



REVISTA

# CÁTEDRA

## Teaching competence in future Computer Science teachers in Ecuador

*La competencia digital docente en los futuros  
profesores de informática del Ecuador Digital*

Juan Rojas-Viteri

Universidad Central del Ecuador, Quito, Ecuador  
Facultad de Filosofía Letras y Ciencias de la Educación, Carrera de Pedagogía de las  
Ciencias Experimentales Informática  
[jcviteri@uce.edu.ec](mailto:jcviteri@uce.edu.ec)  
<https://orcid.org/0000-0003-1033-9350>

Alex Álvarez-Zurita

Universidad Central del Ecuador, Quito, Ecuador  
Facultad de Filosofía Letras y Ciencias de la Educación, Carrera de Pedagogía de las  
Ciencias Experimentales Informática  
[amalvarez@uce.edu.ec](mailto:amalvarez@uce.edu.ec)  
<https://orcid.org/0000-0003-4535-4534>

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### Abstract

The knowledge society and economy of the 21st century demand that students develop the necessary skills and abilities to face the requirements of adult life. Thus, future teachers of computer science secondary education in Ecuador, due to their technical-pedagogical training, face the challenge of developing the digital teaching competence to help their students to face the technological challenges that the current world demands. The present study aimed to diagnose and analyze the level of mastery in the 5 areas of digital competence in the students of the Pedagogy of Experimental Sciences of Computer Science at the Central University of Ecuador, through the application of a questionnaire created by professors Débora Martín Rodríguez, María Saénz, Raúl Santiago and Edurne Chocarro, professors of two renowned universities in Spain. In addition, the instrument was validated by local experts. To measure the reliability of the questionnaire, Cronbach's alpha coefficient was used for each dimension of digital competence in teaching, obtaining a score of over 0.90. The methodology used was empirical-analytical and descriptive, using a non-probabilistic sampling, at the convenience of the researchers, of 161 students of different



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levels and subjects. Among the main conclusions found were that the least developed areas of teaching digital competence are problem solving and safety.

## Keywords

digital competence, teacher, covid 19, students, educational informatics, covid 19, educational informatics.

## Resumen

La sociedad y economía del conocimiento del siglo XXI exigen que los estudiantes desarrollen habilidades y destrezas necesarias para hacer frente a los requerimientos de la vida adulta. Es así como los futuros docentes de educación media de informática del Ecuador, por su formación técnico-pedagógica se enfrentan al reto de desarrollar la competencia digital docente para ayudar a sus alumnos a enfrentar los desafíos tecnológicos que el mundo actual demanda. En el presente estudio se pretendió diagnosticar y analizar el nivel de dominio en las 5 áreas de competencia digital en el estudiantado de la Carrera de Pedagogía de las Ciencias Experimentales de la Informática de la Universidad Central del Ecuador, a través de la aplicación de un cuestionario creado por los docentes Débora Martín Rodríguez, María Saénz, Raúl Santiago y Edurne Chocarro, profesores de dos reconocidas universidades de España. Además, el instrumento fue validado por expertos locales. Para medir la fiabilidad del cuestionario se usó el coeficiente alfa de Cronbach por dimensiones de la competencia digital docente, obteniéndose sobre los 0.90. La metodología utilizada fue empírico-analítica y de tipo descriptivo, se usó un muestreo no probabilístico, a conveniencia de los investigadores de 161 alumnos de distintos niveles y asignaturas. Entre las principales conclusiones encontradas se tiene que las áreas de competencia digital docente menos desarrolladas son solución de problemas y seguridad.

## Palabras clave

Competencia digital, docente, covid 19, estudiantes, informática educativa.

## 1. Introduction

Higher education institutions are currently facing a generation of students born in the 2000s, who have lived surrounded by digital technology. They are accustomed to the use of mobile devices that allow them to satisfy their needs for communication, fun, information, entertainment and education. This phenomenon has allowed them to develop technological skills related to social activities, which are so natural for this age group that they are carried out on a daily basis and serve as a means of interaction between groups of like-minded people or even with strangers. A good example of this is social networks and the great impact they have had on our lives. This reality leads us to reflect on the use that each generation gives to digital tools, which became even more acute with the arrival of the pandemic of covid 19. "Teachers and students at the University cannot escape from the reality in which we live, absolutely conditioned by technologies and also bearing in mind that digital competence is one of the key competencies of the citizen of the XXI century". (Prendes et al., 2018, p.9). This reality is repeated in higher education institutions around the world. In this regard, some studies have been conducted that evidence what these researchers state when referring to people who use technology for social and communicative activities, with a high frequency of use, but do not present a development of competencies for the management of more complex resources, so they are not able to take full advantage of these tools, nor apply them to their own work. The interest of the researchers was to know how prepared the students of the mentioned career were to face the pandemic with virtual classes. The main obstacle encountered was the application and



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collection of data on the subjects of the study. The research presented temporal limitations, since it was intended to study the students in times of pandemic and the results may vary in different conditions. The documentary contribution of this article was the product of a dimension studied and presented in the doctoral thesis of Professor Juan Carlos Rojas in 2020. The present work is created based on the methodology, introduction, methods, results and discussion (IMRyD).

### 1.1. Digital competencies in Ecuadorian higher education

Digital competence turns out to be a great ally for professionals of all specialties, allowing them to create, manage and interpret large amounts of information and thus use it to solve problems specific to their career or in everyday life. To define what digital competence is, the framework suggested by INTEF (2017) is quoted verbatim, which, in its version 2.0, expressed.

Digital competence is one of the 8 key competences that any young person should have developed by the end of compulsory education in order to be able to enter adult life successfully and to be able to develop lifelong learning throughout life according to the European Parliament's indications on key competences for lifelong learning (Recommendation 2006/962/EC of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning, Official Journal L 394 of 30.12.2006). Digital competence not only provides the ability to take advantage of the wealth of new possibilities associated with digital technologies and the challenges they pose, it is increasingly necessary to be able to participate meaningfully in the new knowledge society and economy of the 21st century." (p. 5). (see figure 1). It is clear, then, the importance of developing teachers' digital competence. In the following pages we will use the acronym -CDD-, to refer to this.

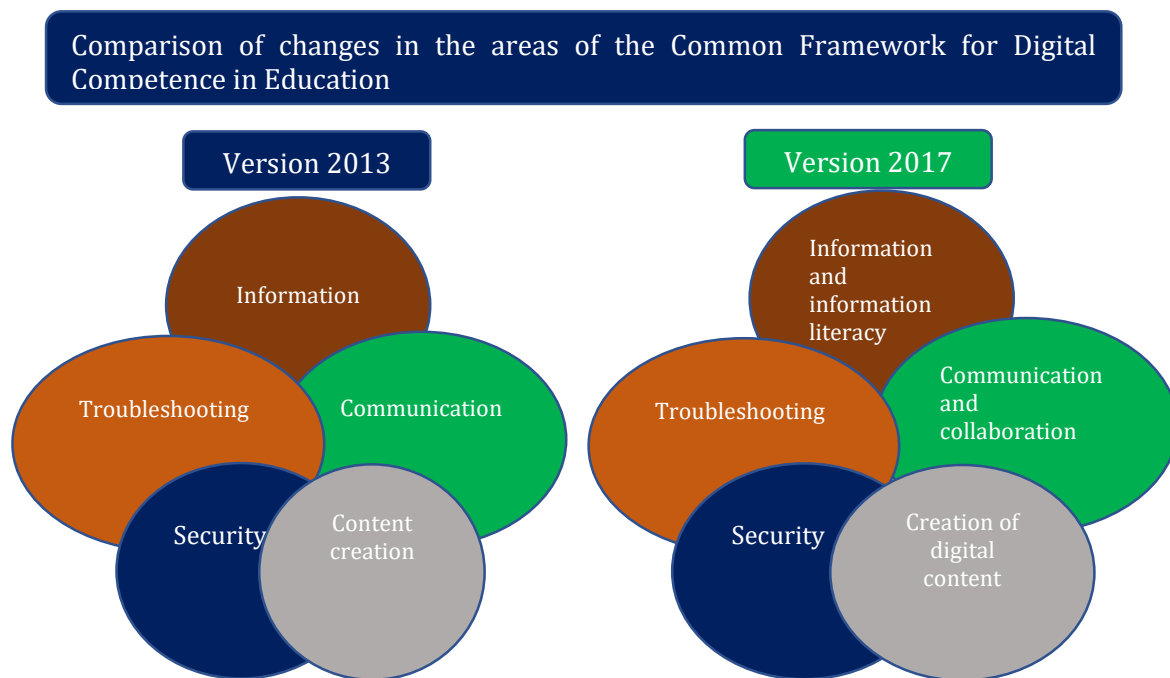


Figure 1. Comparison of changes in the areas of the common framework of teaching digital competence. Source: (Intef, 2016)



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The figure shows the changes that have occurred over time in the areas of teaching digital competence (TDC) in the common European framework.

## 1.2. Digital competence in teaching as a fundamental element of professional development.

The evolution of the term digital competence has had great relevance in recent decades and has been linked since its inception to the need to make people technologically literate, given the digital revolution we are living (Roig-Vila and Moreno-Isac, 2020, p. 4). From the appearance of computers, then the Internet and its introduction in schools and homes, it was necessary to understand how they work, and to try to make the most of them.

It was thus required to enter a digital literacy process that went from being focused on the interpretation and critical expression of the different audiovisual and artistic manifestations to aspects related to access to technology and the management and evaluation of information "technological and information literacy" (Mon and Cervera, 2013, p. 31). Suddenly, "it was no longer only mandatory to know how to read and write" (Roig-Vila and Urrea-Solano, 2020, p. 8), but also to have developed skills and abilities to manage the information generated through electronic and computer media, to adapt to an increasingly changing reality; it is essential "that we enter into a process of digital literacy that allows mastering a broad spectrum of skills, knowledge, awareness and attitudes" (Bawden, 2002, p. 56).

Digital literacy (see Figure 2) is the consequence "of the intersection of three dimensions: technical dimension, cognitive dimension and socioemotional dimension of digital literacy" (Ng, 2012, p. 1066) which, in turn, are made up of a set of specific skills that allow an efficient application of this knowledge in the solution of professional and real life problems:

The technical dimension. refers to possessing a set of skills and abilities that allow using ICT for teaching and learning, as well as in daily activities, i.e., computer management, operating system, office suites, specialized software, utilities such as file compressors, antivirus, internet search, social networks, email, among others.

The cognitive dimension. refers to "the ability to think critically in the search, processing and evaluation of digital information (...) being able to evaluate and select appropriate software to perform a task" (Ng, 2012, p. 1068). "This dimension of digital literacy requires the individual, among other issues, to know the ethical, social and moral derivations related to the reproduction of digital content (copyright and plagiarism)" (Gutiérrez, Cabero, & Estrada, 2016, p. 3).

The socioemotional dimension. focuses on, "being able to use the Internet in a responsible way to communicate, socialize and learn" (Ng, 2012, p. 1068).

And finally, at the intersection of the three dimensions we observe what would be digital literacy, which is the result of the skills provided by the dimensions. To demonstrate that the person possesses these skills Ng, (2012) mentions:

Perform basic tasks with computer equipment and access resources in their daily use.



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Search, identify and evaluate information in an appropriate manner for the purposes of research and content learning.

Develop competence in the use of technological tools to develop tasks, solve problems, etc.

Behave appropriately in virtual communities (p. 1069).

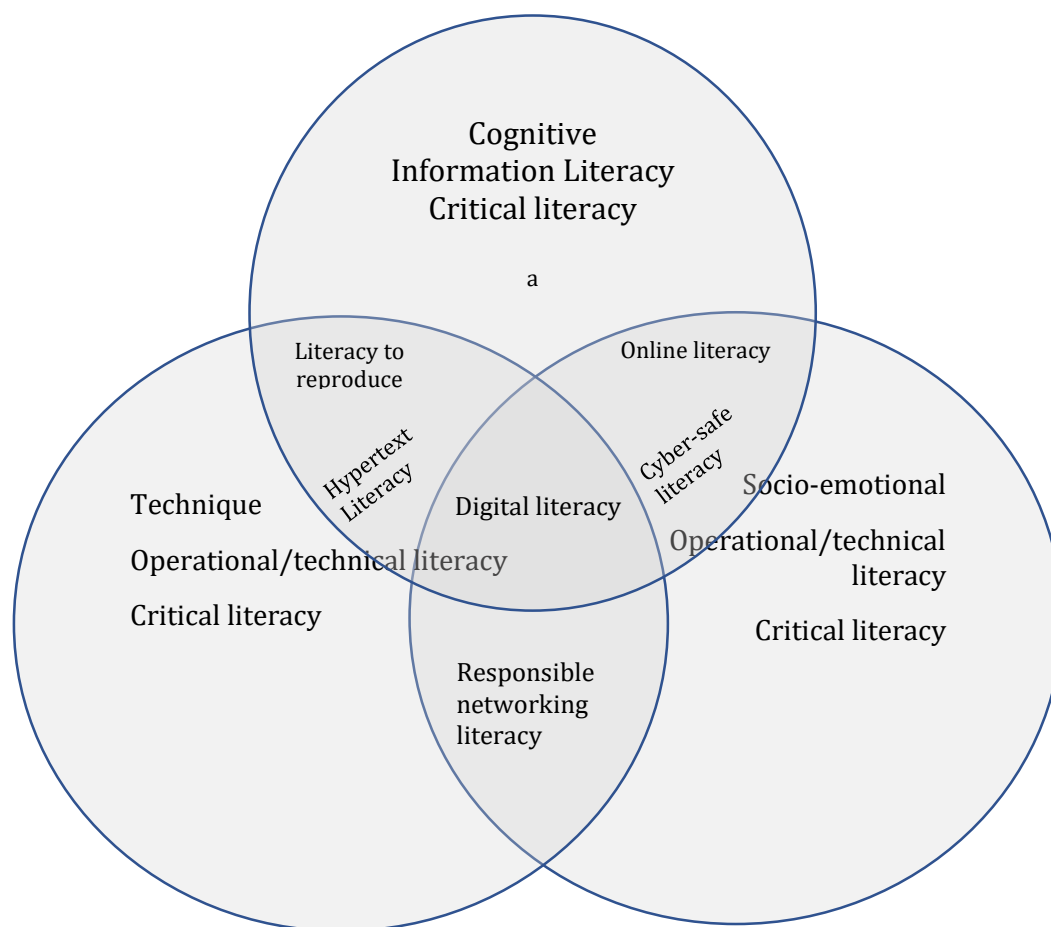


Figure 2. Digital literacy. Source: (Ng, 2012, p. 1067).

It is understood that teaching digital competence is shown to be indispensable and exceeds in extension and depth the mere digital literacy since it "encompasses other aspects such as technological, informational, audiovisual and communicative" (Ferrari, 2012, p. 11).

Undoubtedly, and despite the various positions that different authors express about competencies and digital literacy for this study, it is interpreted that one depends on the other, i.e., digital literacy in a technological culture such as the current one tends to the learning of information technology and education resources (ICT). It is also fundamental in the development of competencies, abilities and cognitive skills related to obtaining, understanding and producing information and its correct application in the different fields that make up the life of human beings. In this sense, the definition of the European Union Parliament (2006) about digital competence is cited:

The safe and critical use of information society technologies (IST) for work, leisure and communication. It is underpinned by basic ICT skills: the use of computers to obtain, evaluate, store, produce, present and



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exchange information and to communicate and participate in collaborative networks via the Internet (p. 8)..

In addition, the CDD encompasses higher cognitive skills needed to process and manage information efficiently and thus be able to use these competencies with our students, guiding them in a learning process based on their needs, favoring a digital culture based on the right to choose and select the information we consume and generate with social responsibility. In this sense, Cabero et al. (2009) presents a series of comments regarding digital literacy:

To speak of digital literacy requires speaking of a literacy that goes far beyond the mere technological and instrumental mastery of ICTs. It implies not only the ability to receive messages, but also their construction. It implies the ability to evaluate and select, according to our educational project and needs, the amount of information that is reaching us through new technologies. Using the media and technologies in their daily lives not only as resources for leisure and consumption, but also as environments for expression and communication with other people. It implies understanding literacy as an attitude of use for communication (p. 12).

It is clear that the process of making a conglomerate of people digitally literate necessarily involves the development of competencies that allow them to face the day-to-day use of ICTs. Classrooms may be a good place to start this process, but the need is so great that governments must prepare national plans to train all the loping different competencies in several aspects:

Know when there is a need for information.  
Identify the information need.  
Work with a variety of information sources and codes.  
Know how to master information overload.  
Evaluate information and discriminate the quality of the information source.  
Organize information (p. 14).

Below are a series of teaching competencies to be developed according to the Common European Framework 2017 (see figure 3).



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 <b>Common Framework 2017</b>	 <b>Competencies</b>
Information and Information Literacy	Identify, locate, retrieve, store, organize and analyze relevant information, evaluating its purpose and relevance.
Communication and Collaboration	Communicate in digital environments. share resources. connect and collaborate with others through digital tools. interact and participate in communities and networks: intercultural awareness.
Digital Content Creation	Create and edit new contents (texts, images, videos, etc.). (texts, images, videos...). integrate and rework previous knowledge and contents. create new productions. multimedia contents and computer programming. Know how to apply intellectual property rights and licenses of use in the classroom.
Security	Protecting data digital identity. security use. safe and sustainable use.
Troubleshooting	Identify digital needs and resources. to choose the appropriate digital tool. according to the purpose or need. solve conceptual problems, technical problems and update their own and their students' competence.

Figure 3. Digital competence of teachers. Source: (Intef, 2016)

The European Commission 2018 conducted a study where the level of digital skills of the inhabitants that make up the European countries was noted (see Figure 4.)

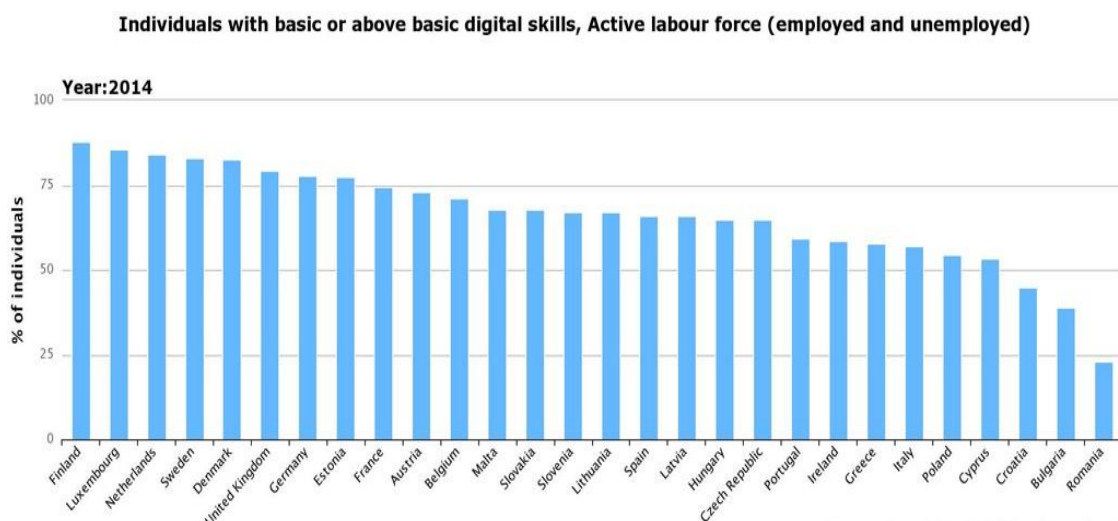


Figure 4. People with basic or higher digital skills, active workforce (employed and unemployed). Source: (European Commission, Digital Agenda Scoreboard, 2018.)



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In the case of Ecuador, there is isolated research published in the form of scientific articles or graduate or postgraduate theses, which are insufficient given the importance of the subject matter. The Organic Law of Intercultural Education of Ecuador (LOEI), in its article 6, literal j, refers to the obligations of the state and states: "guarantee digital literacy and the use of information and communication technologies in the educational process, and promote the link between education and productive and social activities". Likewise, the Ministry of Telecommunications and Information Society (MINTEL), the governing body for the development of information and communication technologies in Ecuador, prepared the National Telecommunications and Information Technology Plan of Ecuador 2016-2021.

Among its objectives is to promote studies, reports or research to improve ICT management. This is why they have been involved with training the population, creating 854 infocenters -community computer centers-, nationwide distributed in 728 parishes, benefiting more than 6.2 million people with an investment of approximately 70 million dollars and have registered until August 2017 more than 12 million visits, being more than 500 thousand citizens trained in the use of ICT and digital illiteracy with 11.5% in ages between 15 and 49 years old.

## 2. Literature review

In 2019, a study was conducted on Digital competence of teachers and its impact on the teaching-learning process of mathematics, the methodology used was a non-experimental and descriptive quantitative approach, working with a sample of 150 students and teachers in the area of mathematics at the middle level in Ecuador. The results show that most of the respondents show non-positive opinions about the impact of digital competence in the teaching-learning process of mathematics given the lack of knowledge and application.

In 2020, a study on Digital competence of teachers to reduce the digital divide: Comparative study of Spain and Costa Rica was presented. This study was carried out with a quantitative, descriptive and correlational methodology where 5 investigations were analyzed in a sample of 126 teachers from both countries. The results show that despite the political, social and educational differences in each country, the perception of teachers is not so different. The main conclusion is that teachers in both countries feel confident in their digital skills, are motivated, understand that the education system does not respond to current needs and see the need for a specific curricular inclusion of the subject.

The study entitled Digital competence of teachers: a systematic review was reviewed. The objective of the research was to review theories and foundations of digital competencies in teachers from years between 2017 and 2021. The methodology used consisted of a systematic review of 441 articles. Forty scientific texts framed literature selection criteria were collected. The results showed that digital competencies are the skills that empower the individual to use digital media in different environments.

In the year 2022, a study was conducted on Digital Competence of Teachers: The Case of Canton Pichincha, Manabí, Ecuador. The methodology was based on a quantitative approach with a non-experimental design, it was descriptive-correlational. We worked with 45 university graduates who work as teachers at the professional technical level. The level of CDD of the teachers participating in the study was characterized by a general medium-low tendency, where there was a homogeneous classification in all the dimensions of the levels of knowledge and use of the teachers.



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In the year 2022, a study called Digital Competence was presented. Here, a systematic exploration of research related to the digital competencies of university professors in Ibero-America is carried out. The methodology used was a documentary review of international academic databases. Among the main results, the need to include ICT in the teaching methodology to improve their teaching practice was evidenced.

### 3. Méthods and materials

#### 3.1. Research Objectives

The following are the objectives that guided this investigation:

- To determine the level of mastery in the 5 areas of competence in the students of the Pedagogy of Experimental Sciences of Informatics.
- To analyze the levels of mastery according to the level of studies and gender.

#### 3.2. Focus and scope

En la presente investigación se usó el enfoque cuantitativo, tal como lo señala Rodríguez-Peñuelas (2010):

It focuses on the facts or causes of the social phenomenon, with little interest in the subjective states of the individual. This method uses questionnaires, inventories and demographic analyses that produce numbers, which can be statistically analyzed to verify, approve or reject the relationships between operationally defined variables, and the presentation of results of quantitative studies is regularly supported by statistical tables, graphs and numerical analysis (p. 32).

This study also relied on an empirical-analytical and descriptive methodology, calculating through frequencies of use, arithmetic mean and standard deviation, what is the level of mastery of the students investigated. For the second part of the study, the Chi-Square test was applied, which is a statistical procedure used to establish significant stocks of expected results.

#### 3.3. Participants

For the realization of this study, 3 subjects corresponding to the Pedagogy of Experimental Sciences of Informatics of the Universidad Central del Ecuador were used. These were: Educational Legislation in the first semester with 63 students, Operating Systems in the fourth semester with 52 students and Projects III, in the eighth semester with 46 students. This was done in this way given the difficulties in collecting information from the participants due to the aforementioned health emergency. In addition, we worked with a non-probabilistic sampling at the convenience of the researchers with a total of 161 students, 99 males and 62 females.

#### 3.4. Procedures

In order to establish the levels of mastery of the CDD in the selected students, work was carried out during the November 2021 - April 2022 semester in virtual classrooms created on the Moodle platform. These virtual learning environments were developed with the instructional design - Analysis, Design, Development, Implementation and Evaluation - (ADDIE). It should be noted that activities and resources that favored work in the following areas were included: information, content selection/creation, communication, safety and problem solving. At the end of the academic period, a questionnaire was applied to measure levels of mastery.



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### 3.5. Instrument

In order to collect the necessary information for the research, a questionnaire created by professors Débora Martín Rodríguez, María Saénz, Raúl Santiago and Edurne Chocarro, professors at two renowned universities in Spain, was used to carry out a study called design of an instrument for diagnostic evaluation of the digital competence of teachers: Flipped Classroom training. This instrument measured the knowledge and use of the CDD through a scale of 4 possibilities and a total of 53 items. The Google forms tool was used for its application, and it sought to measure the dimensions established by the Common Frame of Reference for Digital Competence in Teaching project (2016):

Information. Identify, locate, retrieve, store, organize and analyze digital information, evaluating its purpose and relevance.

Communication. Communicate in digital environments, share resources through online tools, connect and collaborate with others through digital tools, interact and participate in communities and networks, intercultural awareness.

Content creation. Create and edit new content (texts, images, videos...), integrate and rework previous knowledge and content, make artistic productions, multimedia content and computer programming, know how to apply intellectual property rights and licenses of use.

Security. Personal protection, data protection, digital identity protection, security use, safe and sustainable use.

Problem solving. Identify needs and digital resources, make decisions when choosing the appropriate digital tool, according to the purpose or need, solve conceptual problems through digital media, solve technical problems, creative use of technology, update own competence and that of others (p. 11).

The instrument was validated by 3 teachers who are experts in educational technology. Cronbach's alpha coefficient was also used to measure the reliability by dimensions of the instrument (see Table 1).

Indicator	Educational Legislation	Operating Systems	Projects III
Information	0.970	0.943	0.933
Content Selection/Creation	0.977	0.965	0.924
Communication	0.958	0.949	0.948
Security	0.970	0.965	0.945
Troubleshooting	0.986	0.983	0.926

Table 1. Cronbach's Alpha

## 4. Results

The results of the diagnosis of the level of mastery in the 5 areas of competence in the group investigated are presented below. If the subjects are analyzed by academic courses, it can be seen that in Educational Legislation -first semester-, the information indicator presents the values closest to 4 points on the scale for the category's knowledge with a  $\mu = 2.58$  and use with a  $\mu = 2.59$ . This result is typical of a group of digital natives, as are the students



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investigated, since their life practically revolves around the use of technology. On the other hand, the result obtained in the problem-solving indicator is worrisome because it is presented with the lowest score of all, showing the knowledge category with  $\mu = 2.35$  and use with  $\mu = 2.37$ .

With respect to the subject Operating Systems -fourth semester-, the information component once again obtained the highest values with  $\mu = 2.93$  and  $\mu = 2.92$  in the categories knowledge and utilization, respectively. This result is worrying, since despite the fact that the students investigated have already advanced a few semesters, the values obtained are not significantly higher. Also, problem solving is the lowest indicator, obtaining a  $\mu = 2.65$  and  $\mu = 2.62$  in the category's knowledge and utilization, respectively. The information obtained allows us to make a scan of the group investigated and to work on this important aspect for the professional development of the students.

In the subject Projects III -eighth semester- we find that the information component, once again, is the highest value, achieving a  $\mu = 3.21$  in the knowledge category and a  $\mu = 3.14$  in the utilization category. It is understood that the students have improved their information search and analysis skills, although it is disturbing that the other components remain at a much lower increase than expected, despite the academic knowledge that the students are acquiring over the semesters. Problem solving is once again the component with the lowest value in the knowledge category with a  $\mu = 2.86$  and in the utilization category is the communication indicator with a  $\mu = 2.76$ . (See Table 2).

Indicator	Educational Legislation				Operating Systems				Projects III			
	Knowledge		Usage		Knowledge		Usage		Knowledge		Usage	
	$\mu$	$\Sigma$	$\mu$	$\sigma$	$\mu$	$\sigma$	$\mu$	$\sigma$	$\mu$	$\sigma$	$\mu$	$\sigma$
Information	2.58	0.066	2.59	0.050	2.93	0.063	2.92	0.020	3.21	0.086	3.14	0.076
Content Selection/ Creation	2.51	0.055	2.48	0.049	2.76	0.060	2.1	0.051	2.96	0.112	2.87	0.115
Communication	2.48	0.068	2.42	0.049	2.66	0.094	2.65	0.075	2.90	0.125	2.6	0.126
Security	2.45	0.008	2.45	0.036	2.67	0.040	2.65	0.031	2.86	0.085	2.79	0.068
Troubleshooting	2.35	0.052	2.37	0.065	2.65	0.039	2.62	0.031	2.86	0.113	2.78	0.087

Table 2. Arithmetic Mean/Standard Deviation of the level of proficiency in the 5 areas of competence

In response to the need to verify whether the level of studies and gender contribute to the development of digital competence in teaching, the following hypotheses are proposed: the gender variable is related to the development of the CDD, since it is considered that since there are more men in the career and with the sample worked on, they will be at an advantage. To test this hypothesis, the non-parametric chi-square test was used to establish whether there are significant differences between the study variables.

Having too many tables from the analysis in the SPSS software, a contingency table was made to summarize all the necessary data. In this context, the aim is to test the null hypothesis:

- H0: Female students do not develop CDD more than male students.
- H1: Female students develop CDD equally with male students.



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As shown in Table 3, the null hypothesis is rejected, and the researcher's hypothesis is accepted, since in light of the results obtained in none of the areas of competence is there evidence that the value is less than 0.05. Therefore, it is considered in this study and under the given conditions that there is no evidence to affirm that the gender variable is related to the development of CDD (See Table 3.).

Indicator	Sex		Chi-square knowledge		Knowledge likelihood ratio		Knowledge of linear by linear association		Use of chi-square		Use of likelihood ratio		Use of linear by linear association	
	women	men	Df	Asymptotic significance	Df	Asymptotic significance	Df	Asymptotic significance	Df	Asymptotic significance	Df	Asymptotic significance	Df	Significación asintótica
Information	62	99	3	0.010	3	0,040	1	0.020	3	0.001	3	0.049	1	0.02
Selection of content creation	62	99	3	0.040	3	0.043	1	0.001	3	0.049	3	0.039	1	0.037
Communication	62	99	3	0.031	3	0.033	1	0.001	3	0.041	3	0.038		0.032
Security	62	99	3	0.022	3	0.022	1	0.003	3	0.021	3	0.023		0.046
Troubleshooting	62	99	3	0.023	3	0.021	1	0.020	3	0.029	3	0.029	1	0.042

Table 3. Chi-square summary by gender

Thus, we also wanted to investigate whether the academic level of students related to the development of the CDD. For this purpose, the hypothesis was proposed: the variable semester studied is related to the development of the CDD. It is understood that as students pass semesters and advance in their careers, they develop the CDD.

To test this hypothesis, once again the chi-square statistical test was used. Then, supported by this tool we contrasted the null hypothesis:

- H0: Students in higher semesters do not develop CDD more than students in lower semesters.
- H1: Students in higher semesters develop CDD more than students in lower semesters.

In light of the results obtained, we proceed to reject the null hypothesis in the areas of CDD: information, content selection and creation, and problem solving, where the p-value is less than 0.05, accepting the researcher's hypothesis; and the null hypothesis is accepted in the areas of CDD: communication and safety, where the p-value is greater than 0.05, rejecting the researcher's hypothesis (See Table 4.).



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INDICATOR	Semester in progress			Chi-square knowledge		Knowledge likelihood ratio		Knowledge of linear by linear association		Use of chi-square		Use of likelihood ratio		Use of linear by linear association	
	1RO	4TO	8VO	DF	Significación asintótica	DF	Significación asintótica	DF	Significación asintótica	DF	Significación asintótica	DF	Significación asintótica	DF	Significación asintótica
Information	63	52	46	6	0.030	6	0.025	1	0.011	6	0.022	6	0.018	1	0.003
Selection of content creation	63	52	46	6	0.021	6	0.011	1	0.025	6	0.047	6	0.041	1	0.069
Communication	63	52	46	6	0.073	6	0.067	1	0.029	6	0.123	6	0.114	1	0.076
Security	63	52	46	6	0.114	6	0.066	1	0.09	6	0.086	6	0.064	1	0.149
Troubleshooting	63	52	46	6	0.003	6	0.002	1	0.011	6	0.072	6	0.064	1	0.045

Table 4. Chi-square summary by semester

## 5. Discussion

The results derived from the univariate analysis -first part of the study- showed that the students investigated have developed some areas of CDD more than others. It is clear that, being a young group, they are accustomed to using digital devices for practically everything. The CDD areas (information and communication) are the most achieved by those investigated, agreeing with studies by other academics such as (Valdivieso and González 2016, p. 71).

Thus, a reality is also evident in the classrooms and refers to the area of CDD (problem solving) presents the lowest values followed by the area of CDD (security), that is, the management of personal information or not, in digital media. The results derived from the multivariate analysis confirm the former, indicating that the two least developed CDD areas are problem solving and security. In addition, it is verified that, in this case, and in the conditions in which we found ourselves when the research was conducted, the gender variable is not related to the development of CDD. These results are consistent with studies such as that of (Domingo et al.,2019, p. 76).

It is important to note that education careers have an important role with society by training future teachers. Therefore, it is vital to keep curricula updated both in the development of pedagogical and digital competencies, since the next generations of students come loaded with the use of digital technology, enhanced by Artificial Intelligence. "Teachers possess a medium level of ICT competencies, higher in technological than in pedagogical ones" (Suárez-Rodríguez et al., 2013, p. 51)

## 6. Conclusions

The results found in this study belong to a moment in the history of humanity very hard and sad where the pandemic of covid 19 caused by the SARS-CoV-2 virus, tested all the systems that make up societies. This was how public higher education faced the importance of maintaining a powerful and updated technological infrastructure, as was the case of the Central University of Ecuador, which acquired in 2017 a Data Center, same that allowed to face this health contingency, allowing virtual classes to be developed through the Moodle platform and MS- Teams.

On the other hand, this research allowed to bring to light results regarding the development of the CDD in the student body, the data are worrying for the researchers, since it is understood that in the subjects they work not only using digital tools but active learning methodologies that enhance the cognitive development of the student body through



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individual and group strategies such as problem-based learning or project-based learning, as well as collaborative learning.

Active methodologies have been designed to work in conjunction with ICT, thus we have Flipped Learning, which integrates several strategies to develop meaningful learning in students from any electronic device, anywhere and at any time.

This study made it possible to approach the reality of the students of the Pedagogy of Experimental Sciences of Informatics where it is assumed -from the teaching staff- that, being a technical career, the students master computer tools, and although in the areas of informational and communicational competence the results confirm this, there is still much work to be done in the areas of CDD (problem solving and security). From this reality, research needs arise, as is the case of teaching methodologies and the emergence of artificial intelligence, which will completely change education.

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## Authors

**JUAN ROJAS-VITERI** D. in Educational Research from the University of Alicante, Spain in 2020. Graduated in Educational Sciences, mention in Computer Science from the Faculty of Philosophy, Letters and Educational Sciences of the Central University of Ecuador in 2002. Specialist in Virtual Learning Environments (OEI). Master in Higher Education at the Faculty of Philosophy, Letters of Education Sciences of the Central University of Ecuador in 2012.

He is currently a full professor at the Universidad Central Ecuador. Professor of Graduate Studies at several Ecuadorian Universities, consultant and trainer in several private and public institutions in the country.s.

**ALEX ALVAREZ-ZURITA** obtained his Master's degree in Educational Technology and Digital Competencies at the International University of La Rioja (UNIR) Spain in 2019. He obtained his Master's degree in Higher Education from the Faculty of Philosophy, Letters of Education Sciences of the Central University of Ecuador (Ecuador) in 2014 and obtained his Bachelor's degree in Education Sciences Mention in Computer Science from the Faculty of



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Philosophy, Letters of Education Sciences of the Central University of Ecuador (Ecuador) in 2008.

He is currently a part-time professor at the Faculty of Philosophy, Letters and Education Sciences of the Central University of Ecuador.



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