Information Technologies in Higher Education: Lessons Learned in Industrial Engineering

Milagros Delgado-Almonte, Hernando Bustos Andreu and Liliana Pedraja-Rejas
Escuela Ingeniería Industrial, Informática y de Sistemas. Universidad de Tarapacá. 18 de Septiembre 2222, Arica-Chile// mdelgado@uta.cl // hbustos@uta.cl // lpedraja@uta.cl

ABSTRACT

This article describes a teaching experience in which information and communication technologies were applied in five industrial engineering courses at the Universidad de Tarapaca in Chile. The paper compares the performance and course pass rates of the e-learning platform and portable pocket PC platform with those of the same courses teaching in traditional classroom methods. Two of the courses involving 62 students used an e-learning platform and its associated pedagogical model, while the other three, covering 110 students, employed a portable Pocket PC platform and a collaborative pedagogical model. The results show that there is no statistical evidence that technology rise the students marks, but did reveal significant improvements in course pass rates.

Keywords

Engineering education, Information technologies, Collaborative education models

Introduction

In today's world where knowledge and information are key factors driving productivity, competitiveness and increased wealth and prosperity, nations are placing a high priority on developing their human capital. Employers now require workers to have the skills necessary for collaborating, working in teams and sharing information across global networks. Even more important, they must be flexible and able to learn quickly in a dynamic world where learning how to learn and rapidly acquiring new skills are essential. According to the World Bank Institute (Hawkins, 2002), these demands raise three fundamental questions: What defines a quality education in today's global information-based economy? Has education kept pace with a rapidly changing world? Are there good models for reform that we can follow?

It is in this context that Brunner & Tudesco, (2003) refers to the integration of new technologies into pedagogical practices as the "Digital Revolution in Education," noting that the emergence of new information and communication technologies (ICTs) is a genuine educational revolution whose consequences cannot yet be envisaged.

Despite this trend, there is as yet no solid evidence regarding what contribution these technologies can make to the educational process, and the results so far obtained suggest a mix of positive, negative and insignificant effects.

There is thus a need for more analysis of these technological tools based on concrete experiments in order to evaluate their use in different educational contexts and observe the various success and failure factors that explain the results obtained. In this spirit, the present work aims to provide an analysis of an experiment involving the incorporation of ICTs into the teaching-learning process of the industrial engineering program at the Universidad de Tarapacá in Chile. Two technologies were utilized in the experiment, the first a mobile classroom technology and the second a distance education application. In addition to analyzing the results, we report on the perceptions of the students and their satisfaction with the technological tools employed.

ICTs in education

ICTs are paving the way for new forms of communication and collaboration between students that are changing the work environment both for them and their teachers. Technology motivates students and energizes the classroom (Hawkins, 2002), and also prepares them for their future roles in today's society (Bustos & Nussbaum, 2007). The advantages conferred by these technologies are many. They facilitate the updating of educational material, promote various types of interaction between teacher and student, increase the flexibility of strategies for availability of and access to knowledge by enabling learning independent of time and place, allow students to form learning communities, permit facilitators to easily review student progress and encourage a student-centered environment that takes into account the many differences between students (Jolliffe et al., 2001).

Distance education

One of the first and most significant technologies to make its mark in the world of learning is distance education via the Internet. The advantages of e-learning compared to traditional course delivery include flexibility, accessibility and convenience for students, cost and time savings for educational establishments, and the ease and speed with which courses can be updated and revised. However, distance education also means the adoption of instruction methods that differ from those generally used in traditional courses (Northrup, 1998; Moore & Kearsley, 1996), for in the new structure of teaching that emerges, the instructor takes on the roles of facilitator, monitor and collaborator (Shedletsky, 1997).

The educational results for e-learning courses, where students access learning materials through a Web platform and all student communication is computer-mediated, have so far been varied. Findings on tests comparing student performance under this mode of course delivery with traditional classes and evaluations have ranged from no statistically significant difference (Coomey & Stephenson, 2001), (Collins, 2000), (Phipps & Merisotis, 1999), (Johnson *et al*., 2000), (Parker & Gemino, 2001), (Schulman & Simms, 1999), (Wegner et al., 1999), to a significantly better results for e-learning (Kekkonen & Moneta, 2002), (Schutte, 1997), (Zhang, 1998).

A large body of literature shows that interaction is a critical factor in student satisfaction, better academic achievement, a greater sense of involvement and a positive attitude toward distance education (Chapman *et al*., 1999), (Fredericksen et al., 2000), (Fulford & Zhang, 1993). Evaluating the satisfaction level of students in relation to their construction of knowledge in learning environments is also essential (Alavi, 1994).

Results from previous satisfaction studies have been mixed. Some were positive, finding that students were happy with e-learning (Amir et al., 1999), while others encountered lower levels of contentment (Rivera & Mc Alister, 2001). Online learning methods require much discipline and self-motivation (Golladoy et al., 2000), (Serwatka, 2003). Students have also reported that although Web tools are a useful complement to traditional classes, they should not replace them (Yazon et al., 2002).

Mobile technology

Mobile technology can also make an important contribution to the field of education. Interest is growing at the higher education level in collaborative learning, defined by Bustos (2007) as an activity that promotes learning through social interaction. Various studies suggest that working in groups in a collaborative context leads to better academic results (Johnson & Johnson, 1999). In such situations students learn more, retain the learned material longer, develop higher reasoning and critical thinking skills and feel more valued and confident (Gómez & Alamán, 2001).

Cortez et al. (2005) and Liang et al. (2005) demonstrate that the use of mobile devices in collaborative work can improve learning in the classroom. Klopfer et al. (2002) identify five features of personal digital assistants (PDAs or handhelds) that generate educational benefits:

- Portability: due to their reduced size and weight they can be easily transported to different sites.
- Social interactivity: data exchange and collaboration with other students are performed face to face (Nyiri, 2002), thus facilitating the innate human need to communicate.
- Context sensitivity: mobile devices can gather and respond to real or simulated data unique to the location, environment, and time.
- Connectivity: a shared environment can be created by connecting the PDAs to data collection devices, other handhelds or a common network.

- Individuality: the various difficulty levels of the activities can be personalized to suit the individual student's needs.

Zurita and Nussbaum (2007) have suggested that a range of deficiencies detected in collaborative classrooms such as problems of coordination, communication, materials organization, negotiation and interactivity as well as lack of mobility can be solved by creating a collaborative learning environment that is supported by a platform based on mobile computers such as wirelessly-interconnected Pocket PCs.

Valdivia and Nussbaum (2007) highlight the motivational and social aspects, thus, the collaborative work group activities promote social interaction between students in the classroom and also have a positive impact on student motivation and learning.

To sum up on the use of ICTs in education and its known effects, though the results obtained so far are not consistent, there is no denying the importance of these technologies in today's society as a communication medium, a management instrument and a teaching tool that can boost productivity and contribute to innovation in pedagogical practices. This being so, it is indispensable that more information be generated on the benefits to be expected from including ICTs in the teaching-learning process.

Description of technologies used and underlying pedagogical models

UTA^{med} distance education platform

The first technology used in our experiment implements a type of mediated education. Known as UTA^{med}, it consists of a teaching-learning platform based on a communication system mediated through technological resources. The pedagogical model behind it is intended to help students in the process of constructing skills. It is an asynchronous distance education model, meaning that teaching actions do not coincide either in time or place with student actions and uses the Internet as a medium and a learning tool to promote educational activity that is flexible, contextualized and in line with each student's learning pace.

The UTA^{med} is a constructivist formative model that allows the inclusion of ICT –supported learning materials that are designed especially for each course, producing a meaningful learning technology platform, allowing the student to establish close relations between their prior knowledge and new learning, therefore will be able to give a meaning to this new learning object.

The UTA^{med} teaching-learning platform has three environments – Tutor, Student and Manager – that are accessed at http://fad.uta.cl. In the first environment the tutor manages the distance education courses offered through four sections: curriculum planning, students, activities and library. The curriculum planning section has descriptions of the contents of the courses' various component modules, with information on important dates, objectives and activities. The students section contains a list of registered students and gives access to each of their activities so that the tutor can provide feedback and evaluations. The activities section accesses the list of activities with their corresponding deadlines, allowing students to submit the completed activity, and also sets out the activities evaluation rubrics or marking scales. Finally, the library section holds all the documents and tools in the different formats required by the students to properly carry out the activities. The Student environment is similar to Tutor, with sections denoted program, activities and library. Its interface is shown here in Figure 1.

The UTA^{med} distance education process for a course in which it is implemented begins with a presentation of the course syllabus, describing the contents of each module and the estimated dates of performance. The portfolio contains the activities made available by the tutor so the student can work on them. The student downloads an activity, which may be a task, an assignment or a report, and performs the corresponding work it before uploading it by the indicated deadline. The tasks or assignments indicate the documents needed for a given activity, which can be downloaded from the library. Once the student has completed an activity and uploaded it, he or she notifies the tutor, who then evaluates it according to the activity's predefined rubric.

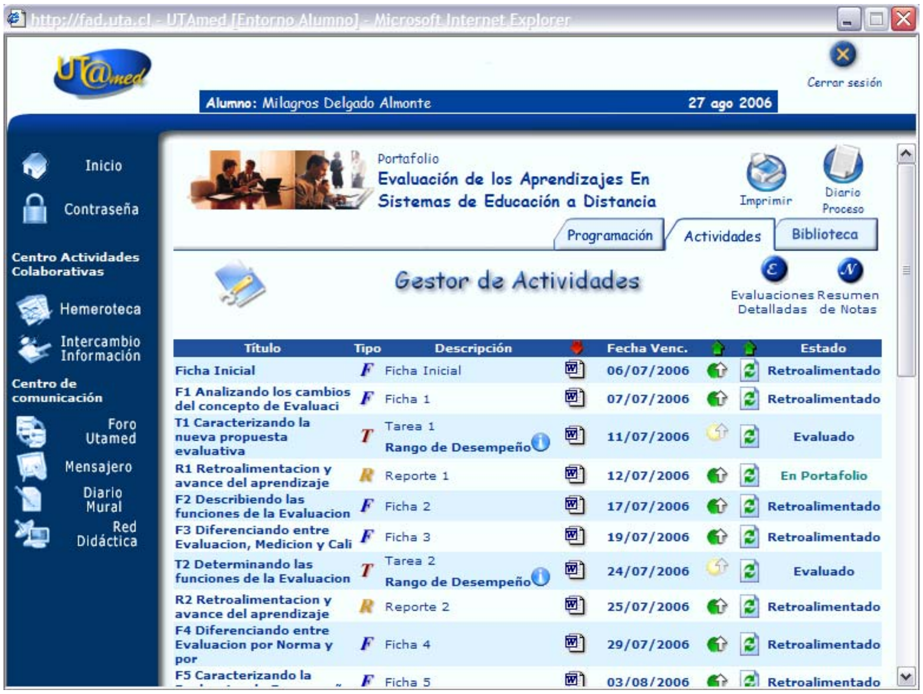

Figure 1. Student's interface - Activities section

In the case of an assignment, since their function is strictly didactic, no grade based on a rubric or scale awarded; rather, the student receives feedback through the platform. For tasks, evaluation is carried out according to predefined rubrics that represent the evaluation criteria and score on a scale of 1 (minimum) to 7 (maximum), with 4 as the minimum passing grade. The result of the evaluation is communicated to the student through the activities section together with an explanation of the criteria applied. Finally, the various task marks are averaged to arrive at the final grade, which can also be consulted on the platform. In the activities section, each activity has a state function that changes to indicate that it has been downloaded or uploaded, or that related feedback or an evaluation of it has been posted. Thus, if the state column reads "evaluated" the student can access his or her grade and any accompanying comments. This function keeps both student and tutor informed of state changes and what actions to take. Finally, reports are feedback activities that allow the tutor to view areas where the activities can be improved and monitor student progress in each module.

Each tutor design and plan the courses, the contents are arrange by different documents, that can be cases of study, lectures, exercises, etc. entirely online. Also each tutor define the system of evaluation that could be constituted by researches, projects, exams, cases, etc. each task have a rubric to define how it will be evaluate and its percentage of participation in the final grade. However all the tasks and the overall evaluation have the passing grade of 4 in a scale from 1 to 7. An example of contents of a course is in Appendix 1.

Mobile technology platform based on Pocket PCs

This technology, described in Bustos and Nussbaum (2007), consists of a mobile Pocket PC laboratory with a local area Wi-Fi network that is easily transported and can be used wherever there is an electrical outlet. It includes 50 Pocket PCs with 802.11x wireless connectivity capability, a router for creating a working network and two modified suitcases for carrying this equipment plus a large battery charger. The laboratory provides a hardware platform for a set of collaborative applications to be used in the classroom. The pedagogical model behind this tool is associated mainly with collaborative work in an on-site (as opposed to distance) context.

The application of the platform can be divided into five steps, as shown in Figure 2 (Bustos & Nussbaum, 2007). The first step is to create a content database of multiple-choice questions. Step 2 consists in designing a classroom pedagogical activity, which may be an evaluation or a collaborative activity, by choosing questions from the database. This activity is then loaded into the instructor's Pocket PC acting as a server (step 3), from which it can be sent wirelessly to the students (step 4). Finally, step 5 is the activity itself in which the students work collaboratively in groups of three chosen at random.

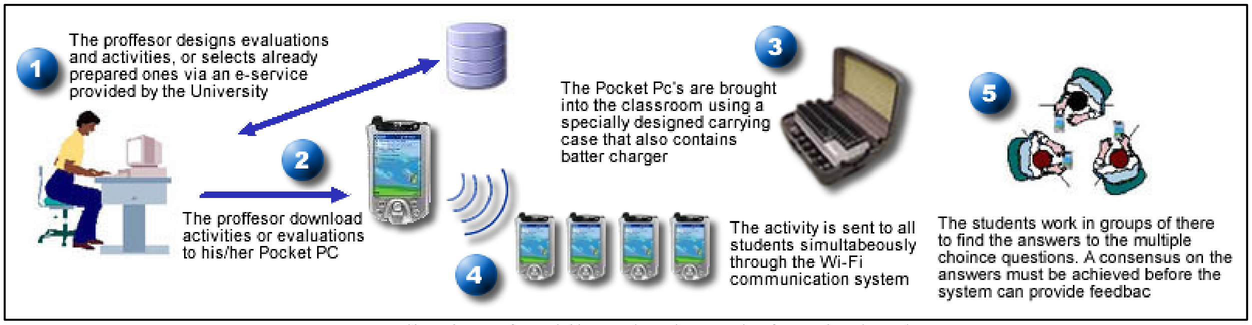

Figure 2. Application of mobile technology platform in the classroom

Two stages can be identified in the pedagogical model underlying the application of the platform:

Execution
The execution stage for an activity begins with the provision of a client Pocket PC to each student. The instructor's Pocket PC, in its role as a server, organizes the students randomly into work groups and creates an independent communication sub-network for each of them. A question is sent by the instructor to the groups, who then discuss and debate as they use their Pocket PCs to collaboratively arrive at a consensus response. Their answers are transmitted to the instructor, and if correct, new questions are sent out. The instructor maintains control over the activity via the Pocket PC server, and can stop it any time to provide an explanation or switch to a different question. Also, the server device has a view with a matrix that displays each group's progress and performance in the activity at any moment (see Figure 3).

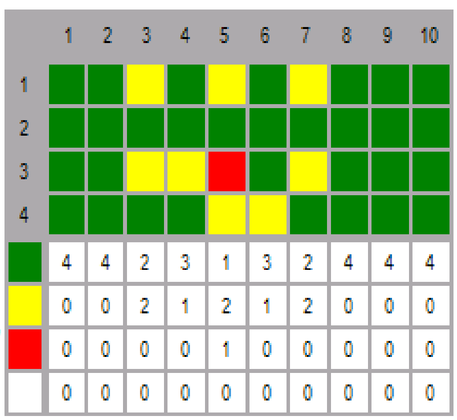

Figure 3. Results matrix

Closing
The closing stage follows upon completion of the execution stage and involves the analysis of the class groups' performance data given in the matrix displayed on the instructor's server device. This information allows the instructor to determine what material needs reinforcement and which groups' performance is lagging behind.

The tutor designs and plans the course in which part of the activities includes this collaborative tool. Each week the tutor prepares the collaborative activity consistent on questions based on the contents of the course explained the previous week, each activity is evaluated in a scale from 1 to 7 with a passing grade of 4, the results of the activities are part of the evaluation system of the course.

Methods

The current policy strategies of the Universidad de Tarapacá stress the role of innovation and technology development in the improvement of both undergraduate and graduate teaching. In this spirit, a group of academics at the institution have volunteered to introduce certain ICTs into their teaching practices within the framework of the present study. In particular, two professors of industrial engineering have adopted the technologies described in the previous sections, which have been applied in five specific courses of the program. Although in other areas of the university also has implemented the use of these technological tools, we chose to focus the study in Industrial Engineering as this area was a pioneer in using both technologies. Therefore, it was possible to analyze the impact of using both technologies in the same professional degree with the same profile of students.

In the case of the UTA^{med} platform, a training process of approximately two years duration was created for the design and implementation of distance courses, leading initially to a graduate diploma and then to a Master's degree in distance education. This program trains future instructors in the pedagogical characteristics of skills-based models such as distance education curriculum management and learning evaluation, and also covers the technological aspects such as the use of the platform and the design and production of multimedia material for educational applications. The combination of the pedagogical with the technological enables academics to experiment with changes in pedagogy by introducing technology into the courses and new strategies for managing them.

As for the Pocket PC-based system, students were trained in the use of this platform for developing educational content and applying technology in the classroom, and also studied its underlying pedagogical model. Thus, the future teacher is provided with both the technical knowledge required to work with the technology platform and the skills for creating educational material and practices to be used at the classroom level.

For both platforms, support was provided to assist professors and students in the use of the technologies and solve any problems that might arise during the activities, such as transporting the equipment in the case of the Pocket PC laboratory.

The experiment carried out for this study embodies a quasi-experimental design. Considering that learning is a social phenomenon, the study applies under normal conditions of a course (no laboratory conditions), therefore, for reasons of academic process and equity with participating students, it is considered that the courses were not be divided into experimental and control groups. However, for purposes of statistical analysis the group that applies technology is considered as the experimental group and for comparison the historical information of the professor for at least 3 instances in which delivered the course (control group 1), and the historical information of the course in the professional degree considering all the instances in which the course was given in the last 4 years including the occurrences of specific professor (control group 2).

The results are analyzed using a *t*-test to measure the differences between groups using technologies (experiment) and traditional courses (control) and Cohen's *d* to determine effect size. The Cohen's d is used to measure the strength of the relationship between two variables. It is often useful to know not only whether a relationship is statistically significant, but also the size of the observed relationship. The effect size measure could then result in a insignificant, small, medium, large or very large effect. According to this levels, figure 4 shows the values for Cohen`s d for interpretation.

Statistic	**Value**	**Interpretation**
Cohen's d	0.20	Small effect size
	0.50	Medium effect size
	0.80	Large effect size

Figure 4. Descriptors for Interpreting Effect Size (Kotrlik & Williams, 2003)

Kirk, (2001) justify the application of the effect size since statistical significance relies heavily on sample size, while effect size assists in the interpretation of results and makes trivial effects harder to ignore, further assisting researchers to decide whether results are practically significant (in Kotrlik, 2009). In the same line Baugh (2002) declared, "Effect size reporting is increasingly recognized as a necessary and responsible practice". It is a researcher's responsibility to adhere to the most stringent analytical and reporting methods possible in order to ensure the proper interpretation and application of research results.

In addition to the statistical analysis, a satisfaction survey of the students was administered. The questionnaire used is an adaptation, first presented in Valdivia & Nussbaum (2007), of the original version by Irons et al. (2002). Participants were asked to voluntarily and anonymously evaluate the distance education or virtual learning experience as well as their experience with the Pocket PC platform.

There were a total of 21 items on the questionnaire. The first three enquired as to the age and sex of the participant and the technological tool used, while the remaining 18 items asked respondents to indicate their conformity with a given statement on a 5-level Likert scale in which 1 indicated strong disagreement and 5 strong agreement. The questionnaire concluded with a section for general comments. The questionnaire is appended in Appendix 2.

The UTA^{med} approach was applied in three different one-semester courses (one of them given twice) in the University's industrial engineering program under the mediated education delivery mode. They were taught entirely as distance courses using the UTA^{med} platform, with students carrying out activities every week consisting of either assignment or tasks, as described above in 3.1. The Pocket PC platform was applied in two courses (one of them twice), with activities held once a week over the duration of the semester.

The various courses are listed in Tables 1 and 2 together with their corresponding enrollments, year and semester. All the courses are given at the upper division undergraduate level of Industrial Engineering, with the exception of Theory of Systems, which is taught in the sixth semester. The degree duration is twelve semesters, and the age average of the students was 22 years. Also for all the courses it was used the same pass grade (four).

Table 1. Courses given using UTA^{med} platform

Year	Semester	Course	Enrollment
2005	II	Industrial Accounting (CI)	27
2006	I	Human Resource Management (ARRHH)	13
	II	Industrial Accounting (CI)	22
		Total Enrollment	62

Table 2. Courses given using Pocket PC platform

Year	Semester	Course	Enrollment
2006	I	Management Information Systems I (SIA I)	34
	II	Management Information Systems II (SIA II)	36
	II	Systems Theory (TS)	26
2007	I	Management Information Systems I (SIA I)	14
		Total Enrollment	110

Additionally, to minimize variability related to the evaluation system and criteria of evaluation by the teacher, a comparison was made of historical pass rates of the same professor in the course with the pass rate of the course with technology.

Results

Initially we looked for whether there was difference in the courses grades, by comparing the courses that applied the two technologies with traditional courses, respectively (control group). For traditional courses we considered the historical grades of the course of the last 4 years and professor's grades dictating that course in the last three years. These results are shown in Table 3, where the columns experimental, control 1 and control 2 displays information of the means and standard deviations for experimental and control groups in the respective courses. The column "with technology versus historical professor" displays the results of the comparison of experimental and control 1 groups using t test (t-test column), the Cohen test (Cohen's d column) with its respective interpretation of impact (column effect size). In the same way, the column "with technology versus historical course" shows the results of the comparison of experimental and control 2 groups.

From the results of Table 3, it is observed that both the t-test results as the effect size showed no statistical evidence that confirms that the use of technology has an effect on the courses grades, except in one course: Industrial Accounting.

A second analysis was performed on the pass rates of the courses, i.e. the number of students who passed the course (the passing grade is 4), it was compared the pass rates of the courses that applied technology versus traditional ones (historical pass rate of the professor and course). The results of this analysis show that there is a statistically significant positive effect of the use of technology in the passing rates of the courses. The results are shown in Table 4 and 5.

From a qualitative perspective, the application of the questionnaire in the experimental group yields the following deduction:

The results of questions 7, 8 and 21 reflects that the student feels that communication and access to tutor have been enhanced by the use of UTA^{med} for courses without technological support, specifically UTA^{med}. Questions 4, 6, 10 and 19 are clearly a flaw relating to teamwork and communication with other students during the development of the course because students perceive that the technological tool, UTA^{med}, has had no effect on improving their communication and interaction with other students on the course.

The results of Question 9 strongly support the perception of power easier access to the resources on this subject. Questions 13, 18 and 20 are related to the student's desire to retake a subject using such technological tools or recommend other students to take a course with similar characteristics. The qualitative results of these questions indicate that students are more likely to take another course with UTA^{med} or recommend it to other students. Question 17 is not positive or negative evidence regarding the understanding of materials used in the subject. The answers to questions 11 and 12 show the positive image that share students on the course and feel more involved.

Table 3. Statistical significance tests: course grades (Significance level 5%)

					With technology vs historical professor							**With technology vs historical course**				
Course	Experimental		***Control 1***		***t-test***			***Cohen's d***	*Effect size*	***Control 2***		***t-test***			***Cohen's d***	*Effect size*
	M	SD	M	SD	T	df	p			M	SD	t	df	p		
SIA I	4.31	0.41	4.46	0.61	-0.99	28.30	0.1647	-0.30	Insignificant	4.32	0.92	-0.01	140.63	0.50	0.01	Insignificant
SIA II	4.80	0.35	4.90	0.62	-0.77	44.03	0.2232	-0.20	Insignificant	4.49	0.61	3.69	107.28	0.00017	0.56	Médium
TS	4.55	0.52	4.49	0.43	0.47	46.25	0.3189	0.13	Insignificant	4.53	0.72	0.17	39.44	0.4339	0.03	Insignificant
ARRHH	4.62	0.46	4.86	0.68	-1.56	25.17	0.0656	-0.37	Insignificant	4.78	0.68	-1.09	22.05	0.1445	-0.25	Insignificant
CI	5.1	0.74	4.6	0.72	3.86	88.11	0.0001	0.71	Large	4,4	0,74	5.38	78.56	0.0000004	0.92	Very large

Table 4. Pass rates with technology platform and historical results

Course	**Pass rate using technology (%)**	**Historical pass rate, professor (%)**	**Historical pass rate, course (%)**
SIA I	96.0	94.48	78.57
SIA II	100	93.3	89.9
TS	96.15	87.88	88.34
ARRHH	100	95	95
CI	97.92	91.58	87.68

Table 5. Statistical significance tests: course pass rates

Comparison	*Experiment*		*Control*		*t-test*			*Cohen's d*	*Effect size*	*Comments*
	M	*SD*	*M*	*SD*	*t*	*df*	*P*			
With technology (experiment) v/s Historical (professor)	98.01	1.96	92.45	2.87	3.58	7.07	0.0044	2.26	Very large	In both cases, the results are significant. The use of the technology is strongly related to the improvement in pass rates.
With technology (experiment) v/s Historical (course)	98.01	1.96	87.90	5.95	3.61	4.86	0.0081	2.28	Very large	

Discussion

These outcomes indicate that the effect of employing the technology on the course marks was not statistically significant, that is, the application of technological tools like e-learning and Pocket PC didn't impact on the students grades. However, a significant effect was found for the pass rates, the courses that used technologies have higher pass rates than the ones that applied a traditional methodology, i.e. without technology.

Moreover, comparing the media columns of the experimental and control groups in table 5, it show that application of the technology resulted in a pass rate increment of 10% over the historical rate for the course, and a 5% increment over the historical rate for the professor teaching it. Note also that the actual pass rates for the courses using the technology were all above 95% and in two cases reached 100% (table 4).

From the academic point of view we might point out that it is highly valued to improve pass rates of courses. Since this improves retention and graduation rates, critical factors in engineering programs in the country. On the other hand, from the point of view of governance and institution, the impact of these improvements in the aforementioned indicators, promote issues related to accreditation of the professional degree and the institution, funding, student perception, among others.

Secondarily the application of these information technologies contributes to the development of generic skills such as use of ICTs, teamwork, interpersonal communication and self-learning, defined in the profile of industrial engineering degree.

On the other hand, the satisfaction questionnaire taken by each of the groups in the experiment yielded the following results regarding the students' views and opinions on using the technology platforms:

For the Pocket PC platform:

- The technology was found to be attractive and its use in other courses would be welcomed.
- It was recognized that the technology increased communication and the effectiveness of work among participants.
- The technology was perceived to facilitate learning and greater participation.

For the UTA^{med} platform:

- It was strongly perceived thatstudents can access easier to course resources.
- The students expressed a greater willingness to take another course using this platform or recommend it to other students. Their responses manifested a positive image of the course and a greater sense of involvement.
- As regards the contribution of UTA^{med} to mastery of course content, the students felt that the platform had significantly contributed to their learning.

- Finally, the skills-based model applied in virtual education, in which the student learns to know, to do and to be and emphasis is placed on the student's work, the tutor's role becomes that of a learning facilitator. This led students to comment on how arduous was the work they had to perform, particularly the constant assignment and tasks that had to be carried out, as opposed to the traditional system.

Limitations and future address

The work presented was generated from an exploratory perspective. It is hoped that future work is oriented to an explanatory research. This approach would involve the determination of empirical measures of how education is measured by changes in learning and improving the quality of education with the use of technological tools.

Conclusions

First of all, the statistical analysis of the experimental results confirmed the variability of the findings in previous studies of ICTs as to whether their use contributes significantly to the teaching-learning process specifically over students' performance (average grades). Nevertheless, there is significant evidence that the use of ICTs leads to substantial improvements in class group performance (pass rates).

Secondly, in comparing both technology platforms there is no evidence of significant differences between the two groups' performance by technology was found. Though, it was observed that the Pocket PC platform was more easily assimilated by the students due to its underlying collaborative learning model.

As regards the process of applying ICTs to the courses, we may say that the use of ICTs requires that instructors invest additional time and effort in their courses due to the need for preparing/adapting to the teaching resources, learning the technology and adapting the pedagogical model , also students invest more time reading and studying by themselves than in a traditional class. Moreover instructors will adopt a particular technology more quickly if it "fits" their mental model of teaching courses in their field. Proper planning of a technology's use and the support provided to both instructors and students play a fundamental role in the successful adoption of an ICT.

Whether or not ICTs bring about improvements in teaching quality, their inclusion in educational processes is beneficial given that by learning to use them, students acquire an important competitive advantage for today's globalized and computerized society.

The results of the questionnaire indicated that the use of ICTs is valued positively by the students, who recognize them as a tool that facilitates learning. Although for future research would be to develop an explanatory analysis of the incorporation of technology in the classroom that would identify which factors have the greatest impact on the quality of the teaching-learning process and proof the enhancement of education besides the grade or the pass rates.

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Appendix 1

Course Contents

1. Introduction to the Human Resources Management
1.1 Definition and concepts
1.2 Function and objectives of the Human Resources Management
1.3 External and internal conditions for the Human Resources Management
1.4 Equality of opportunity and the law

2. Recruitment and Placemen
2.1 Job analysis, description and specification of the charge
2.2 Sources for recruitment
2.3 Recruitment procedures
2.4 Planning

3. Training and human resource development
3.1. Training and development
3.2. Management and career planning

4. Performance Evaluation
4.1. Objectives, concepts and criteria
4.2. Methods for evaluation
4.3. Possible mistakes and problems within performance evaluation

5. Maintenance of Human Resources
5.1. Compensation system
5.2. Employee benefits and services
5.3. The worker safety and health
5.4. Industrial relations

6. Strategic aspects of human resource management
6.1. Strategic planning and human resource management
6.2. Effects of technology in the HRM
6.3. Quality of work life
6.4. New Challenges in the HRM

Appendix 2

Questionnaire

The following questions are related to your experience with the use of the e-learning platform UTA[med] in the course _______. Please answer each question according to this experience. They will be very useful to enhance the design of future versions of this course.

1. Age:
2. Gender:
    1. Male ☐
    2. Female ☐
3. Name:

Item	**Strongly disagree**	**Disagree**	**Indecisive**	**Agree**	**Strongly agree**
	1	2	3	4	5
1. The use of the technological tool has increased my communication with other students.	1	2	3	4	5
2. The use of the technological tool has significantly contributed to my learning of the contents of the course.	1	2	3	4	5
3. The use of the technological tool has allowed me to work effectively with other students.	1	2	3	4	5
4. I have communicated more with the teacher due to the use of the technological tool.	1	2	3	4	5

Please compare your experience as student of this course with previous experiences in other traditional courses of your career.

Item	**Strongly disagree**	**Disagree**	**Indecisive**	**Agree**	**Strongly agree**
	1	2	3	4	5
1. Access to the teacher has increased through the use of the technological tool.	1	2	3	4	5
2. Access to resources for this course has been more convenient.	1	2	3	4	5
3. I have communicated more with other students due to the use of technological tool.	1	2	3	4	5
4. This course was more boring than other courses I have taken.	1	2	3	4	5
5. I feel less "involved" in this course than other courses.					
6. I wouldn't take another course using this technological tool.					
7. I learned more because of my participation in classes.					
8. Attend this course improve the quality of my education.					
9. It was difficult to receive the attention of the teacher during class when necessary.					

If applicable, describe the manner in which garnered the attention of the teacher:

Item	Strongly disagree	Disagree	Indecisive	Agree	Strongly agree
	1	2	3	4	5
1. The materials used in class (guides, notes, exercises) were easy to understand.	1	2	3	4	5
2. I would recommend this course to other students.	1	2	3	4	5
3. It was easy to communicate with other students in this course.	1	2	3	4	5
4. I would not recommend a course using this technological tool to other students.	1	2	3	4	5
5. It was easy to communicate with the teacher, particularly when using the technological tool.					

General comments from the course: