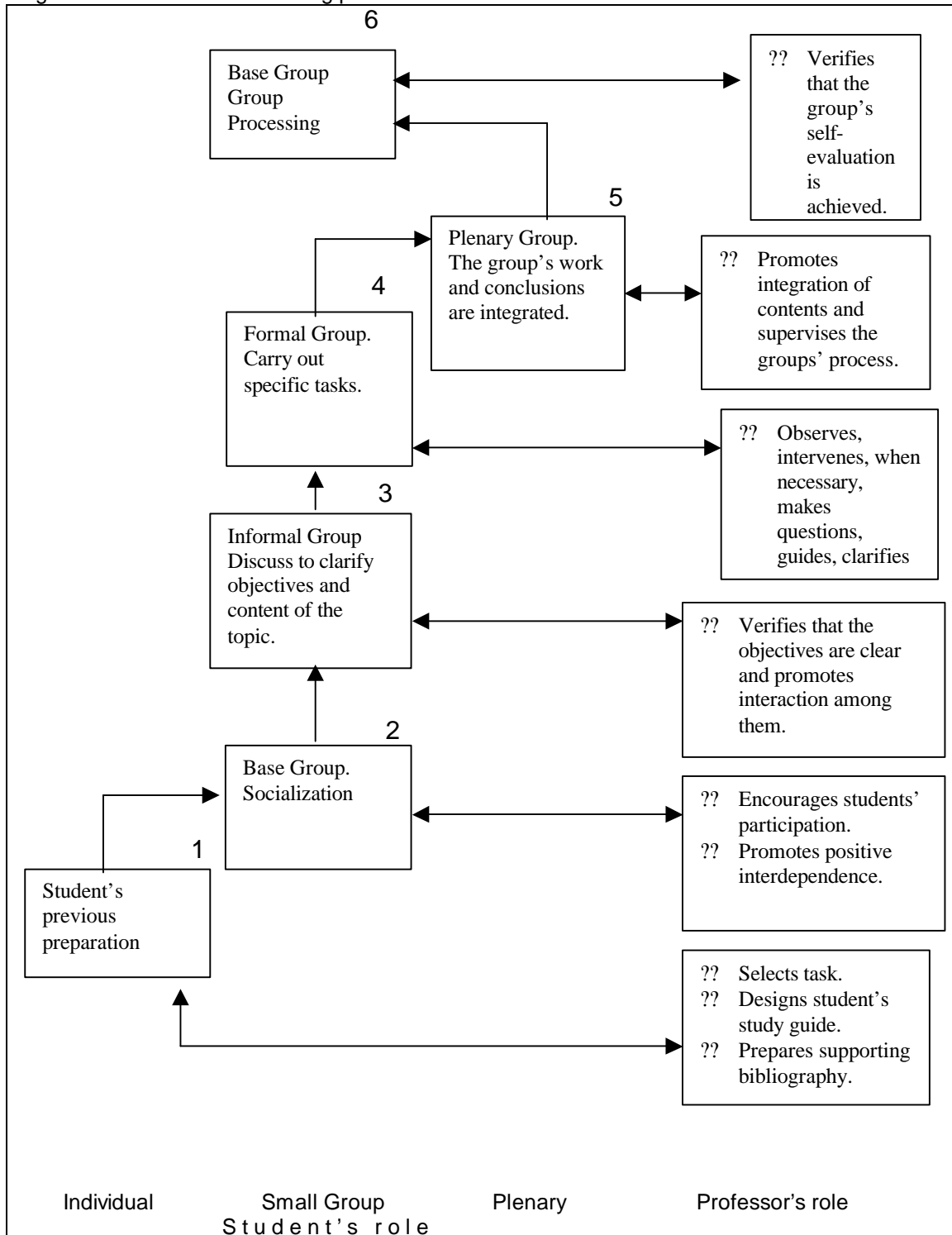
**Student evaluation**

To evaluate collaborative learning the following aspects are considered: individual learning, success in the performance of the team of students, and

Table 6.3 Abilities and attitudes that are developed and promoted in collaborative learning.

<p>Abilities and social attitudes:</p> <ul style="list-style-type: none"> <li>?? Accept and request help.</li> <li>?? Mutual respect.</li> <li>?? Tolerance.</li> <li>?? Active listening.</li> <li>?? Co-responsibility.</li> <li>?? Peer evaluation and self-evaluation.</li> <li>?? Negotiation.</li> </ul>	<p>General abilities:</p> <ul style="list-style-type: none"> <li>?? Time administration.</li> <li>?? Project and task administration.</li> <li>?? Analysis, synthesis, and evaluation.</li> <li>?? Decision-making.</li> <li>?? Oral and written communication.</li> <li>?? Acquisition, construction, and transference of knowledge.</li> <li>?? Making conclusions based on discussion.</li> </ul>
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Figure 6.4 Collaborative learning process



the product generated with the collaborative activity. In these activities the support to partners is responsibility of each student; this is why, performance and individual responsibility are two essential components of the evaluation. Another

aspect to be evaluated is the content of the course, participation in class, and the personal preparation that each student carries out.

For the evaluation of collaborative learning activities, different situations and instruments can be used, like:

- ?? Class presentations.
- ?? Presentations among groups.
- ?? Team exams.
- ?? Applying concepts to specific situations (problems or cases).
- ?? Observing students' behavior during the team's activities.
- ?? Peer evaluation of performance. This is carried out by members of the group.
- ?? Individual exams.
- ?? Individual and team tasks.

A fundamental activity which is used for the evaluation of the attitudes of collaboration is *group processing*. This consists in reflecting, under the professor's guidance, about the performance of the members of the group in order to identify what actions contribute to achieving the goals and which ones make it difficult, and after this, make the decisions to improve.

In *group processing* the professor's role is to:

- ?? Offer each student and each group feedback about efficiency in performing the tasks and team work.
- ?? Verify that the groups reflect about the feedback they receive.
- ?? Help groups to set objectives to improve their performance.
- ?? Encourage students to celebrate their good performance.

Table 6.4. shows an example of a course based on collaborative learning.

### **Critical aspects**

The following situations are frequently faced by the professor when working collaboratively, especially at the beginning:

Table 6.4 Example of a course based on collaborative learning

*Course:* English IV from Senior High School

*Level:* Fourth Semester

*Professor:* Evangelina Romero, State of Mexico Campus

*Technological Platform:* Blackboard

The course of English IV is taught in fourth semester of senior high school. In this course it is expected that students develop abilities to express their ideas orally. This course is part of the group of language courses that are offered in senior high school. The course is totally organized using the principles of collaborative learning.

The information of this course is in the technological platform of Blackboard. A characteristic of the course is the use of technology through activities denominated *webquest* in which students solve a problematic situation in a collaborative way (stated in a Web page). In this type



of activities, students carry out research about the topic, analyze, and discuss contents of the course, developing abilities that are expected according to their English level.

From the beginning of the course, base groups are formed and in each session they perform different activities that fortify positive interdependence between members. The purpose of this activity is to reach a maximum level in their learning and their partners' learning.

In order to work with the contents of the course topics that are common to students, like *extreme* sports, are selected. This promotes interest among students for reading and encourages their participation in the learning activities.

Within the collaborative process of the course, different groups are formed with different objectives:

- ?? *Base Groups*: these are formed in an heterogeneous way; the main purpose of this activity is to give mutual help and stimulate interpersonal relationships to generate a greater compromise. These groups are formed from the beginning of the course and in each session the group has a brief participation to motivate confidence in the integration of the members.
- ?? *Informal Groups*: these can last from a few minutes to a class session; they are used in simple activities to focus attention in a specific content, analyze expectations or to assure that students process the information. These groups are commonly used in the classroom.
- ?? *Formal Groups*: these groups can last one or more class sessions and can be used for complex learning activities. Students participate in an intellectual activity, to organize and explain material, or to summarize and integrate contents. These groups can work both in as well as outside the classroom.

Finally, rubrics are used to evaluate the course, for individual evaluation as well as for co-evaluation between students. Observation guides are also used during students' participation in the different activities. These rubrics include the students' degree of performance, in relation to learning the contents and to the development of collaborative abilities.

In contrast with a traditional course in which students do not participate because they are afraid of being laughed at, which keeps them from advancing in their learning, applying collaborative learning I find that students:

- ?? Improve their English level through constant practice.
- ?? Express they enjoy the class and that the activities let them develop a positive attitude, respect, and support among partners; improve their behavior; and establish goals that go farther than the professor's expectations.

The results of applying the technique show the time is enough to cover the contents and that students improve their grades.

- ?? An individualist, competitive, and resistance attitude of some students due to lack of confidence in their partners and in the working methodology.
- ?? Students do not accept their responsibility and contribution to improve the performance of the group.
- ?? Students' lack of interest in using technological tools for distance collaboration.
- ?? Professors' lack of time to offer timely feedback, adjusted to students' needs, and permanent during the course.

### **Suggestions offered by professors**

- ?? Use rubrics for evaluating collaborative work. This facilitates registration and guides observation.
- ?? Sensitize students, professors, and deans about the philosophy of collaborative learning, informing about its importance and advantages.
- ?? Answer and give timely feedback to students about their performance. This motivates learning.
- ?? Have appropriate furniture and spaces in the classroom, like, moveable chairs and tables and class sessions of more than one hour to facilitate interaction between group members.
- ?? Have an adequate balance between learning the contents and applying the technique.
- ?? Include, as a course requirement, collaborative activities in virtual spaces, and promote interaction with the professor through e-mail.

### **Case studies**

A case is the registration of a complex and real situation that serves as means of discussion. In this discussion problematic situations are faced, divided analytically, and reconstructed. The purpose of this is to let students express different attitudes and opinions in the classroom.

This learning methodology was first used in Harvard in 1914 for teaching law in the business field. This *case system* expected students to look for a solution to a specific story and defend it. With time, Harvard University prepared researchers and professors exclusively for preparing cases, not only to be applied in this university, but also to be edited and used in all the world. With these experiences, the method has been widely developed in the formation of professionals in the field of law, business administration, medicine, and political sciences, among others.

### **Characteristics of case studies**

- ?? Does not give solutions. It gives specific information for group members to reflect, analyze, discuss, and propose different alternatives for solutions.
- ?? It is interactive, dynamic, and is basically concentrated on student participation.
- ?? Students have to dedicate time to study the case individually so the discussion can have a depth dynamic.
- ?? The professor is the facilitator of the process. He/She structures and guides discussion in the moments in which it can deviate from the learning objectives that he/she previously established. The case (written document) is an occasion for discussion that is carried out in the classroom.
- ?? Students must prepare clear and well based assumptions in relation to the information that is not available in the case.

### **Student and professor's role in case studies**

To fulfill these characteristics the professor and students have to perform the following activities:

**The professor**

- ?? Formulates, during discussion, questions that support a close analysis and decision-making.
- ?? Maintains a sincere, friendly, informal and democratic relationship with students.
- ?? Lets students speak when they request to do so. Makes everybody participate, but without anybody having complete control of the conversation.
- ?? Takes the groups from one phase to another, progressively summarizes what the group discovers and avoids expressing personal ideas.
- ?? Uses the blackboard to summarize, structure, and clarify. He/She also controls time according to the teaching plan.

**The student**

- ?? Follows a specific method to look for causes, consequences, and solutions for a concrete case.
- ?? Closely analyzes all the details of a given case.
- ?? Learns to not jump to conclusions, avoiding prejudices and intuition.
- ?? Learns to make decisions preventing consequences.
- ?? Trains systematically, with a mature and objective focus on solving problems that can later be present in real life.
- ?? Learns to consider several correct solutions for the same problem.

**Organization of a process with case studies**

There are several ways to solve the cases, even though, basically, all of them are based in group discussion, which is the essence of the method. Figure 6.5 presents the basic scheme of a learning process with case studies.

The professor has to consider the following in order to do a good job using case studies:

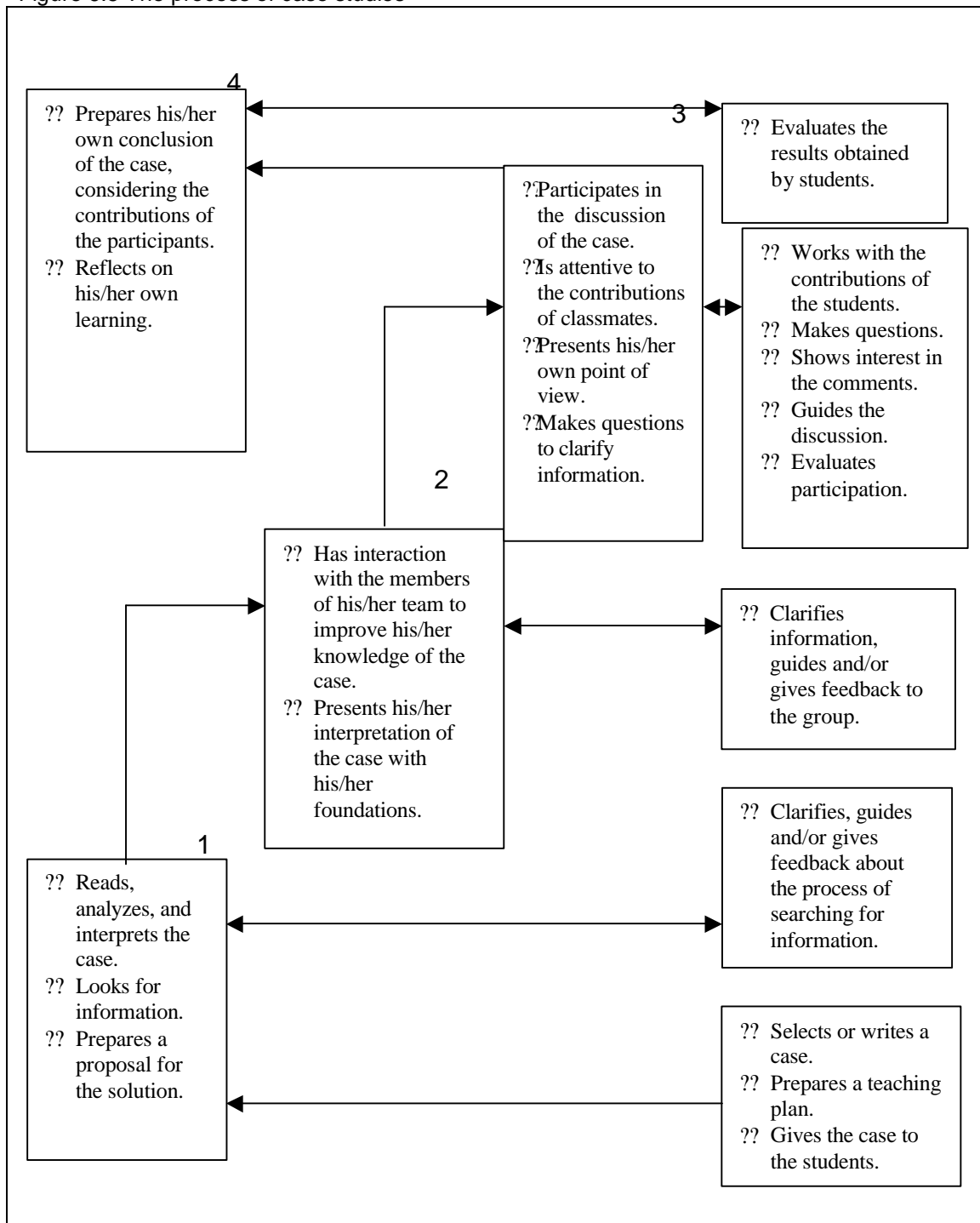
1. Prepare a time-table which will enable him/her to adequately distribute the different topics to be covered during the week. This way, he/she will fulfill the different phases and the teaching objectives of the case during the discussion.
2. Specify, when preparing the teaching plan, the type of techniques that will accompany the discussion during certain moments of the process, like, role-playing or simulation to make a decision.
3. Be attentive to the contributions of each student to register and evaluate their participation at the end of the session.

**Learning that is promoted with case studies**

- ?? Self-directed learning, through individual preparation of the case.

- ?? Critical thinking, through the process of analysis and formulation of the solution of the case, as well as comparing their own thinking processes to the rest of the members of the group.
- ?? Ability to analyze, when laying the foundations of their proposals for the solution of the case.

Figure 6.5 The process of case studies



Individual	Small Group	Plenary	Professor's role
Student's role			

- ?? Ability to solve problems according to the situations presented in the case.
- ?? Ability to make decisions in business situations.
- ?? Collaborative attitudes and abilities through participation in small discussion groups and in a plenary session.
- ?? Vision of the national and international environment in the area when working in cases of different contexts.
- ?? Engagement in the development of the country and its communities.
- ?? Clear awareness of the needs of the country and its regions, if the professor uses appropriate cases.

### Students' evaluation

The evaluation of students who study a case is based in two fundamental aspects:

1. *Student's participation in class discussion.*

This evaluation is done through observation. Some of the criteria that are used are:

- ?? Listens carefully.
- ?? Interacts with other members of the class.
- ?? Makes contributions and relevant interventions.
- ?? Tries out new ideas, instead of only giving secure comments.

After the participation in class, it is convenient for the professor to offer feedback to each student considering the registered information as a reference.

2. *The grades of the student in written evaluations.*

Two exams, generally a half-term and final exam, are applied to evaluate knowledge and abilities. These exams are prepared using cases.

Table 6.5 shows an example of a course based in case studies.

### Critical aspects

Some problems that students have in working with cases are:

- ?? They expect that at the end of the discussions the professor will give the solution to the case.
- ?? They do not have the knowledge and maturity necessary to have a debate about their ideas. This is more common in the first semesters.
- ?? They frequently do not prepare well. Because of this, it is difficult to have a session based on discussion.

Table 6.5 Example of a course based in case studies.

*Course:* International Business Environment

*Level:* Professional, fourth semester of the major in International Trade, fifth semester of B.A. in Financial Administration.

*Professor:* Jose Luis Marin, Mexico City Campus

*Technological Platform:* Blackboard

This course is part of the basic subjects of the majors in International Trade (fourth semester) and Financial Administration (fifth semester). The group is formed by thirty-two students.

The contents of the course are related to aspects about the way in which companies interact with different government institutions of the country, as well as aspects related to the structure of the world trade system and the impact of business regulations (NAFTA, European Community, and APEC) on enterprises and countries.

The Blackboard platform is used for the information about the course, the follow-up of activities, and the interaction among all the participants. This platform includes all the essential planning elements that allow students to know the learning process that they will be using during the course.

Case Studies is used as the basis strategy for teaching and learning. Through this strategy, students know and analyze real and challenging situations of multinational enterprises. This helps them develop problem-solving abilities, decision-making, and critical thinking.

Students individually read the case and look for information necessary to formulate a solution proposal. Students then present this proposal in a written report and put it in the space that has been assigned in Blackboard to his/her team. The teams are formed by five members who compare these proposals to fortify their individual foundations and at the same time fortify their partners', without necessarily arriving to only one solution since the case always allows more than one solution. After this, there is a plenary session in which the professor guides the discussion to reach the learning objectives that have been established. At the end of the session, a space is given so each student can determine the final proposal of the solution for the case and reflects about the learning achieved in the process. The product of this last phase is a written report prepared by each student. This report is sent to the professor through the space assigned in the Blackboard platform.

During plenary discussion sessions, the professor evaluates students' participation. This is done not only considering the number of participations but also the quality. The criteria of these evaluations are given to students from the beginning of the semester as part of the working policies. Students also have an opportunity to participate in their evaluation.

This course works with five topics as cases. Approximately a week is dedicated to each topic and students dedicate three hours for preparing and discussing about the topic. Sometimes students have to read additional chapters from other books, besides the textbook, related to the topic.

The following are evaluated during the discussion: the knowledge that the students have of the topic, the quality level of the solution proposed to the group, the foundations of the expressed arguments, and in general, the degree of participation in the group's process.

**Suggestions offered by the professors:**

The professors consider that in order to successfully work with this technique, it is very important to pay attention to the following suggestions:

- ?? Offer an introduction to students previously to working with this technique to make them aware of their responsibility in this process and show them the advantages it has in their formation.
- ?? Insist that the professors, from the departments in which the technique is applied, prepare a gradual implementation plan through out the major.

- ?? Consider the amount of work and time required when deciding the number of cases that will be used in the course in order not to exceed students' academic load.
- ?? Make sure that the selected cases are relevant and related to the student's environment to get them interested.
- ?? Offer individual and group feedback to students when they have deficiencies in their participation.
- ?? Request a colleague to observe and give feedback about the professor's performance during the discussion. This will help improve his role as a conductor and guide of discussions.
- ?? Facilitate the professor's registration to forums and associations where cases can be exchanged and sold.
- ?? Generate a database in each campus with cases that can have been used and will be used in each course. This will avoid repetition.
- ?? Count with adequate areas for discussing cases, like, offices close to students, technological resources, and blackboards.
- ?? Program classes of 90 minutes, twice a week or a three-hour session in order not to interrupt discussion.
- ?? Use difficult cases only with students of advanced semesters, like for example, starting with sixth semester of the majors.
- ?? Apply this technique in senior high school and in the first year of the major, using brief cases (mini-cases) and gradually advance to more difficult or complex cases.

Table 6.6 presents the comment of a teacher in relation to her concept and experience with case studies.

### **Project oriented learning**

This technique guides students to construct their own learning from planning and developing activities. This gives as result a tangible product applied to a real and problematic situation.

The project consists of work that is carried out during a specific time to create a unique service or product by a series of tasks and the effective use of resources. During its development, students have to make decisions, decide the content, organize the work, decide which would be the best technological and scientific tools to carry it out and, finally, the group presents and defends the result. A project based learning requires continuous supervision by the professor and a space for students to work in group.

Since the beginning of the eighties, the Aalborg Universitet, in Denmark, adopted and developed this technique in all its academic programs. With this, it is the leader in this methodology, model in the application of the technique, and headquarters where professors from different parts of the world have been trained.

Table 6.6 Testimony of a professor

The case is a didactic technique especially prepared to motivate class discussion. It is based making questions more than giving answers. It's a dynamic and active method, not dogmatic, centered in who learns and not in who teaches. Its purpose is for students to develop their own criteria and to contribute to students' formation instead of only giving them information.

A case is a description of a real situation that is discussed in class under the guidance of a professor. In case studies, both the content of the course as well as the process through which this content is transmitted are important. This process develops and forms in students the capacity to face new situations with their own criteria because the professor's responsibility goes beyond the mere transmission of knowledge. The objective is that students really learn to think on their own.

The professors' expositions facilitate the transmission of knowledge and theories, but tend to be less formative and more dogmatic. In a case, the most important is the development of each student's own judgment based in a content full of concepts, theories, and quantitative aspects.

The best professor, in mi opinion, is the one that is unnoticed: the class has a natural rhythm, as if the professor were not needed, because the emphasis of the discussion is on the student. Nevertheless, being unnoticed is not easy for a professor. It requires to refocus his/her activities, basically to:

1. Design his/her own course, preparing the pedagogical objectives of each session in terms of students' learning.
2. Investigate, develop, and write appropriate and challenging situations that will motivate the students and that are relevant for the objectives and contents of the course in which they are applied.
3. Facilitate the session in a structural way through a teaching plan, with timing and aspects to be considered, questions, and transitions between topics. The key is to make good questions and develop in students a inquisitive mind. The conduction of a session is like art because besides having a well structured and prepared session, the professor must be flexible to create a good atmosphere and a learning contract with the group.
4. Finally, the professor must give time for students to reflect about the achieved learning and to evaluate them.

The main goal is to prepare executives and enable them to make decisions under uncertain conditions. These abilities are not acquired just by listening to the professor through a conference or by reviewing a text. These are reached through experiences like, assuming a participative leadership in the plenary session. Here the student discusses, listens to, and understands his/her partners with an attitude of giving and receiving ideas through an efficient and well based communication. This process allows students to develop the necessary abilities and attitudes and also consolidate their knowledge.

Students need time to accept how to work with case studies because they still have as a reference the traditional teaching method. Every time a course starts, students make the following comments:

- ?? There are some classmates that make us lose time with their inappropriate, repetitive, and mistaken interventions.
- ?? You are the professor that knows about the subject. We have registered in the course and we have to receive that knowledge from you.
- ?? We cannot be responsible for learning, because we could be wrong in the way we understand and make conclusions about a problem and make wrong decisions or leave critical points without being covered.

Nevertheless, and based on experience, I consider that it is worthwhile to face this resistance and introduce case studies because it is more effective than the traditional method to form leader executives in the area of administration.

Dr. Martha Corrales  
Professor of EGADE  
Monterrey Campus



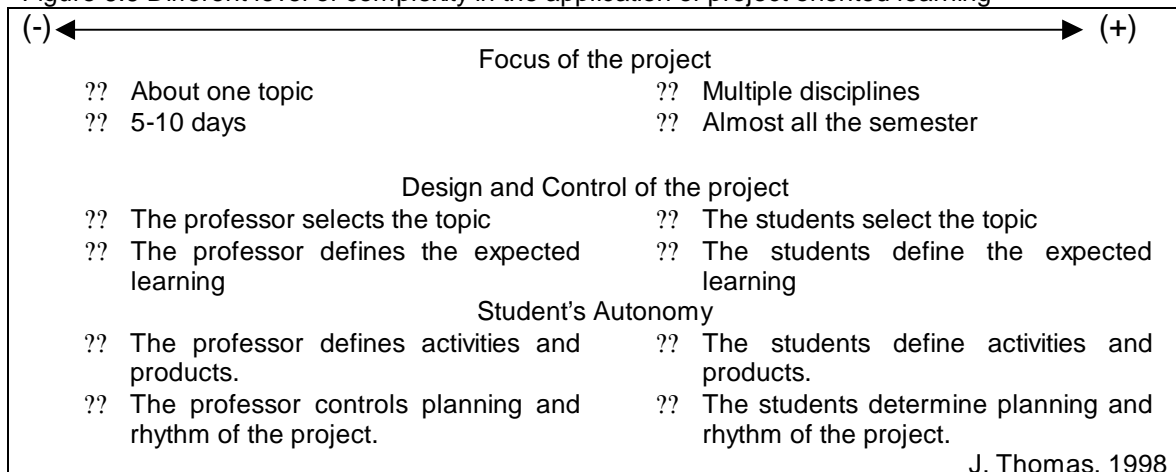
### Characteristics of project oriented learning

Project oriented learning has a high degree of difficulty for students because of the complexity of the process. The following are the elements that are characteristic of this methodology.

- ?? It is expected that students learn to solve problems using relevant knowledge.
- ?? It is centered in exploring and working with a practical problem with an unknown solution.
- ?? The problems must include at least one course and can include several contents integrated from different disciplines and even interaction among several of them.
- ?? The project is designed in such a way that the student applies knowledge from different subjects from the same semester in which the project is carried out or from previous semesters. This helps students understand the relationship among these disciplines.
- ?? There should be freedom for students to generate new knowledge when looking for innovative solutions.

Because of its complexity, the focus of the project, design, professor's control, and degree of autonomy of the student vary according to students' level, as indicated in Figure 6.6.

Figure 6.6 Different level of complexity in the application of project oriented learning



### Student's and professor's role in project oriented learning

In project oriented learning, the student and the professor have more complex responsibilities than in the other techniques, as stated below:

#### Activities of the professor

- ?? Tutor and supervisor

- ?? Administrator of the projects
- ?? Designer and expert
- ?? Evaluator
- ?? Advisor and teacher

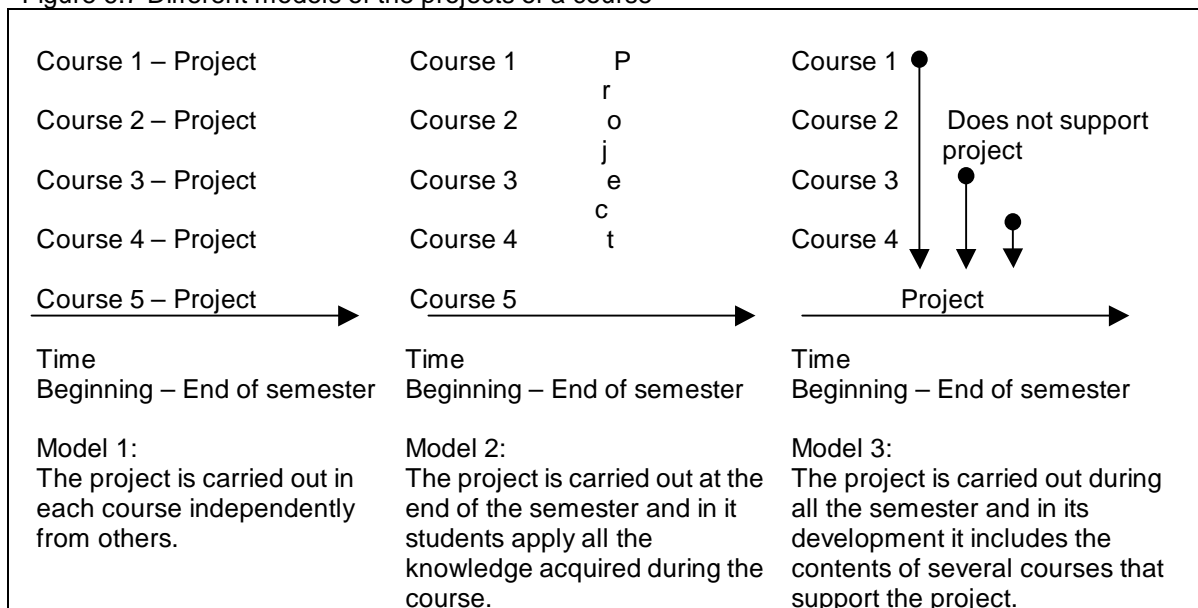
**Activities of the student**

- ?? Organizer of the process
- ?? Administrator of his/her own time, resources, and learning
- ?? Researcher of knowledge to obtain better results
- ?? Communicator, expert in interpersonal relationships and group management.

**Project models**

When applying this methodology, it is necessary for the professor to define from the beginning which model is going to be used. Figure 6.7 presents the models of projects used by the Universiteit Twente.

Figure 6.7 Different models of the projects of a course



The duration of the project is generally of one semester. At the beginning the project is presented to students and they are the ones who decide the form of working during the time the project lasts.

Once the model to be used is defined, the most adequate project for the course will be selected in such a way that it considers the contents as much as possible. In the application of the project it is established that the students work in groups formed by six or eight members.

**Organization of the process of project oriented learning**

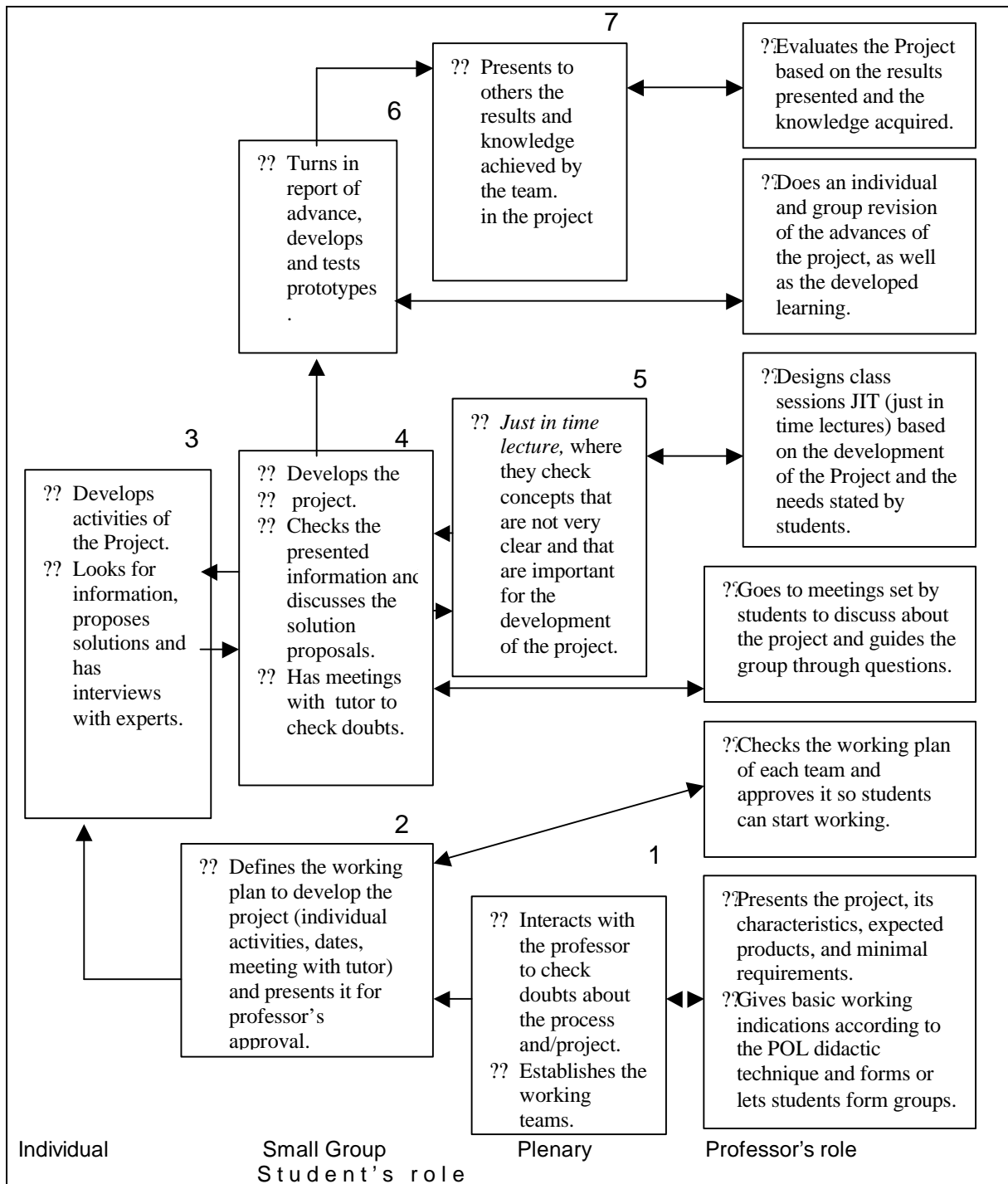
In general, it can be established that the project is a process that has several phases (see Figure 6.8), in each one of which the student has different responsibilities.

Figure 6.9 presents the basic scheme of a project oriented learning process.

Figure 6.8 Phases of a project and responsibilities of the student

Analysis of the Project	Solution of the Project	Design and elaboration of a prototype	Presentation of results
<ul style="list-style-type: none"> <li>?? Presentation of the problem within a context.</li> <li>?? Discussion about the problem.</li> <li>?? Evaluation of its relevance and discussion about possible solutions.</li> <li>?? Looking for relevant readings.</li> <li>?? Interviews with experts in the field.</li> </ul>	<ul style="list-style-type: none"> <li>?? Evaluation of the possible ways to solve the problem.</li> <li>?? Determining the level of depth with which the contents will be studied.</li> <li>?? Division of the project.</li> <li>?? Carrying out tests of the prototype.</li> </ul>	<ul style="list-style-type: none"> <li>?? Preparing a report to document the project, as well as conclusions and acquired knowledge</li> <li>?? Development of prototype tests.</li> </ul>	<ul style="list-style-type: none"> <li>?? Oral presentation of acquired knowledge, in a plenary session with the evaluating committee.</li> <li>?? Demonstration of knowledge and communication abilities, interpersonal relations and group management.</li> </ul>

Figure 6.9 Process of project oriented learning



**Knowledge that is developed**

Project learning makes it possible to have a variety of knowledge. In order to fulfill the student's profile, the following aspects are emphasized in Tec:

- ?? Work in interdisciplinary groups.
- ?? Solve complex problems.
- ?? Be able to offer clear, specific, and scientifically based explanations.
- ?? Apply technical knowledge of the field to real situations.
- ?? Organize, plan, and administrate time and resources.
- ?? Formulate objectives, goals, and purposes to start and finish a project within the limits, resources, and determined structures.
- ?? Develop critical thinking when assessing the value of the information in decision-making.
- ?? Develop responsibility and ability to innovate.
- ?? Have a clear awareness of the needs of the country and its regions.
- ?? Be committed to be agents of change and have respect for nature.
- ?? Be committed to work and be willing to help.

**Student's evaluation**

The evaluation is done at the end of the semester and is centered in the work carried out in the project which is the key aspect of the course. Each student should be able to explain the results of what his/her studies both to project team partners as well as to the professor. Knowledge is established if one is able to explain it (Kjersdam, 1997).

The evaluation includes the following elements:

- ?? Presentation of the project by the team to the group and the teacher advisers.
- ?? Written report of the project presented by each team.
- ?? Demonstrate command of the subject.
- ?? Demonstrate talent in the development of the prototype and its operation.

Table 6.7 presents an example of a course with project oriented learning.

Table 6.7 Example of a course with project oriented learning.

<p><i>Course:</i> Computer Sciences for Architecture III  <i>Level:</i> Professional, fifth semester of the major of in Electronic Systems  <i>Professor:</i> Omar Humberto Longoria Gándara, Guadalajara Campus  <i>Platform:</i> LearningSpace</p> <p>The course of Computer Sciences for Architecture III is offered in the major in electronic systems, in fifth semester and has the characteristic of integrating subjects taken in previous semesters, as well as being the basis for subjects in following semesters.</p> <p>This course is specified as 3/4/5, which means that the student dedicates three hours in the classroom, four in the laboratory, and five in activities out of the classroom. During the class the professor has the role of expert and in the laboratory as tutor.</p> <p>The purpose of the course is for students to apply knowledge of computer sciences for Architecture and assembler language, develop abilities for collaborative and autonomous work, and develop his/her creativity and apply the methodological principles of engineering.</p> <p>Since the course requires students to apply specific knowledge, self-negotiation abilities, and collaborative work for the creative development of a product, the technique of project oriented learning</p>
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was established as didactic strategy. The project consists in designing and assembling a basic electronic computer.

All the documentation of the course is in the technological platform of LearningSpace, so students can check all the information related to the project and at the same time put the reports of the advances made so the professor can supervise its development.

The project is divided in six phases:

1. *Design the mnemonics for a 4 bit basic electronic computer.*
2. *Design and simulate a 4 bit basic electronic computer data path.*
3. *Design and simulate a 4 bit basic electronic computer control unit.*
4. *Integrate and simulate the data path and control unit of the 4 bit basic electronic computer.*
5. *Implement and test the 4 bit basic electronic computer.*
6. *Oral presentation and written report.*

Once all the aspects related to the project are presented and achieved, the students form working teams and carry out the following activities:

- ?? Define the working plan for the parts of the project in which they establish: the activities that each member of the group will do (research in different sources, revision of the elements that the design of the computer must have), the calendar of the meeting with their tutor and the dates to finish the product.
- ?? Present the working plan to the professor so he/she can approve it and the group can start the development of the project.
- ?? Work in individual or pair activities to take results to the group discussion. Interview experts in the field and their tutor. Attend class, where they learn basic concepts about computer sciences architecture VHDL and in LearningSpace the tutorial materials and other technological resources (movies, formats) that the professor has put to support their learning.
- ?? Take to the laboratory the expected products for each part of the project and each week, they individually put in *CourseRoom* in LearningSpace, their personal report in which they present an analysis and their experiences with the learning achieved.
- ?? Prepare, in the last part of the project, a written report about the process that they followed and the results that they obtained and be prepared to present the work (prototype) to their classmates and professors.

In this process, the professor is an observer, evaluates all the products made by students, offers feedback to each team and assigns a grade.

During the two semesters in which I have taught the subject, what has surprised me the most is when I present the project to the students like an unreachable challenge. The motivation, creativity, and ability to self-learn are activated in such a way that the advances that they achieve are remarkable. Students reach a higher level in knowledge, abilities, and attitudes that I could have imagined during the class sessions. This goes beyond the walls of the classroom because each team works in a house, a laboratory, etc., having as objective the development of the project.

#### **Critical aspects**

When using this technique in a course it is important for the professor to consider these aspects:

- ?? It takes a professor a long time to prepare a course with a project for the first time.
- ?? Students, especially the younger ones, can get lost in the process and forget its objective.
- ?? Long-term projects are not recommended for very young students.

- ?? It is very difficult to determine the objectives, learning goals, and evaluation.
- ?? It is difficult to keep students and teachers constantly active.
- ?? Evaluation is difficult.

**Suggested offered by the professors**

- ?? A complex multidisciplinary project can be developed to culminate a major, creating a project that offers a professional solution to a real problem that has not been solved and in which multidisciplinary abilities, attitudes, and knowledge can be applied.
- ?? The professor who teaches a course based in a project needs to prepare multiple details, like defining the project and the enterprise where it will be developed. Also, he/she has to prepare materials and resources. For this, it is suggested that the professor be informed that he/she will teach the course, three months before it starts.
- ?? Laboratories that are adequately equipped are required for students to carry out their projects.
- ?? In the subjects based in projects, the best is to have a flexible evaluation scheme to report students' advances or grades.
- ?? Consider the number of students that take a course based in a project because the tutor's activity is very difficult with big groups.
- ?? It is important to participate in the system faculty committee to evaluate the students' projects, as well as to provide projects that are the result of research carried out by the professors.
- ?? Identify strategic subjects to incorporate projects because students can be saturated with projects in many courses.

**Problem based learning**

Problem based learning is a didactic technique that has been adopted by many universities all over the world. It was developed and taken to practice in the seventies in the School of Medicine of the Mc Master University in Canada. Since then, this education approach has had a great dissemination in higher education. The Universitet Maastricht in Holland, where professors from Tec. receive training, counts with more than twenty years of experience in the technique and applies it with good results in the schools of Medicine, Health Sciences, Law, and Economy. Another place where our professors from the fields of Engineering and Basic Sciences also receive training, is the University of Wheeling (USA). In this university, the application of the technique, compared to the Dutch University, has some differences, like students' involvement in decision-making to solve real and complex problems in which they take the role of advisers. This makes the methodology from Wheeling more appropriate for courses in advanced semesters and also for subjects from the area of basic sciences whose knowledge supports the specialty courses.

**Characteristics of problem based learning**

With the technique of problem based learning, students work in small groups to look for the best solution for a problem presented by the professor. The good performance of the group depends, on one hand, in the route students follow to solve the problem, and on the other, on the interaction between the members of the group. Each tutorial group has a discussion leader, who is member of the group and whose task is to assure that the discussion is carried in an appropriate way in relation to the method and the process. The members of the group exchange ideas and point of views related to the problem. The way in which the contributions are presented, what has been said, and how the partner reacts, both verbally and nonverbally, influences the acquisition of new knowledge and the understanding of the information. The tutorial group is supervised by a tutor whose main task is to promote the learning process and the cooperation among the group. The performance of the group is responsibility of all the members, the discussion leader, and the tutor.

**Description of the problems**

A fundamental element to be considered in applying the technique of problem based learning is the way in which the problems are presented to the students. They are generally not very well defined descriptions of problematic phenomena or the events that are considered to be challenging. The structure and complexity of the problems should be adapted to the level of the students and should increase as students acquire more knowledge and maturity. The process of maturity is related to the advance in student's independence, and this, at the same time is related to the professor's level of interventions, as is presented in Figure 6.8.

**Participation in the tutorial group**

The basic element of problem based learning is the tutorial group. In it, problems are analyzed, learning needs are determined, and the results are shared during the self-directed study. Table 6.8 presents the roles of the participants in this process.

**Organization of a problem based learning process**

The organization of the technique consists in a preliminary discussion in the tutorial group to define and analyze the problem. Having as basis the previous knowledge of the members of the group, an inventory is made of the knowledge that is required for the solution of the problem, and students individually consult information and use other resources, like interviews, to explain aspects that were not solved. During the following meeting, the results of the self-study are discussed; in this phase, students are informed about the new knowledge acquired and the information that was obtained, assuring that everything is understood. Finally, the group evaluates the process that was followed and the depth with which the topic has been treated. Figure 6.10 represents the process in graphic form.



### Learning promoted in problem based learning

Problem based learning promotes the development of basic abilities that are required in other more complex techniques (case studies and project oriented learning) like:

- ?? Ability for self-learning.
- ?? The ability to analyze, synthesize, and evaluate.
- ?? The ability to identify and solve problems.
- ?? Critical thinking.
- ?? Self-directed learning.

This learning makes it possible to apply the technique to courses in senior high school and in the basic subjects of professional studies.

Table 6.8 Roles of the participants in the tutorial group

Leader of the discussion	<p>Determines the agenda to be followed to assure that the meeting is carried out in an effective and efficient way.</p> <p>Indicates the discussion plan, checks the relevant topics for discussion and promotes the effective use of time.</p> <p>Begins and maintains the rhythm of the meeting, promotes a balance in the contributions of all the members of the group and stimulates the preliminary and final discussion.</p> <p>Presents in a precise form what a partner has contributed to increase comprehension and check to see if what was said was understood by the leader of the discussion and the members of the group.</p> <p>Listens to what has been done, decides and makes everybody agree on a common point for the next meeting.</p>
Member of the group	<p>Takes notes and makes diagrams to visualize and summarize the exchange of information in the meeting of the tutorial group.</p> <p>During the preliminary discussion makes comments with partners about what is known and complements and explains anything that was not clear.</p> <p>Makes questions to clarify and ask for additional information or explanation to check and increase his/her own knowledge and that of his/her partners.</p> <p>Contributes to improve the comprehension of the topic and stimulates the process and the product of the group.</p> <p>Gives his/her opinion in relation to the content, the working methodology used or to the group's behavior.</p> <p>Asks for information related to his/her behavior and its effects on others.</p> <p>Is prepared to receive feedback from others and, subsequently, determine what is wanted and what can be done to obtain it.</p>
Tutor	<p>Motivates so students' work is carried out in-depth and coordinates the preliminary and final discussion, influencing relevance and application of the topic.</p> <p>Helps students discover and solve on their own, mistaken concepts and incorrect points of view, among other aspects.</p> <p>Gives a brief explanation and presents practical and illustrative examples of similar situations with the purpose of guiding a depth discussion in the group if students cannot find the way to solve the problem.</p> <p>Informs students about the positive and negative effects of the tutorial group, especially of the individual roles, the content of the discussion, and the application of the procedures to increase students' participation in relation to their performance in the group and, if necessary, gives guidance to improve it.</p>

**Evaluation of students**

The process for the solution of a problem produces a great number of activities that can be evaluated, like: the work of each student, presentation, written report of the team, and the acquired knowledge. It is important for the professor, at the same time that he/she provides the problem, to give students the criteria by which they will be evaluated.

The following are the different aspects that can be evaluated, since the professor is responsible of selecting them, as well as the points assigned to each activity.

**Individual work or contribution**

It is the work –report, essay, or other- that students generate as a result of their activities to solve the problem and as part of the team.

**Team work or contribution**

It is the result of team work.

**Written exam**

It is an exam in which the students answer to questions that prove the acquisition of abilities and their transference to problems or similar topics.

**Practical exam**

They are exams in which students should demonstrate that they are able to apply the abilities learned during the course.

**Categories and criteria to use in the evaluation of the student in each category**

- ?? *Preparing for the session.* Uses relevant material during the session, applies previous knowledge, shows initiative, curiosity, and demonstrates organization and evidence of his/her preparation for the group work sessions.
- ?? *Participation and contributions to group work:* participates in a constructive way and supports the group process.
- ?? *Interpersonal abilities and professional behavior:* communicates with partners, listens to and responds to the different contributions, is respectful and ordered in his/her participation, collaborates and is responsible.
- ?? *Attitudes and abilities:* states knowledge about personal strengths and limitations, listen to others' opinions and is tolerant when he/she does not agree with their ideas.
- ?? *Critical evaluation:* clarifies, defines and analyzes the problem, is able to generate and prove a hypothesis, and identifies the learning objectives.

Figure 6.10 Process of problem based learning

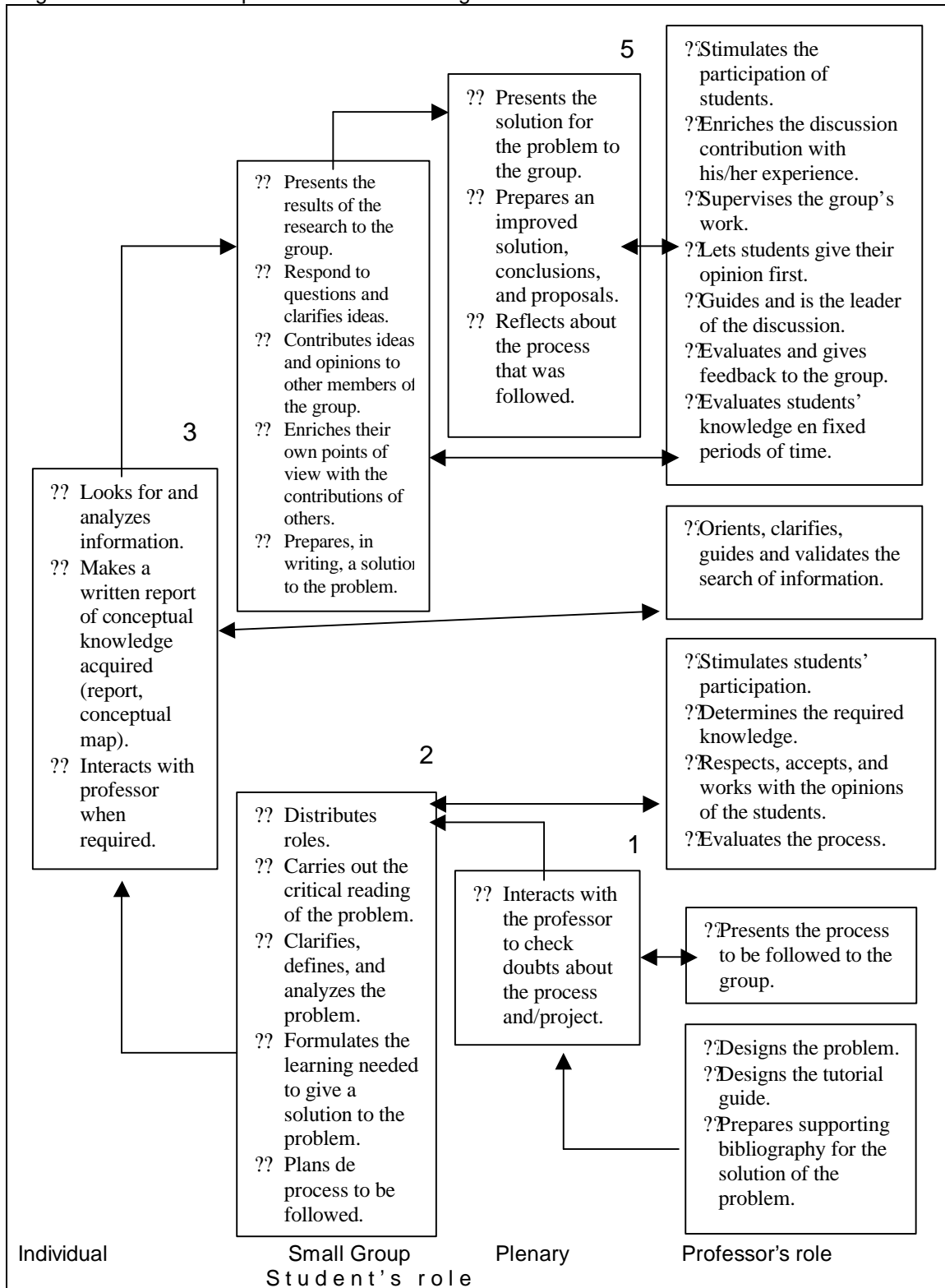


Table 6.9 shows an example of a course with problem based learning.

### Critical aspects

- ?? With this technique we can clearly see the limitations of the traditional model and the tendency that students have to be receptive and dependent on the professor. They find it difficult to be active, autonomous, and constructors of their own learning.
- ?? The professors find it difficult to cover all the topics of the course if they apply this technique as basic methodology.
- ?? Some occasions the classroom furniture and space available are not appropriate to work with the tutorial group. Although it might not seem important, being in a traditional classroom makes students demand a traditional class and it is more difficult to accept working with this scheme.

### Suggestions offered by the professors

The professors who use the problem based learning technique consider the following aspects as important:

- ?? Share with other colleagues the reading the problems to be evaluated.
- ?? Include in the problem elements that students face in real life so they can be able to relate it with their personal experiences.
- ?? Consider that good results have been obtained with two sessions of an hour and a half but that the best is to have a three-hour session a week.
- ?? The technique of problem based learning can be applied in the first semesters as well as in the last subject of the major, but with a different level of complexity.

This technique can be used in all the subjects of the basic subjects of the majors, because it has a series of steps that are clearly structured and this helps students develop abilities for working collaboratively and self-studying.

Table 6.9 Example of a course with problem based learning.

*Course:* Administration

*Level:* Professional, at the beginning of all the B.A. majors.

*Professor:* Hortencia Jiménez, State of Mexico Campus

*Platform:* Blackboard

The course of Administration is one of the basic subjects that students take in all the B.A. majors in the first semesters. This course expects to show students the importance of administration as a discipline in any working field.

The course covers topics like the history and evolution of administration, the characteristics of a good administrator, the basic structure of an enterprise, the concepts of social responsibility, and enterprise ethics, management of different functional areas of an enterprise (production, marketing, human resources, and finances) and how an enterprise can get into the international market.

The course is structured in the technological platform of Blackboard and is totally designed with the technique of problem based learning that has as main objective to include students and make them responsible, in an active way, of their own learning process.

In order to do this, nine scenarios are handled (one for each topic), besides an initial scenario, not related to the subject that is used to train students in the technique during the first week of classes.

Scenario 0: *The Sack*. Training students in problem based learning.  
Scenario 1: *Story of an Old Man*. History and evolution of administration.  
Scenario 2: *PAN\* for the New Millennium?* The enterprise and its environment.  
Scenario 3: *If you leave me now*. Social responsibility.  
Scenario 4: *Making the adequate decision*. Planning.  
Scenario 5: *Organizing the enterprise*. Organization.  
Scenario 6: *Whatever the client wants*. Control.  
Scenario 7: *Unexpected growth*. Human resources.  
Scenario 8: *And, where is the storage department?* Production.  
Scenario 9: *You, the consultant*. Marketing.  
Scenario 10: *Gusy, the caterpillar, around the world*. International business.

The work with problem based learning is carried out using the following steps: clarification of terms, defining the problem, analysis of the problem, setting learning goals, self-study, discussion, and report.

In the classroom, students work in teams of five or six and, for each scenario, they determine who will be the leader and the secretary of the discussion. These teams change at the beginning of each period. The professor always has the role of tutor. All the scenarios are in the section of *Course Documents* of Blackboard. Here, students can check them before the corresponding session where they carry out the first four steps to conclude the learning goals that were established and approved by the professor.

Step five, *self-study* is done out of the classroom. To carry it out, students can use resources like the Digital Library, the Library-Information Center, Internet sites, journals, newspapers, including interviews with experts. Independently from the sources used, they should report them according to the guidelines of *Guide for the presentation of written reports* (<http://www.cem.itesm.mx/consulta/guia>).

To verify that all the students are preparing appropriately in the process, they are asked to send an individual report, using *Digital Drop Box* from the *Tools* section, with their research on learning goals. They also have to take this report to the session of discussion and reporting (step six). In this session, which follows the session used for steps one to four, all the members of the team share the results of their individual research in order to give a solution to the problem. Once the discussion is carried out, the leader of the team must send a group report with their conclusions, using the option *File Exchange*, which is in the space of their team in *Group Pages* (in *Communication*). Finally, to close the topic, each student should prepare and turn in a mind map about the topic. This is the only document that is turned in printed, because not all the students count with the programs they need to do it on the computer.

Besides the scenarios, the course includes expositions by the students and others by the professor which have the objective of closing the topic. There are also sessions of electronic discussion using *Discussion Board*.

I have applied the technique of problem based learning in this course during the last three semesters and the point that I consider to be one of the most important is to make students understand the technique. I do this at the beginning of the course. The first scenario does not have anything to do with the content of the course and is used exclusively for students to learn how to use the technique with their own experience. I have had excellent results because students become aware of all the benefits that they obtain in working with the technique. This way it is easier for them to feel at ease when using it during the course. On the other hand, I have seen that it is necessary to ask them, before the discussion and conclusion phase, to turn in an individual report with their research on learning goals. I find that lowers the percentage of students who come to class with having done anything and only paraphrase what their partners say. To verify that students have understood the most important aspects of each topic, they have to turn in an individual conceptual map.

In general, my experience has been very positive and students have favorably responded to the use of problem based learning. They participate more in research and in the discussions about each one of the topics.

\* Notice the double meaning of: *PAN* is the acronym of a political party (Partido de Acción Nacional) which happens to mean *bread* in Spanish.

### **The didactic techniques in the study plans**

- ?? Not all the didactic techniques are applied to all the disciplines, nor one same technique is used with the same complexity in all the levels.
- ?? One same technique can cover all the courses of a study plan of a major with different degrees of difficulty, according to the level of each student, like for example, the career of medicine using problem based learning.
- ?? There is a correlation between abilities, attitudes and values to be developed in students and the complexity of the technique.
- ?? The most complex techniques require that students have command on basic abilities and attitudes, in order to have a successful performance in the technique.

Because all of this, the selection of the appropriate didactic technique is related to the academic discipline, the abilities, attitudes, and values to be developed, and the level in which the course is. The decisions that have been made in Tec in relation to which technique to be used and for what course or areas, had as reference the experiences already validated by world-wide prestigious universities and the experience of the professors of the Institute.

In order to help professors in the selection, a system-wide proposal has been developed. This proposal presents a curricular distribution of the abilities, attitudes, and values, according to the academic level and the application of the technique according to the discipline. (See Figure 6.11).

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Figure 6.11 Curricular Distribution of Abilities, Attitudes, and Values According to Academic Level and the Application of Discipline.

Level	Didactic Techniques				AAVs
	Case Method	Problem Based Learning	Project Oriented Learning		
Specialty Courses in Professional Level	<ul style="list-style-type: none"> <li>?Administration</li> <li>?Business</li> <li>?Ecology*</li> <li>?Values in the Profession*</li> </ul>	<ul style="list-style-type: none"> <li>?Social Sciences</li> <li>?Humanities</li> <li>?Medicine</li> <li>?Communication</li> </ul>	<ul style="list-style-type: none"> <li>?Computer sciences</li> <li>?Electronics</li> <li>?Architecture</li> <li>?Food Technology</li> <li>?Development of</li> </ul>		<ul style="list-style-type: none"> <li>?Leadership</li> <li>?Enterpriser Spirit</li> <li>?Innovation Attitude</li> <li>?Clear awareness of the needs of the country at regions.</li> <li>?Commitment with the sustainable developme the country and its communities.</li> <li>?Commitment to be age of change.</li> </ul>
		<ul style="list-style-type: none"> <li>?Law</li> <li>?Leadership*</li> </ul>		<ul style="list-style-type: none"> <li>?Engineering</li> <li>?Information</li> <li>?Agronomy</li> </ul>	
Basic subjects in Profession Level	Problem Based Learning Collaborative Learning Techniques				<ul style="list-style-type: none"> <li>?Critical thinking</li> <li>?Capacity to define and solve problems.</li> <li>?Consolidate AAVs in senior high school.</li> </ul>
Senior High School	Problem Based Learning Collaborative Learning Techniques				<ul style="list-style-type: none"> <li>?Capacity for self-learn</li> <li>?Capacity to analyze, synthesize, and evalua</li> <li>?Team work</li> <li>?Efficient use of NTIC</li> <li>?Know English</li> <li>?Oral and written communication.</li> </ul>
Collaborative Work					
Technological Platform					

\* Course

AAV: Abilities, attitudes, and values

NTIC: New information and communication technologies