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Artículos Científicos

Competencias para el uso de las TIC en estudiantes de educación superior: un estudio de caso

ICT Competences in students of higuer education, a case study

Competências para o uso de TIC em estudantes do ensino superior: um estudo de caso

Carlos Miguel Amador Ortiz
Instituto Tecnológico José Mario Molina Pasquel y Henríquez, campus Puerto Vallarta, México
carlos.amador@vallarta.tecmm.edu.mx
https://orcid.org/0000-0001-6654-8448

Leticia Velarde Peña
Instituto Tecnológico José Mario Molina Pasquel y Henríquez, campus Puerto Vallarta, México
leticia.velarde@vallarta.tecmm.edu.mx
https://orcid.org/0000-0003-1096-1035

Resumen

En este trabajo se presenta un estudio llevado a cabo en el Instituto Tecnológico José Mario Molina Pasquel y Henríquez (TECMM), campus Puerto Vallarta, en el que se analizan las competencias para el uso de las TIC de estudiantes. Para tal fin, se diseñó un cuestionario tomando en cuenta los dominios e indicadores de los estándares de la International Society for Technology in Education (ISTE, 2007). El estudio se llevó a cabo con una muestra estratificada de 310 estudiantes (de una población de 1605 alumnos). Los resultados más significativos se consiguieron en el uso de las TIC en el TECMM y ciudadanía digital, mientras que los más bajos se obtuvieron en comunicación y colaboración, y creatividad e innovación. Por carrera, los hallazgos más consistentes se

encontraron en ingeniería en Sistemas Computacionales, mientras que los más bajos fueron para Gastronomía e ingeniería en Electromecánica. Con estos datos se espera diseñar estrategias que permitan mejorar las capacidades de los alumnos en las áreas con menor desarrollo de competencias.

Palabras clave: competencias tecnológicas, estándares TIC, estrategias de capacitación.

Abstract

In this paper is presented a study carried out at the Higher Technological Institute of Puerto Vallarta, which analyzes the competences for the use of ICTs for students, for which a questionnaire was designed taking into account the domains and indicators of the standards of the International Society for Technology in Education (ISTE, 2007). The study was carried out with a stratified sample of 310 students from a population of 1605, and the results show a considerable development of competences for the use of ICTs in some domains in relation to others, a relevant aspect to design strategies to improve the skills of students in the less developed areas.

Keywords: technological competences, ICT standards, training strategies.

Resumo

Este artigo apresenta um estudo realizado no Instituto Tecnológico José Mario Molina Pasquel e Henríquez (TECMM), campus de Puerto Vallarta, no qual são analisadas as competências para o uso das TICs dos alunos. Para tanto, foi elaborado um questionário levando em consideração os domínios e indicadores dos padrões da Sociedade Internacional de Tecnologia em Educação (ISTE, 2007). O estudo foi realizado com uma amostra estratificada de 310 alunos (de uma população de 1605 alunos). Os resultados mais significativos foram alcançados no uso de TIC no TECMM e cidadania digital, enquanto os mais baixos foram obtidos em comunicação e colaboração, criatividade e inovação. Por carreira, os resultados mais consistentes foram encontrados em Engenharia de Sistemas de Computação, enquanto os mais baixos foram para Gastronomia e Engenharia Eletromecânica. Com esses dados, espera-se criar estratégias que permitam aos alunos melhorar suas habilidades nas áreas com menor desenvolvimento de habilidades.

Palavras-chave: habilidades tecnológicas, padrões de TIC, estratégias de treinamento.

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Introduction

Throughout history, the different institutions that make up society must constantly change to adapt to the needs of each era. An example of this is the universities, educational entities on which the responsibility falls both to generate the most up-to-date scientific knowledge and to transmit it to future generations. This has always been the case, as it happened in Plato's academy or as it happens in more modern institutions, such as the University of Bologna in Italy, the University of Paris in France and the University of Oxford in England, which stand out for having a formal structure and recognized studies (Buchbinder, 2011; Gómez, 1998).

> Indeed, in all the historical route that goes from Antiquity to the present, universities have been characterized by their flexibility to adapt to the different scenarios that have been presented. In fact, today the technological revolution has required universities to include within their training environment the use of multimedia resources to improve educational quality and to train professionals with high standards around digital skills. In this regard, Navarro (2007) comments: "Information and communication technologies (ICT) have developed an extraordinary potential in recent decades by configuring a new type of society in the information age" (p. 6).
>
> The universities, for being educational systems
>
> open, they cannot be oblivious to the changes that occur in their environment

Perrenoud (2010) defines a competence as "an ability to act effectively in a defined type of situation; ability that relies on knowledge, but not reduced to them "(p. 7). The competences involve a set of knowledge (knowledge, skills and attitudes) in relation to a particular performance, since the ICT approach in students of Higher Education implies the abilities to use these technological tools effectively as part of their training process (to learn), and for its application in the professional field.

In this context, and as Cabero (2007) comments, the massive use of the Internet and free access to huge amounts of information from any mobile device has served to create new spaces for interaction: "We move in a new space, cyberspace , in a new society, cybersociety, in a new culture, cyberculture, with new money, electronic money, and in new educational rooms, virtual centers

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”(p. 5). Therefore, it is necessary that new professionals can take advantage of the advantages offered by the latest technologies to optimize production processes and to solve problems of different areas of knowledge (Amador, 2013).

Explained the above, it can be indicated that in the present work we have tried to determine what are the competences that the ICT students handle at the José Mario Molina Pasquel y Henríquez Technological Institute (TECMM), Puerto Vallarta campus. The purpose is to provide relevant institutional information for the design of training strategies in the areas that require greater consolidation in terms of how students use ICT. This is expected to help respond to the challenges imposed by the productive sector to higher education institutions, especially in everything related to the need to train professionals who are able to adapt and solve problems in their respective specialties.

Overall objective

- Analyze the development of skills in the use of ICT of students of TECMM, Puerto Vallarta campus, in order to establish levels of appropriation according to ISTE standards and design strategies that contribute to educational improvement.

Specific objectives

- Review the status of the issue of proposed standards in competencies for the use of ICT in students.
- • Diagnose the technological competences for the use of ICT by students of TECMM, Puerto Vallarta campus, based on ISTE standards.
- • Describe the development of skills for the use of ICT by students of TECMM, Puerto Vallarta campus, to propose recommendations and improvement strategies.

Methodology

This was an analytical and transversal research, with a quantitative approach, since the variables were quantified for analysis. Likewise, the study was based on the principles of descriptive research because aspects of reality were examined and described that made it possible

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to determine the competences regarding the use of ICT by students of TECMM, Puerto Vallarta campus. Likewise, and with the results obtained, strategies were proposed to promote the most efficient use of ICT in the teaching and learning processes.

As for the method, this was deductive because pre-established models were used that allowed a tour that began in general and culminated in the particular; but, at the same time, it was inductive because for the collection and analysis of the data we worked with a probabilistic sample that allowed us to generate more general conclusions. In general, the following steps are presented in this investigation:

1. Review of the state of the question about standards for the use of ICT in university students and about instruments to analyze the use of ICT.
2. Determination of the type of instrument to administer.
3. Sample selection and instrument administration.
4. Data processing, obtaining results and drawing conclusions.

Review of the status of the issue on standards for the use of ICT in university students and on instruments to analyze the use of ICT

After reviewing the state of the matter, it was decided to adopt as a theoretical-conceptual framework the proposal of standards in ICT skills for students of the International Society for Technology in Education (ISTE, 2007).

Figura 1. Estándares ISTE para estudiantes

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Fuente: International Society for Technology in Education (2007)

This proposal includes six standards: 1) creativity and innovation, 2) communication and collaboration, 3) research and information management, 4) critical thinking, problem solving and decision making, 5) digital citizenship and 6) operations and concepts of ICT On these standards, indicators of ICT use competencies are specified. According to the International Society for Technology in Education (2007), these indicators are relevant because they specify "what students should know and be able to do to effectively learn and live productively in an increasingly digital world" (p. 2). These indicators are described below.

a. Creativity and innovation

This indicator refers to when students demonstrate creative thinking, build knowledge and develop innovative products and processes using ICT. In other words, students fulfill the following tasks:

- Apply existing knowledge to generate new ideas, products or processes.
- Create original works as means of personal or group expression.
- Use models and simulations to explore complex systems and issues.
- Identify trends and anticipate possibilities.

b. Communication and collaboration

This indicator refers to when students use digital media and environments to communicate and work collaboratively, even remotely, to support individual learning and contribute to the learning of others. Students meet the following:

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- Interact, collaborate and publish with peers, experts or others, using a variety of environments and digital media.
- They effectively communicate information and ideas to multiple audiences, using a variety of media and formats.
- Develop a cultural understanding and global awareness by linking with students from other cultures.
- Participate in teams that develop projects to produce original works or solve problems.

c. Research and information management

This criterion has to do with students who apply digital tools to obtain, evaluate and use information. Students perform these tasks:

- Plan strategies that guide research.
- • Locate, organize, analyze, evaluate, synthesize and use information ethically from a variety of sources and media.
- • Evaluate and select sources of information and digital tools to perform specific tasks, based on their relevance.
- • Process data and communicate results.

d. Critical thinking, problem solving and decision making

This variable refers to when students use critical thinking skills to plan and conduct research, manage projects, solve problems and make informed decisions using appropriate digital tools and resources. Students, therefore, fill the following assignments:

- Identify and define authentic problems and significant questions to investigate.
- Plan and manage the activities necessary to develop a solution or complete a project.
- Collect and analyze data to identify solutions and / or make informed decisions.
- Use multiple processes and diverse perspectives to explore alternative solutions.

e. Digital citizenship

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In this criterion, students understand the human, cultural and social issues related to ICT and practice legal and ethical behaviors. In short, students perform these types of activities:

- Promote and practice the safe, legal and responsible use of information and ICT.
- Exhibit a positive attitude towards the use of ICT to support collaboration, learning and productivity.
- Demonstrate personal responsibility to learn throughout life.
- They exercise leadership for digital citizenship.

f. Functioning and concepts of ICT

This criterion is related to students when they demonstrate an adequate understanding of the concepts, systems and operation of ICT. In this regard, students consider the following activities:

- Understand and use technological information and communication systems.
- Select and use applications effectively and productively.
- Investigate and solve problems in systems and applications.
- Transfer existing knowledge to learning new ICT.

Determination of the type of instrument to administer

A questionnaire prepared by Amador (2015) was used, which is composed of 46 items based on the dimensions mentioned above, to which the use of ICT dimension in the TECMM was added, based on similar works (Cabero, Llorente and Marín, 2010; Llorente and Cabero, 2010).

Regarding the validity and reliability - essential requirements of any measuring instrument (Hernández, Fernández and Baptista, 2010) - an expert review was made for the preparation of the instrument. The results of this step are shown in Table 1, specifically in Cronbach's alpha internal consistency coefficient (Oviedo y Campo-Arias, 2005).

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Tabla 1. Índices de fiabilidad obtenidos para la escala

Dimensiones	Alfa de Cronbach
1) Creatividad e Innovación	.719
2) Comunicación y colaboración	.694
3) Investigación y manejo de Información	.833
4) Pensamiento crítico, solución de problemas y toma de decisiones	.891
5) Ciudadanía digital	.818
6) Operaciones y conceptos de las TIC	.848
7) Uso de las TIC en el TECMM	.706
TOTAL	.787

Fuente: Elaboración propia

For the analysis of the data, based on a work of a similar nature (Rangel and Peñalosa, 2013), a scale was proposed to interpret the average results of the students in each of the dimensions according to the following values:

- Level I (from 0 to 5.5): Low development of academic skills for the use of ICT; it requires more generalized training for the academic use of ICT.
- Level 2 (from 5.6 to 7.4): Average development of academic skills for the use of ICT; It requires strengthening some areas.
- Level 3 (from 7.5 to 10): High development of academic skills for the use of ICT; It does not require training, although a constant update in skills for the academic use of ICT is necessary.

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Sample selection and instrument administration

For the population and sample, a probabilistic cluster stratified sampling consisting of 310 students from a population of 1605 was used. Groups from the different careers were randomly chosen to meet the expected sample, as shown in Table 2:

Tabla 2. Datos de la muestra por carrera (estratificada)

Carrera	Población	Muestra
Ingeniería en Gestión Empresarial	516	100
Ingeniería en Sistemas	201	39
Informática y Tecnologías de la Información	50	10
Electromecánica	232	45
Arquitectura	289	56
Gastronomía	317	60
Total	1605	310

Fuente: Elaboración propia

Data processing, obtaining results and drawing conclusions

The data obtained from the form were exported to a spreadsheet where graphs were generated that were analyzed and served to issue conclusions.

Results

The results collected in the surveys applied to the participating students are presented below:

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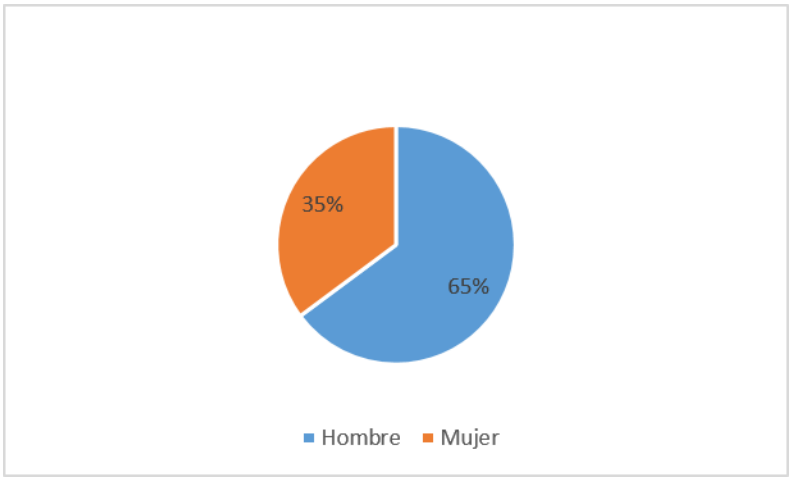
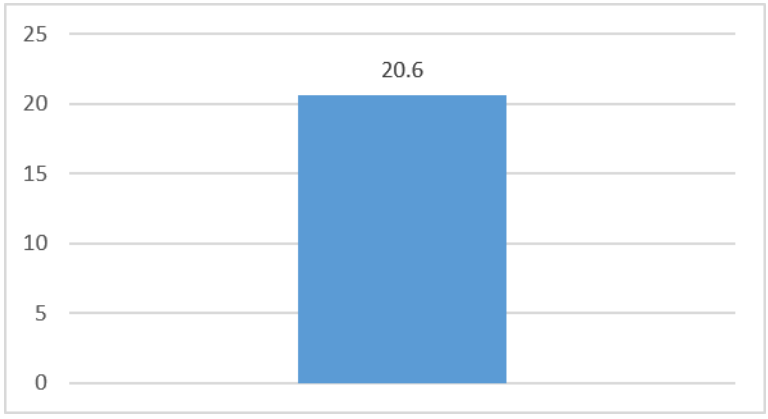
Figura 2. Alumnos encuestados por sexo



Fuente: Elaboración propia

Figure 2 shows the results obtained according to the 310 surveys carried out. This figure shows that 65% (210 students) were men, while the remaining 35% (109) were women.

Figura 3. Promedio de edades de alumnos encuestados



Fuente: Elaboración propia

The average age of the students surveyed was 20.6 years; As for the age ranges, the younger ones were 18 years old, while there was a 46-year-old person (higher age range).

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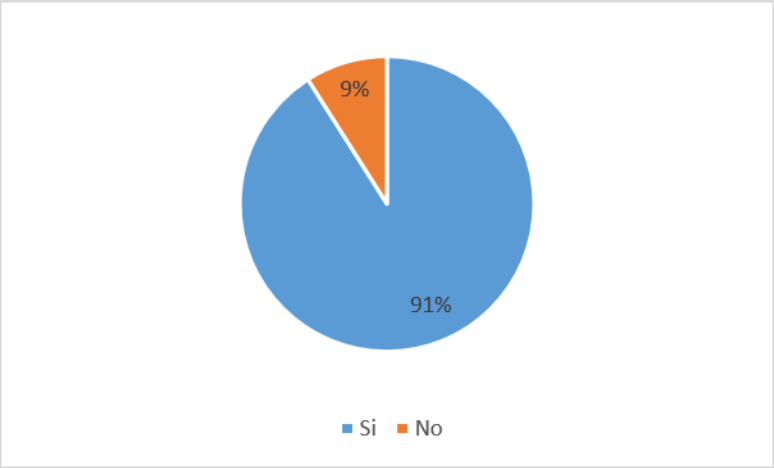
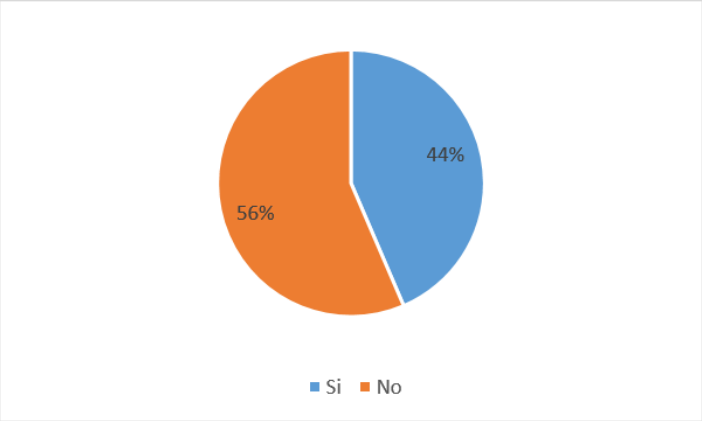
Figura 4. Equipo de cómputo



Fuente: Elaboración propia

Of the 310 respondents, 282 (91%) indicated that they had their own computer equipment, while 28 students (9%) responded negatively. This data is relevant, since it is an indicator of students' access to ICTs and the importance that this has for higher education.

Figura 5. Computadora de escritorio en casa



Fuente: Elaboración propia

The results of students who have a desktop computer at home are presented in Figure 5. In this regard, 135 (44%) indicated that they did have this equipment, while 175 (56%) responded negatively.

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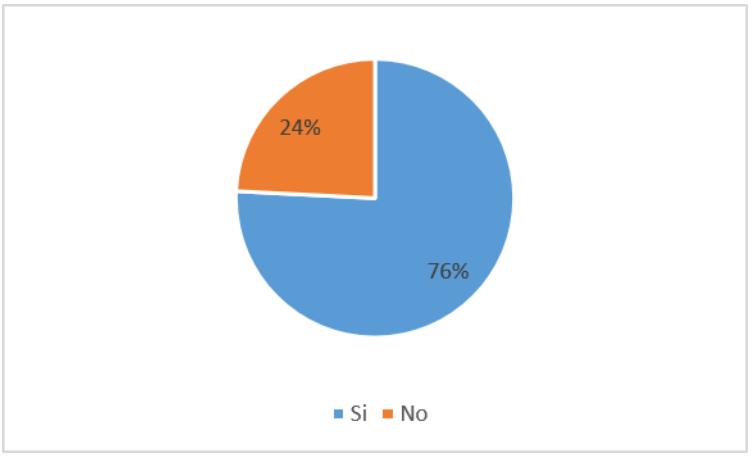
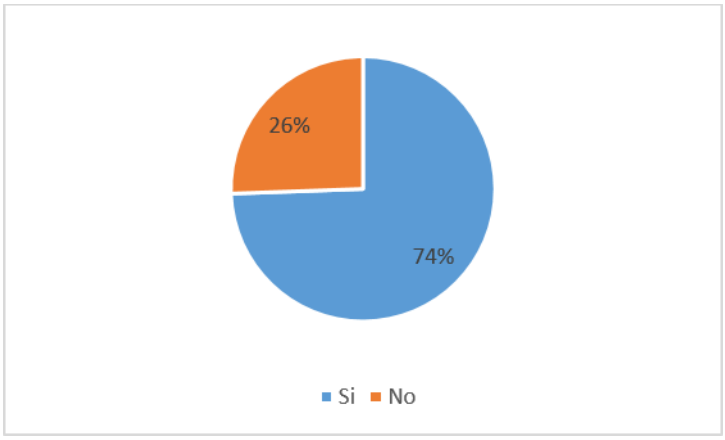
Figura 6. Computadora personal (*laptop*)



Fuente: Elaboración propia

Figure 6 shows the results of the students who have a personal computer or laptop. In this regard, 235 (76%) do have that device, while 75 (24%) do not have a laptop. If this result is compared with the information shown in Figure 5, it can be seen that there are more students who have a laptop compared to those who have a desktop computer.

Figura 7. Servicio de internet en casa



Fuente: Elaboración propia

Figure 7 shows that 230 students (74%) have internet at home, while 79 students (26%) do not have this service.

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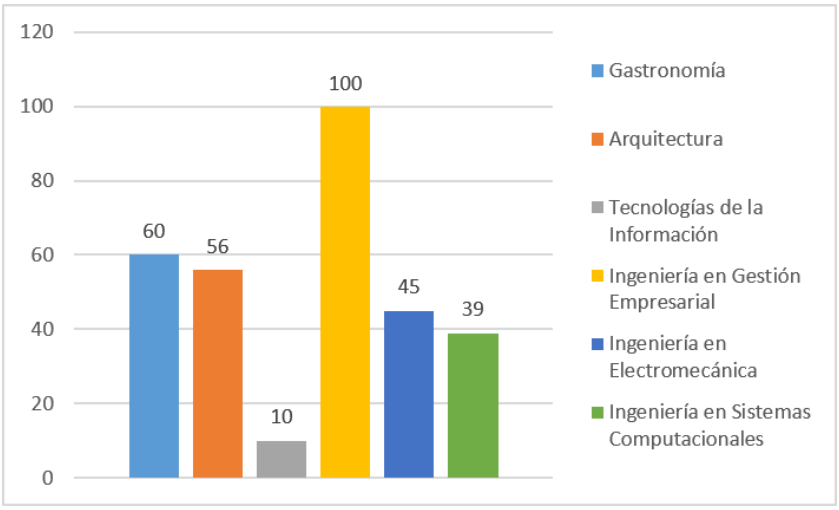
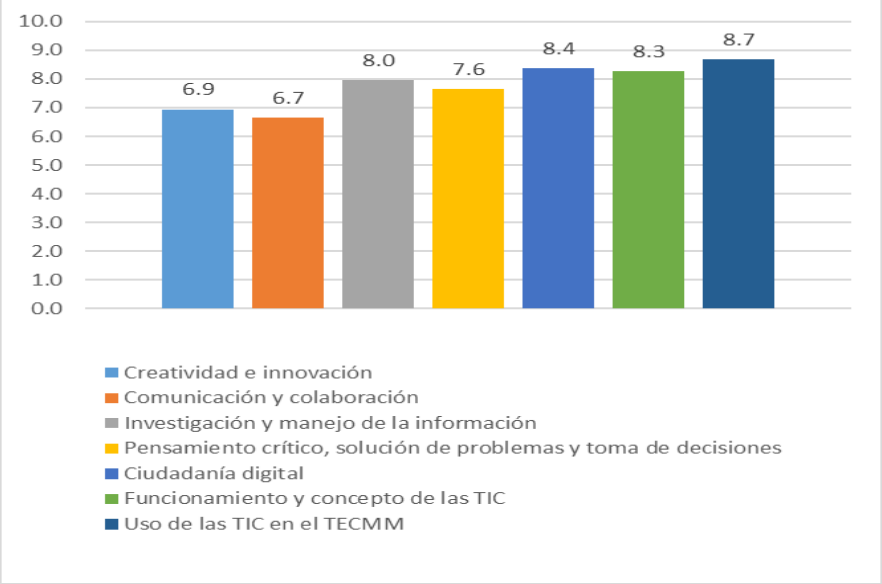
Figura 8. Alumnos encuestados por carrera



Fuente: Elaboración propia

Figure 8 shows the distribution of the total sample per run. According to the data collected, the largest number of students surveyed (100) studied the Business Management degree, while Information Technology only involved 10 students because this date was a new career.

Figura 9. Resultados generales por dimensión



Fuente: Elaboración propia

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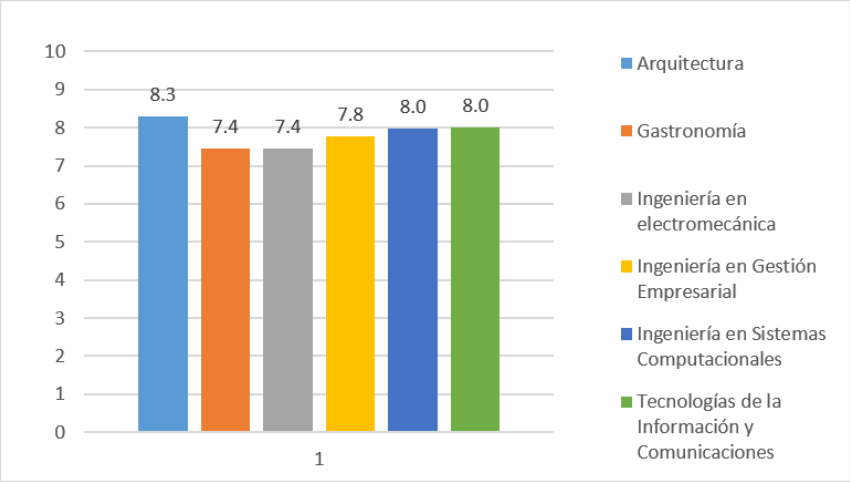
Figure 9 shows the general results of all races for each of the dimensions analyzed. The lowest values were obtained in the communication and collaboration dimension with 6.7 out of 10 possible, followed by creativity and innovation with 6.9. The highest values were found in the use of ICT in the TECMM. In general, it is emphasized that students use the institutional tools related to ICTs, such as the distance education platform and the internal system for academic procedures.

Figura 10. Resultados generales por carrera



Fuente: Elaboración propia

Figure 10 shows the general average values obtained in each of the races. The lowest were obtained in Gastronomy and in Electromechanical Engineering with 7.4, and the highest values were found in Architecture with 8.3. In this regard, it should be mentioned that in this last race students must use specialized software for architectural design; It is also notable that students in the area specialized in ICT (Computer Systems Engineering and Information Technology and Communications) reached the second highest result, which indicates that although they have good technical skills, they need to develop skills applied to academic fields.

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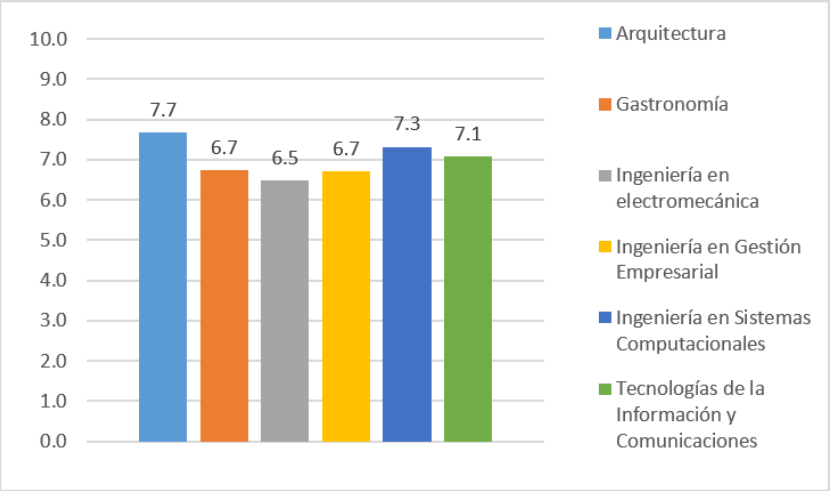
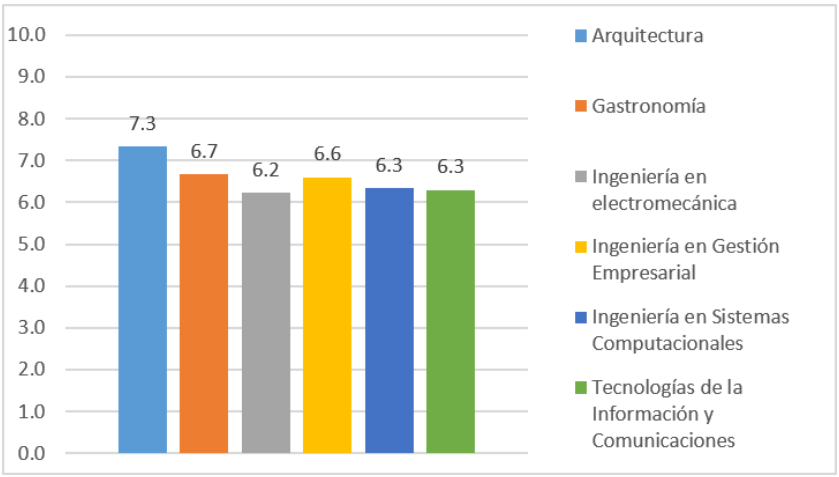
Figura 11. Creatividad e innovación por carrera



Fuente: Elaboración propia

Figure 11 shows the average results per career obtained in the creativity and innovation dimension. The lowest values were achieved in Engineering in Electromechanics with 6.5, and the highest in Architecture with 7.7. As indicated in Figure 10, it should be taken into account that the latter use specialized tools in ICT for architectural design, hence developing skills related to creativity and innovation.

Figura 12. Comunicación y colaboración por carrera



Fuente: Elaboración propia

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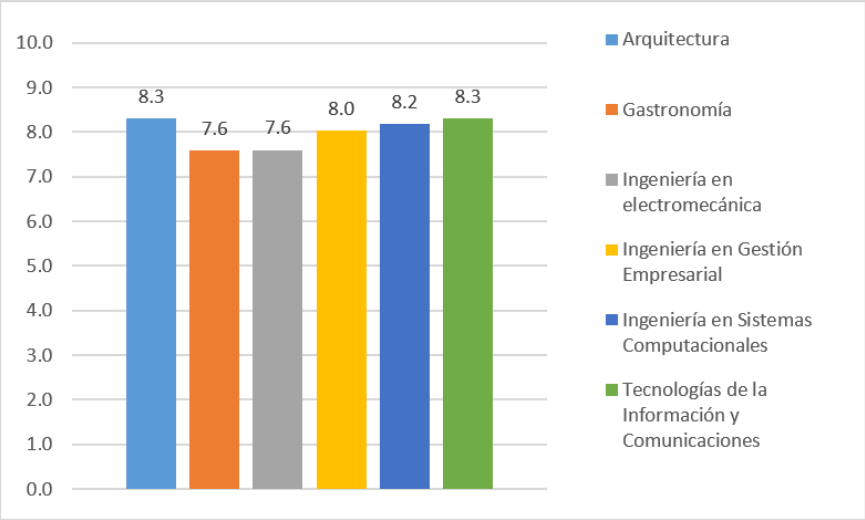
Figure 12 shows the average results obtained by career in the communication and collaboration dimension. The lowest values were found in Engineering in Electromechanics with 6.2, and the highest in Architecture with 7.3, results similar to the creativity and innovation dimension.

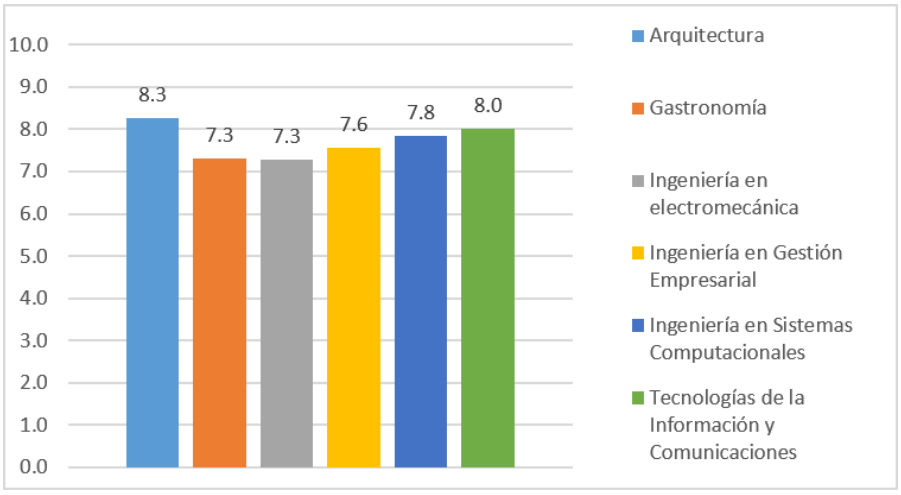
Figura 13. Investigación y manejo de la información por carrera



Fuente: Elaboración propia

Figure 13 shows the results of the research and information management dimension. The lowest values were in Gastronomy and in Electromechanical Engineering with 7.6, and the highest in Architecture and Information Technology with 8.3.

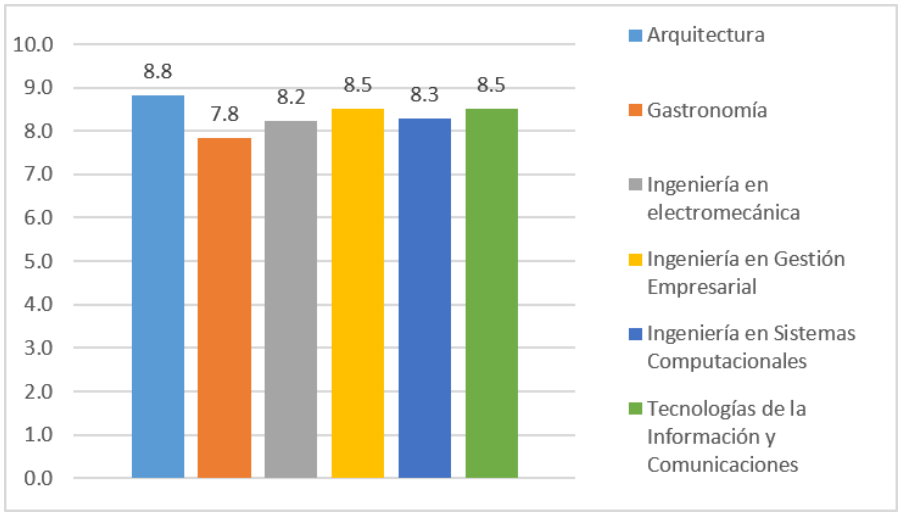
Figura 14. Pensamiento crítico, solución de problemas y toma de decisiones por carrera



Fuente: Elaboración propia

Figure 14 shows the results of the critical thinking, problem solving and decision making dimension. The lowest values were obtained in Gastronomy and in Electromechanical Engineering with 7.3, and the highest in Architecture with 8.3.

Figura 15. Ciudadanía digital por carrera



Fuente: Elaboración propia

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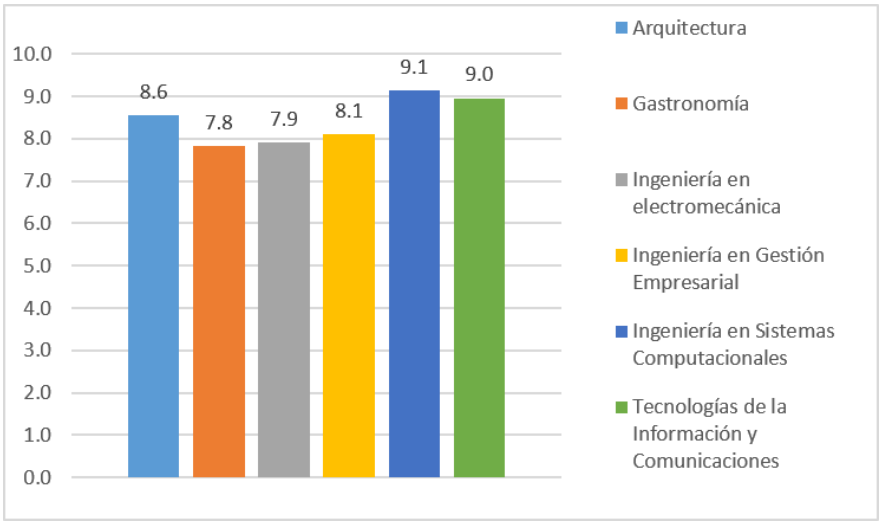
Figure 15 shows the average results per career in the digital citizenship dimension. The lowest values were obtained in Gastronomy with 7.8, and the highest in Architecture with 8.8.

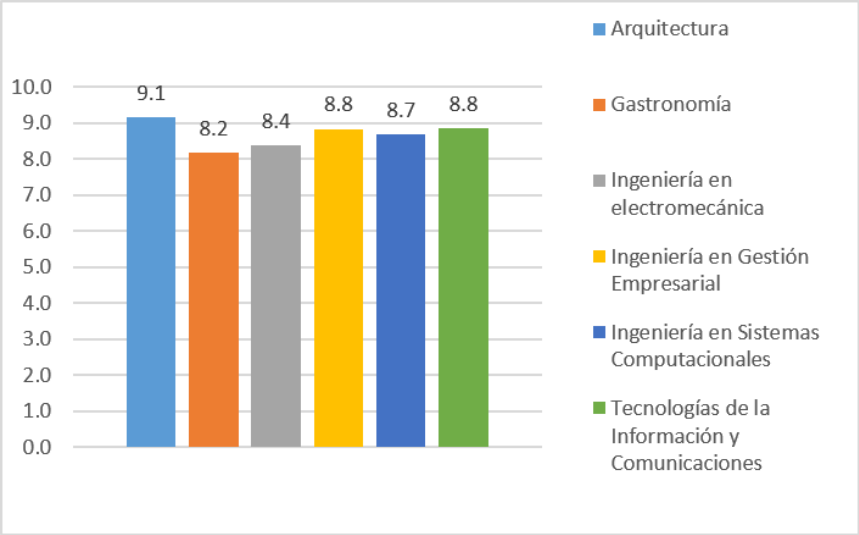
Figura 16. Funcionamiento y conceptos de las TIC por carrera



Fuente: Elaboración propia

Figure 16 shows the average results obtained by career in the operation and concept of ICT dimension. The lowest values were achieved in Gastronomy with 7.8, and the highest in Engineering in Computer Systems with 9.1, followed by Information and Communications Technologies with 9.0, which is consistent with the professional profile of the students of these careers.

Figura 17. Uso de las TIC en el TECMM por carrera



Fuente: Elaboración propia

Figure 17 shows the average results obtained per career in the ICT use dimension in the TECMM. The lowest values were in Gastronomy with 8.2, and the highest in Architecture with 9.1.

Discussion

Regarding the analysis of competences for the use of ICT by university students, it should be noted that of 310 students surveyed, only 28 (9%) do not have a personal computer, either desktop or laptop. Also, 79 (25%) do not have internet service at home. These figures are related to the infrastructure and the level of penetration that ICTs have in the field of higher education.

On the other hand, it can be indicated that the average results obtained in each of the dimensions was 7.8 out of 10 possible, which demonstrates a high level of appropriation of ICT students in the institution. If these figures are interpreted as considered by Unesco (2008), it can be affirmed that the students of the institute are at level three of integration, which refers to access to computer, internet and other ICT resources, as well as to capacities for information management, academic use of the internet, communication through different technological devices and mastery of different ICT tools to support academic training. This categorization has to do with the fact that

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most of the students surveyed were born towards the end of the 1990s, that is, during the mass dissemination of the Web, hence they are considered digital natives (Prensky, 2001).

In summary, it can be indicated that the main results of the dimensions analyzed were the following: 8.3 in operation and concept of ICT; 8 in research and information management, and 6.7 in communication and collaboration. Although this last result is less than 7, it can be generally guaranteed that it covers some aspects of level four proposed by Unesco (2008), which refers to computer and internet access at home and at school, access to other ICT resources (such as video projectors, cameras, scanner, smartphones), use of ICT tools for self-management, information management skills and use of online learning platforms. In fact, as collected in the present study, it was found that all students have access to a desktop computer and internet in the institute (most even have these tools at home). In addition, in the institution students have access to video projectors, cameras and scanner.

On the use of ICT tools for self-management and information management skills, in the research and information management dimensions, 8.0 results were obtained, and in critical thinking, problem solving and decision making, as well as in digital citizenship, results of 7.6 and 8.4 were obtained respectively. Likewise, in the dimension of ICT use in the TECMM (where it was asked about the use of the institutional distance education platform) values of 8.7 were achieved. This means that level 4 is also largely covered according to Unesco's ICT standards (2008).

Regarding the results per race, the lowest average values of all dimensions were obtained in Gastronomy and Electromechanics with 7.4, and the highest values in Architecture with 8.3. Likewise, the lowest dimensions, in general, were communication and collaboration with 6.7 and creativity and innovation with 6.9, while the highest value was the use of ICT in the TECMM with 8.7.

Finally, and based on the results obtained by students in all dimensions, it can be affirmed that a general average of 7.8 out of 10 was achieved. Consequently, there is an important development of skills for the use of ICT based on the standards proposed by the ISTE (2008). These results are similar to those obtained in other studies (López, 2007; López, 2008). Similarly, on the scale proposed for the analysis, it can be said that it was located at level 3 (ranging from 7.5

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to 10), which means a high development of academic skills for the use of ICT according to the standard implemented

Conclusions

From the results found, it can be concluded that there is an important level of penetration in the use of ICT by students, which has happened naturally, since the participants belong to a generation that has been born since its birth seen submerged in a context where new technologies are used on a daily basis for multiple activities. However, it is worth noting that there is still a need to propose strategies to improve communication and collaboration and creativity and innovation indicators, dimensions in which lower averages were obtained.

On the other hand, and in terms of the values obtained by career, it would be convenient to investigate how certain specialties (e.g., Architecture, Business Management, and Information Technology) have a more decisive influence on the use of ICTs that other careers (eg, Gastronomy and Electromechanics), although, as mentioned, these technological resources can be very beneficial to boost academic training in any area.

Likewise, and in accordance with the diagnosis made and with the theoretical revision consulted, it can be pointed out that it would be convenient to design institutional guidelines that contribute to 1) defining objectives and strategies for the use of ICT in the institution; 2) define periods for the equipment of technology in order to update the institutional infrastructure according to the cycles of change, because in this way technological advances can be promoted; 3) establish levels and criteria for the use of ICT in academic processes based on international standards; 4) establish training regulations for the updating of academic and administrative staff based on student requirements.

Finally, regarding specific strategies with students, it is recommended to 1) improve the skills for information management with the use of ICT; 2) promote the self-management of learning through ICT; 3) define strategies for learning specialized software according to the professional profiles of each career; and 4) encourage the use of online platforms to boost self-management, planning and time organization, as well as individual responsibility for the process of learning.

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Rol de Contribución	Autor (es)
Conceptualización	**Carlos Miguel Amador Ortíz**
Metodología	**Carlos Miguel Amador Ortíz**
Software	**Leticia Velarde Peña**
Validación	**Leticia Velarde Peña**
Análisis Formal	**Carlos Miguel Amador Ortíz**
Investigación	**Carlos Miguel Amador Ortíz (principal)** **Leticia Velarde Peña (apoyo)**
Recursos	**NO APLICA**
Curación de datos	**Leticia Velarde Peña**
Escritura - Preparación del borrador original	**Carlos Miguel Amador Ortíz**
Escritura - Revisión y edición	**Carlos Miguel Amador Ortíz (principal)** **Leticia Velarde Peña (apoyo)**
Visualización	**Leticia Velarde Peña**
Supervisión	**Leticia Velarde Peña**
Administración de Proyectos	**Carlos Miguel Amador Ortíz**
Adquisición de fondos	**Carlos Miguel Amador Ortíz**

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