

Perception of the Students in Computer Engineering in the Use of Online Courses as Teaching-Learning Process Support in the Software Engineering I Course

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Abstract The majority of individuals possess a reference endowed by the experience left by their passage through classrooms in the process of educational and vocational training. However, on addressing support for student-centered learning, we must determine what this is concerned with and what it covers. The aim of this paper was to analyze the implications of learning on students applying an unconventional model, supported by the Information Technology and Communications and with the incorporation of new methodological paradigms in the teaching-learning process for presentation and management of courses, urging both teachers and students toward a change in the role that they had played to date, after their preliminary training process had been based on a traditional model. The analysis refers to the case of the Ciénega University Center of the University of Guadalajara, Mexico, with data from surveys of a statistically representative sample of the student population enrolled in this institution during the 6th, 7th and 8th academic year of the Software Engineering I course on computers and educational programs offered on this same computer, because it is in those cycles that the experiment was held on the process and the learning tools specific to this educative model, particularly the use of online courses.

Keywords: *academic model, online courses, instructional design, students, technologies*

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1. Introduction

Since the 1990s, a decade during which the Internet expanded in society worldwide, the potentiality became evident of the technologies for supporting teaching-learning processes, thus the importance of incorporating these new technologies in institutions of higher learning and, in general, in all educative institutions.

Within this context, the Department of Technological Sciences of the Centro Universitario de la Ciénega, of the University of Guadalajara in Mexico, attempts to update the requirements of flexibility and support in these information and communications technologies, proposing the incorporation of virtuality in the educative process, introducing the modality of online courses for the academic subject Software Engineering I.

The main challenge in the design of the course was to detect and consolidate the relevant material of the software process and its applications. The didactic technique employed is that of collaborative learning, whose objective is to promote significant learning through teamwork, without leaving to one side the development of individual skills. In the virtual environment, the course contents of Software Engineering I is presented in the Moodle platform; the benefits of the media are taken

advantage of by making use of text, instructional material, images, and videos. Online courses are frequently related with a lack of personal contact, which can be criticized in new students or in those without prior experience in online education.

This perception is note to the degree that the course design and structure allows the student to "personalize" their experience and offers them the necessary tools for their learning [5]. The latter directly affects the perception of students on their experience in the course.

The general content of the course consists of six modules and of five to six themes per module. The didactic of each theme consists of a process that begins with the planning and discussion of practical applications of the biological principle of the theme being treated so that later, linking this information with the theoretical and conceptual content, in this manner generating interest in the student on "bringing down to earth and concretizing" the theoretical information, highlighting the practical importance of this with some application.

In traditional terms, biology does not form part of the basic subjects in the academic formation of engineers; thus, the general idea that permeates the correct utilization of Information and Communications (ICT) permits the creation of the adequate conditions for achieving the internal dynamic desires in the knowledge schemas of the students, understanding with this not only those that

include knowledge in the strict sense of the word, but also values, attitudes, and skills, in addition to orienting and leading the student to their own learning, reflection, independence, and assessment.

The materialization of some of the possibilities that are foreseen in the new technologies will depend not only on technological advances or on the availability of the media, but also on the policy decisions and the institutional commitments created in this regard. It is necessary to conduct an analysis of what has taken place to date in order to evaluate the results obtained and to outline new work challenges.

The present work had as its basic objective the presentation of the results of the analysis of the main aspects on taking into account the design of online courses with the utilization of ICT, from the experiences obtained in the development of the investigation.

It is necessary to recognize that information and communications technologies are inserted into a sociocultural dynamic that comprises the global society or the global network. Within the framework of this society, the technologies play an important, but not a primary or an absolute, role. Similarly, the technologies are not reduced to online course, but rather, they comprise a diversified variety of technological tools that have come on the market and that can support the teaching-learning processes.

2. Teaching-learning Process

In all teaching-learning processes, students are offered a set of conditions that can support them in carrying out an action; thus, it must be considered that on designing a course, first the desired objective to be achieved should be defined, that is, *What is it exactly that the student learns?* The answer is not always clear; everything that is unnecessary should be eliminated, obviously guaranteeing that the content of the course fulfills the students' expectations.

3. What are the Characteristics of a virtual Learning Platform?

As cited by [6] these tools have been designed so that the management, administrator, or member of a teaching staff can administer and develop a course, allowing the latter to have a control and progress of the course. It can be affirmed that in their majority, these virtual learning platforms are characterized by possessing the following components: facilitator tools; student tools; instructional support or educative design support; administrative tools; functioning characteristics, and technical requirements.

It must be acknowledged that students who, for the first time, have as a support the tools that are offered virtual environments, do not know what this implies. In fact, the students derive from a traditionalistic formation in which, in the majority of cases, many of the strategies applied do not adjust well with those that will be developed and applied in a virtual ambience. It is evident that the teaching staff as well as the university itself, are key in helping their students to acquire a certain preparation as online students, beyond the content, the abilities, and the attitudes of the students themselves. In addition, the

contribution of the teaching staff and of the educative institutions can produce great satisfaction in the students in their formative experience.

4. The Role of the Student

It is noteworthy that the most important component in the entire teaching-learning process is constituted of the students, who, in virtual environments go on to play a more active, independent, and collaborative role, controlling their learning rhythm. Correct utilization of ICT permits the creation of adequate conditions for achieving the internal dynamic desired in the students' learning schemas. The latter is understood as not only including knowledge in the strict sense, but also values, attitudes, and skills.

All teaching-learning processes require providing the student with the tools that facilitate maximal exploitation of then program. In this respect, potentiating self-learning strategies in the student must be considered. Learning through the ambiances of virtual environments require, on the part of the student, a set of abilities (for example, searching for information on the network, broadening and generalizing knowledge, being in contact with a virtual tutor or with other persons, etc.) that lead students to manage their own learning.

Although the pupil-student duality does not represent two completely different figures, and the passing from being a traditional pupil to being a pupil-student is more appropriately an evolutive process, it is very useful to note some differential aspects about the conception of one who studies, considered as a pupil or as a student, as it observed in Table A as follows [2]:

Table A. Comparison of the main characteristics the student body and students

Pupil – Traditional	Pupil - Student
Reactive attitude. Has a narrow decision margin with respect to his own learning performance, strongly conditioned by the Director's office and the decisions of the teaching staff.	Proactive attitude. Possesses and utilizes the wide margin that is provided for decision making regarding his own learning and performance.
Relative or scarce implication in his own learning.	Clear implication and heightened commitment to his own learning.
Scarce goals of his own beyond complying with the academic subject or the course.	Establishes his own goals that extend beyond complying with the subject or course.
Scarce reflection on his own attitudes, skills, and learning strategies.	Is aware of his own attitudes, skills, and strategies, and of those that he should acquire and apply for learning.
Competitive environment, in many cases induced by the formative model and the action of the teaching team.	Collaborative environment, fostered by the formative model and by the action of the teaching staff.
Mainly memory and knowledge replication skills.	Skills related with communication, and with the search for, selection, production, and diffusion of information and knowledge.
Applies strategies related with a directed learning: has not had the opportunity to learn to be, or to be, autonomous.	Applies strategies related with autonomous learning; has had the opportunity to learn to be autonomous and to be so.
Creates a limited personal and professional profile, one removed from ongoing formation.	Creates a personal and professional profile that is akin to continuous formation and to lifetime learning.

Students who make use of virtual environments become independent, self-directed, and disposed to learn from other remotely, but for this, no training is offered. It is important to teach students to be anonymous in their learning so that they depend on self-understanding of the styles of individual learning, but for this to occur, they must know what they are going to do and how to do it.

In a virtual environment, the student is capable of tolerating a certain degree of ambiguity and uncertainty, due to the confluence of the asynchronicity of the teaching staff as guide (not as direct transmitter of content) and of the availability of all of the instructional material and learning resources that in some way gives rise to confusion or moments of insecurity. And this is because they are no longer only listening to the voice of the teaching staff member but also that to the contents that they have available to them from the first day of class are not provided little by little. Thus the student is persuaded to make his own decisions and to organize his own performance. All of this occasionally make the student feel insecure and disoriented, especially if he does not have experience with this formative modality. The student's anxiety level in the face of moments of uncertainty will diminish or disappear by means of reading support documents and through communication with their classmates with teaching staff.

To evaluate the students' degree of satisfaction with the development of the course, an opinion questionnaire was designed that was applied at the end of the course ($n = 100$). The questionnaire was anonymous and in it, the students were asked to score the course by means of the Likert scale (1 totally disagree–5 totally agree), expressing their opinions with respect to the online course and their personal perception of course functionality, structure, and interface.

For this investigation, we used a nonexperimental study design, in that we did not deliberately manipulate the phenomena, but rather observed these in their natural environment. The design type was descriptive trans-sectional, because we collected data within a unique time and with the aim of describing the phenomena and analyzing their incidence at a given moment in time [9]. Validation of the questionnaire implied two aspects: validity and reliability. To determine validity, that is, the degree at which an instrument measures the variable that it intends to measure, we employed content validity. This refers to the degree to which an instrument reflects a specific content domain of what is being measured" [9] and this was conducted by means of a panel of experts. For estimating the reliability of the instrument, we utilized the Cronbach alpha index. This calculation method of requires a sole administration of the measuring instrument and allows determination of the test's internal consistency, indicating how consistent the performance of the item is as examined through the items individually. If the items examined exhibit consistent performance, the instrument is said to possess internal consistency [1].

Later this was presented to seven expert judges, who were allowed a norm for evaluating, from 1 to 3, the pertinence of the dimensions and their items with regard to the questionnaire, as well as also with a space for proposing changes and/or suggestions. To determine content validity by means of the judgment of the experts, were utilized the content validity formula of Lawshe [11], which establishes a minimal validity ratio of 0.99 with seven experts. In the questionnaire, we obtained a Content validity index (CVI) of 1; however, it was convenient to remove three items from the simple dimension in their being considered *nonessential*. The instrument finally comprised two categories and 12 items.

Table B. Results of the instrument's content validity for knowing the perception of the students regarding the functionality, structure, and interface of the Online Software I Engineering course

Category evaluated	Lawshe index by category
1 Course functionality and Virtual interface [9]	1
2 User satisfaction [3]	1
Instrument validity index "Questionnaire on the Opinion Survey applied to students regarding the online course and their personal perception of course functionality, structure, and interface"(CVI)	1

The reliability levels obtained with the Cronbach Alpha method in each of the dimensions ranged from 0.913–0.927, as can be observed in the table. These results

reflect a high index of internal consistency in the questionnaire.

Table C. Reliability of the dimensions. Chronbach Alpha method

Dimensions	No. of items	Internal consistency
Course functionality and Virtual interface	9	0.927
User satisfaction	3	0.913

Table D. Information concentrated on the opinion survey applied to students regarding the online course and their personal perception of course functionality, structure, and interface

Course functionality and Virtual interface
The Software Engineering I course develops competencies in the student that provide advantages for him in his profession. Competencies
Navigating within each of the course sections is easy.
The information presented in each section is adequate, accurate, and clear.
The time for completing the activities is appropriate.
The number of activities is adequate for each session.
The work burden is adequate.
The activities applied in the Software Engineering I course (individual tasks, collaborative work) were effective in their process.
User satisfaction
I felt satisfied working with the Software Engineering I course supported by the online course.
The course instructor responds to your questions and doubts in a timely manner.
Interaction among students is significant.
Instructor-student interaction is motivating.
Would you take another subject supported by the online course tool?

All students who answered the questionnaire made very positive comments on the functionality of the structure and interface of the course; however, there were those who considered that there was a lack of the polishing of instructor-student communication-interaction.

The willingness of the great majority of students to take another online course indicates that working with this tool, such as online course, as well as the instructional material, produced great satisfaction in the students due to the novelty of their being able to be more independent and self-suggestive in their learning process.

Because of the comments expressed, it can be said that student-interface interaction was very efficient, when the latter comprised an important element, because students have to undergo a change in behavior on being required to use this type of tool. The degree of satisfaction in terms of the functionality of the course's structure and interface was very high, indicating that the training given to the

students prior to initiating the semester allowed for the interaction with the interface was sufficient for exploring the content and the structure of the course.

5. The Teaching Staff

Although the student is a central element, the teaching staff should be aware of the actions of lacks in which they themselves can be involved. Despite the facilitator and guidance functions, with the accuracy or the clumsiness of their actions, the teaching staff can exert an influence in a determining manner on the motivation or the frustration of their students. Therefore, the teaching staff should prevent or avoid some actions or situations. Let us look at these [3].

Not having been an online student
It is fundamental for a member of the teaching staff to have experienced in the flesh what it means to be an online student. The strategies and skills that should be employed, the interaction and complicity that should necessarily be fostered, cannot be complete if the member of the teaching staff, at least on one occasion, has not been an online student. [10] is very explicit in this respect: «It is essential to give future online tutors an extensive opportunity to experience collaborative learning online. This gives them a deep understanding of the essential issues involved and a feel for the subtle differences that an online tutor needs to be able to cope with, when facilitating online.»
Not responding or responding late
Of all of the teaching staff's actions that can cause frustration in the online student, perhaps this is the most severe. The student who does not receive instructions, or a response, considers that he does not have the support of his guide or his instructor. The online teaching staff should be aware that a rapid and adequate response, even of the «I'll find out and get back to you» type, keeps the student motivated and aware that there is an open channel to his instructor. [8] observe this clearly in their case study:
Having a sporadic or null presence in the classroom
The action of teaching staff members along the online course is crucial for the success of the students. However, the teaching staff, in addition to correct and timely application of the staff-designed action, should ... know that on beginning the course, their mission consists of orienting the students during their first contact with the content and resources, and in the work and planning of effort during the course [4]. ...to progressively increase the degree of socialization with and empathy toward the students [4].
Not showing clarity in the instructions
In addition to the effort involved in studying, interconnecting, and participating in class, for the online student the fact of ambiguity or the lack of instructions or of not knowing most certainly which steps to take, is discouraging. It would be an error to think that students who have participated in various virtual subjects or courses do not require instructions and clear information from the beginning of the course [4].
To be excessively rigid
Although recognizing that in general the teaching staff should apply, respect, and make the timelines involved in the course be respected, every online student, however successful, needs at some moment to be give a certain flexibility by his professor. Excessive rigidity in terms of times and dates can become very difficult for the student, and can even lead to his withdrawing from the course
Not showing closeness
Online teaching staff should demonstrate accessibility and should be accessible to their students, so that they can motivate and guide them adequately. This closeness will foster the student's voicing their doubts or communicating their problems.
Contributing to the student's academic burden
In any formative ambit, and especially in online formation, the danger of saturation of information is evident. [10] indicates the following: «Skilled online tutors will be able to regulate the information flow so that course participants have sufficient activity to keep them motivated, whilst at the same time not making them weighed down with too much information.»
Not fostering interaction and collaboration
In the design and development of online formation, it is considered that learning is a process of the construction of knowledge [7], in which collaboration among students online and their perception of belonging to a group presents demotivation and their withdrawal from the course [12].

6. The Institution

The contribution of the institution is also very important in the preparation of students as such. Because there are university students who have never been online students, the university should provide the necessary preparation, or even support the teaching staff in this preparation.

There are very concrete fields in which the timely intervention of the institution is determining for the good pace of the formation of the student. In the first instance, the student wants to learn and to finalize their formation. The institution should prevent or avoid some actions or situation. Let us take a look at these [3].

Offering deficient technical help
<p>Technical difficulties are a key element in the frustration of the online student. [10] explains the basic lines of good service of technical help:</p> <ul style="list-style-type: none"> -Should have profound knowledge of the programs and the equipment that the student uses (knowing how to distinguish where to find the true problem among everything that the student communicates). -Must be kind (which will be redundant in that the student will recover confidence in the help provided and in the professionalism of the technical team). <p>Therefore, it is important to assign budget and personnel in order to provide the student with an efficient technical aid service, establishing adequate channels –and making them known– in terms of asking for help and for problem solving.</p>
Not providing adequate training to the teaching staff online
<p>An on-site teaching staff member does not automatically possess the strategies and abilities that should be employed in online teaching. Thus, it would be convenient for the institution not only to provide or facilitate the formation of its teaching staff, but also to give them the opportunity to experience online formation, from the other side of the table, as students.</p>
Not offering the student «preliminary formation»
<p>Not knowing or the lack of strategies and skills in relation to online learning and communication is probably one of the most important inconveniences for online students.</p> <p>It is the institution’s direct responsibility to offer «preliminary formation» that provides the essential keys to the student (who probably has not been an online student in his formation, in order for him to be a good online student, which at the same time will contribute to preventing the demotivation and frustration that could result in this being lacking).</p>
Establish complicated administrative formalities
<p>Complicated student registration procedures or overwhelming administrative steps during the student’s formation add a component of unnecessary difficulty and the sensation of the loss of time, which increases the student’s frustration.</p>

The institution also must act decisively to change the didactic methods considering the diverse variables that most directly influence these.

In the following tables by [3], the actions are expressed (in the form of a checklist) that can be used as a reminder or a recommendation, so that the agents of online

formation can be more aware of what they are doing to prevent the frustration of the online student. Some actions should be carried out prior to the formation (a), while others will be performed throughout the formative process (d).

Table 1. Actions on the part of the student
Student

- TIME MANAGEMENT
- a. Find out the time required for devoting to each subject.
 - b. See how much time you have.
- c. Obtain agreement with the family and the company concerning the time necessary to devote to the course.
 - d. Make the necessary adjustments for increasing the amount or the quality of the time available.
- EXPECTATIONS
- a. Find out the volume and amount of work required for each subject.
 - b. Be responsible in registering for the course you will take: time available and previous knowledge.
 - c. Current and future real costs.
 - d. Know from the beginning that the media, resources, and methodology require more time and effort.
- PREPARATION AS AN ONLINE STUDENT
- a. Know the basic strategies to be a good online student.
 - b. Have the skills necessary to be a good online student.
 - c. Know where and how these can be known or acquired.
 - d. Detect improvements in order to incorporate these into your own strategies and abilities: teaching staff and classmates.
- PERFORMANCE AS AN ONLINE STUDENT
- a. Know which knowledge is necessary for the course or the subject.
 - b. Learn with or from your classmates.
 - c. Participate actively in the course’s spaces of communication.
 - d. Know where the documentation, learning materials, and the subject’s resources are available.
 - e. Know where to ask for help from the teaching staff, from your classmates, and from the institution.

The following table illustrates the actions in which the teaching staff should include if it wants the students’

frustration level to be minimal in what concerns their teaching staff action.

Table 2. Actions by the teaching staff
Teaching staff

- TRAINING:
- a. Formation as online teaching staff.
 - b. Having carried out at least one online course as a student.
 - c. Help the student in the acquisition of strategies and adequate skills for online formation.
- COMMUNITY:
- a. Foster the online interaction among your students.
 - b. Provide collaboration among your students.
- TEACHING STAFF ACTION:
- a. Design an adequate reading burden and an adequate evaluation.
 - b. Clearly indicate what is expected of the student.
- Continued
- a. Make known the time limit for responding to doubts and questions, and comply with it.
 - b. Exhibit accessibility and closeness, empathy with the student and his situation.
 - c. Be flexible in position, avoid being excessively rigid.

Table 3. Actions by the institution or the company of formation

<i>Institution or company</i>	
INCIDING IN THE STUDENT	
a.	Offer preliminary formation in strategies and formation necessary for a good performance.
b.	Offer the student a reasonable expectation of his being a student and of finalizing his education.
	c. Provide efficient technical help services.
	d. Provide an effective service of technical aid.
	e. Provide an aid service and one of academic orientation.
	f. Establish clear, simple, and rapid administrative steps.
	g. Establish an adequate reading burden.
h.	Carry out a coherent evaluation of the methodology employed online.
INCIDING IN THE TEACHING STAFF	
1.	Train the staff taking the course as online teachers.
2.	Provide effective technical help service.
3.	Provide pedagogical support and orientation.
VIRTUAL TEACHING: LEARNING ENVIRONMENT	
a.	Ensure that the teaching material is adequate and functions correctly.
b.	Guarantee the rapid access of the student to his classroom, to the materials, and the rest of the resources.
c.	Resolve incidences of the functioning of the environment and of the materials.

In order to achieve these objectives, being supported by this tool, such as online courses, it is necessary to incorporate new methodological paradigms in such a way that a change is produced in the action of the student in a *receptive* manner, through the materials that are provided to him, and *self-managing*, developing his knowledge in a creative, deductive, and integrative fashion.

It is noteworthy that these aspects should conform to the characteristics of the virtual courses themselves, in which receptive actions are not provided by the presence of an instructor in the classroom, but instead by the instructional material and the interrelationship that the instructor achieves with each student.

7. Conclusions

The demands of modern life have obliged the universities to affiliate themselves with the tendencies of current formation. Thus, they should improve the quality of the services that they offer and broaden the possibilities of academic development in all spheres; in this respect, ICT offer a conducive alternative to the improvement of higher education in Mexico, placing it on a par with that offered in European countries, due to that these permit the student to develop the following competencies: the capacity of analysis and synthesis; the capacity of learning to learn; problem solving; adapting to new situations; a concern for quality; the ability of information management; the ability to work anonymously; the ability to work in a team, and the capacity for organizing and planning.

The use of ICT in learning can facilitate the proposal of more flexible learning because, thanks to the communication networks that have overcome time-space barriers, these can bring information to a greater and more diverse number of persons, with which it breaks with the paradigm of the classroom in conventional systems, that is, the classroom understood as the physical space where students converge to develop knowledge and to obtain learning, which can be obtained anywhere due to the support of the technologies and contributing to dynamism in the classroom.

Each environment is designed, consciously or unconsciously, from a pedagogical philosophy.

Some environments privilege the creation and distribution of formative content, assuming that the contact of students with relevant, carefully designed, materials is the key element in learning.

We are able to state, with satisfaction, that the results found in this investigation validate the efficacy of working with the new information and communications technologies, as well as the processes provided to us by Blended-Learning, when the students and the teaching staff have had prior training in this respect.

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