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Research Article

Competencies in Digitalization: An Experiment in an International Course

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This research aims to explore competencies in the digital global context through an international experiment conducted at the Veracruzana University in Mexico and the Public University of Navarre in Spain. In this paper, we report test scores of a course from both universities ($N = 85$). The course was grounded on Industry 4.0 and digital transformation. Students were required to work in international teams through virtual communication and coworking tools. The main findings show that digital competencies though necessary, do not seem sufficient. Additionally, the research identifies the most developed competencies (decision-making and cognitive development competencies) and the competencies that need to be strengthened (digital competencies). From a practical perspective, the international experiment facilitates a collaborative learning scenario.

1. Introduction

The digital transformation has had a huge influence on daily routines. Technologies have transformed human habits; such changes are likely to become even more relevant in the ensuing years, complementing the real world with a virtual one [1].

This development affects young people to the greatest extent. Youth should be prepared to face this virtual world and its future development. Youngsters and adolescents are digital "natives," that is, growing up using digital modalities, they are likely to have developed higher digital skills than older generations. This engenders a competitive advantage for them over other workers across a broad range of professions and sectors [2].

With this aim in mind, institutions have been focused on further development and refinement of digital skills in young persons. Indeed, digital skills are considered by the Council of the European Union as the main field of development in the educational area. Importantly, the education reform defined in the Europe 2020 strategy includes ICTs as a key element. Along the same lines, in the Mexican context, the Union of Businessmen for Technology in Education (UNETE), a nonprofit organization that aims to improve quality in Mexican education, has been providing public schools with ICT equipment and connectivity; it also trains teachers in digital learning competencies. From an applied perspective, there are several initiatives to foster digital skills in youngsters across Europe and Latin America (e.g., Youth on the Move; An Agenda for New Skills and Jobs; the "Opening up Education" initiative to foster digital skills in schools and universities; and the Mexican projects BRAINET, CLASSMATE, and KHAN-ACADEMY). In fact, educational centers are required to adapt their proposal to include digitalization in order to contribute to the development of these computer-based skills [3].

There is an ongoing debate concerning the impact of these technologies on young people, as can be concluded by a large number of published papers over the last few years in this field. Several of these articles [4, 5] highlight the positive role of technology for young people as it promotes autonomy and wellbeing in persons of this age. On the contrary, Holt and Brockett [6] found a weak relation between self-direction and technology use. Conversely, cyber-aggression or technology addiction can be cited as negative effects of ICTs [7–9].

However, even if ICTs have positive or negative effects, their relevance in the workplace is unquestionable. Precisely, this importance justifies the present research paper in that it contributes to an understanding of the role of digital skills for youths (via definition of an international experiment in groups of university students from Spain and Mexico). Student participants learned the digitalization process through its practice in a virtual and international team.

In particular, this research contributes to the study of digital skills in young persons by (1) delineating an international experiment to train digital skills that can be replicated in other educational centers, (2) developing the analysis of the main results derived in the experiment, (3) identifying the critical competencies within the studied digital context, and (4) considering the role of digitalization from an inclusive perspective (in which the teamwork is effectuated by digital tools and in virtual teams.

2. Theoretical Background

Digital transformation can be defined as the digital representation of information and objects in binary code, enabling computer processing as a basic technology and fostering convergence among technological applications of diverse fields of application [1]. In addition, Hart [10] argues that the digital transformation is not about linking elements of social and mobile learning to existing services and programs; instead, it involves establishing changes in learning cultures and generating new business models.

The digital transformation not just affects companies. It is fundamentally changing society, as people find themselves increasingly dependent on digital services. Indeed, the digital economy affects all spheres of life and, consequently, every sector. As a result, people actually behave in two parallel contexts: the physical world and the online environment.

The digital transformation has just started. Schweer and Sahl [11] predicted a huge increase in the digitalization field. As they observed, digital transformation is unstoppable—as a result, a robust virtual world has come into being. In this sense, digitalization is a global trend [12].

The rapid evolution of robots confirms this view. Indeed, just a glance at increases in annual sales indicates the vast growth of this technology, across a range of sectors. The International Federation of Robotics [13] facilitates the large increase of sales in the robotics markets; it has gone from 121,000 robots sold in 2010 to 384,000 global robot installations in 2018. In the 2013–2018 period, annual robot installations increased by 19% on average per year. The automotive industry leads in the implementation of robots (30% of total), followed by the electrical/electronics sector (25%) and the metal and machinery industry (10%).

On the contrary, this increase in the robotic market is predicted to continue in the ensuing years. The aforementioned International Federation of Robotics [13] expects an increase of 12% in sales of robots per year, on average, from 2020 to 2022.

To sum up, digitalization is a global trend—one that can be expected to increase in the following years. Both Europe and America are implementing these changes.

2.1. Digital Skills. The digital transformation described above implies the development of technological competencies. As a consequence of this digital transformation and according to the European Commission, 90% of the jobs will require digital skills by 2020 [14]. Nevertheless, as stated by the Council of the European Union, there is still a gap in digital skills, and, particularly, in the incorporation of these skills in the job market [15].

In this context, an increase in the use of ICTs at work can be globally expected. Consequently, there is a need to acquire basic digital skills in this transforming labor market which justifies the interest in this topic.

Along with this line, as previously mentioned, most research focuses on the positive effects of digital skills in young people. Technology facilitates youth's autonomy and wellbeing through informal learning and the development of competencies required by the job market, among others (e.g., [4, 5, 16]). Additionally, youth empowerment can be reinforced through digital tools [17]. Even more, technology allows autonomy in the case of young people that suffer from disabilities [18]. Consequently, the development of digital skills is particularly relevant in these circumstances [19, 20]. All the described advantages support the importance of including digital skills in the educational process.

Nevertheless, negative effects should also be considered: ICTs imply inclusion problems [21], technology should face cybersecurity risks [8], technology addiction appears as a new risk for youth [7, 9], and there is an evidenced relationship between smartphones addiction and lower academic achievements [22], among other problems.

In the described scenery, citizens are required to adapt their competencies to this new context. The use of technology in virtual services (health, education, etc.) and the development of digital skills in the workplace are considered crucial to prospering in a digitalized economy.

Young people have an additional interest in developing these digital skills, as future virtualization will be even more relevant. In this context, training in digital skills is required for the integration of digital knowledge as a means of succeeding in the new context (where smart industries substitute traditional factories [23]. For instance, the introduction of specific educational programs about advanced networking technologies and sensors is considered crucial for engineers in the field of intelligent industries [24].

On the whole, data experts, mathematicians, and computer scientists, among others, are essential in the implementation of digital transformation. Consequently, digital skills should be included in students' courses; additionally, educational centers should consider them and adapt their programs to align with this trend.

Even more, according to Romero et al. [25], a new worker's profile can be defined: the so-called Operator 4.0. Operator 4.0 refers to a smart and skilled operator who performs "work aided" tasks by machines if and as needed.

To sum up, although technology has positive and also negative effects on youth, digital skills are required to join the job market. The demand for these digital skills will increase in the future. Consequently, training and educational programs are needed to incorporate youngsters into this virtual world, particularly in the working market. Finally, it is generally accepted that jobs will change and new qualifications will be required, so there is a need to prepare young people for digital skills.

2.2. Competencies in a Digital Context. Although digital skills are relevant to succeeding in the virtual world, they are not enough. Technical competencies should be complemented with core competencies: interpersonal, functional, and so on. Ausubel's [26] significant learning theory states that we add and adapt the new information to our previous knowledge. Consequently, the development of digital skills affects core competencies, and, in parallel, a digital context implies a different way of performing competencies.

According to the Organisation for Economic Cooperation and Development [27], there is a mismatch between the students' competencies and those required by the labor market in Mexico. Around 50% of employers complain about the lack of competencies required by their sector. Both specific and transversal competencies seem to be inadequate. In this context, the OECD Skills Strategy [28] identified eight skills-related challenges to Mexico to foster better and more suitable skill sets.

Spain presents a similar situation: competencies are below the average level of the OECD countries. There are also imbalances between the competencies needed and those supplied [29]. In general, the highest levels of basic and also advanced cognitive competencies are required.

Table 1 displays the main indicators of skills performances in Spain and Mexico, as compared with other OECD countries. Figure 1 shows that although the Spanish situation is better than the Mexican one, both Spain and Mexico present levels of these indicators below the average of OECD-member countries. According to the previously mentioned mismatching between skills demanded and those offered, this situation can be explained by a high mismatching in all the OECD countries, so that being in the top 20% still implies a mismatch with the labor market—even with the requirements of the companies operating in each country (Table 1).

In short, there is a mismatch between the competencies demanded by the labor market and the ones offered by youth adolescents. This situation justifies the interest of the present research in conducting an international course to develop digital skills and core competencies in a digital context; it also contributes to reducing the mentioned mismatch.

3. Materials and Methods

This study shows the design of the intervention structured and collaboratively implemented by the Public University of Navarra in Spain and Veracruzana University in Mexico to promote digital skills in students through a virtual course. The objective was to learn about the different technological innovations such as Industry 4.0.

As noted by Touriñán [30], educational intervention is the intentional action to carry out actions that lead to the achievement of the integral development of the student. The educational intervention is teleological in nature: there is an agent subject (educating-educator), there is the propositional language (an action is carried out to achieve something), it is carried out in order to achieve a future (the goal), and events are intentionally linked.

Accordingly, different didactic strategies were incorporated and used to carry out academic products that allowed reaching the established ones. Fandos ([31]; p. 3) suggested "the current challenge we have before ICT as a didactic medium and its educational application." The medium refers us to the communicative process while the technology focuses on its material support. It is as important to work with the communicative process that underlies all learning to study the instruments we use and their strategies for that use.

In the empirical analysis of this study, a quantitative method was used. This study represents a set of processes that is both sequential and empirical in nature. It uses data collection to test hypotheses based on numerical measurements and statistical analyses to establish behavior patterns and test theories [32]. This study also has a descriptive scope that allows us to identify the basic competencies of Industry 4.0. The descriptive study sought to specify the important properties of people, groups, communities, and any other phenomenon that, at some point, are relevant to the analysis [33].

3.1. An Overview of the Experiment

3.1.1. First Stage: Analysis of the Context. The global digital movement that we are experiencing on a daily basis requires a constant and permanent encounter with technological development in urban life, business, socialization, and, of course, the academic and knowledge-based arenas. Rueda ([34]; p. 5) noted that throughout the development of human's life, the media have played an important role. These have contributed from the beginning to bringing people closer, in the sense that interaction and information have been increasingly favored. This fact can be seen patently reflected from the invention of radio, telephone, television, fax, cell phones, satellites, the Internet, and so on. These media—by placing them on a timeline—show a great technological evolution that has allowed borders to be crossed in a wide variety of social fields.

Because of what is mentioned in the previous paragraph, higher education at its various levels has needed to incorporate more and more skills and competencies in the management of new technologies. This enables groups or networks to be formed for academic collaboration and exchange. The capacities demonstrated by the latest technologies (especially networks) in functions such as the transmission of information and knowledge or communication have given rise to the idea of incorporating these resources into the training process itself [31].

Table 1: Indicators across pillars of the skills strategy.

		Mexico	Spain
Developing relevant skills	How skilled are youth?	Bottom 20%	Bottom 20%–40%
	Are skills of youth improving?	Top 20%–40%	Top 20%
	Are skills of youth being developed inclusively?	Bottom 20%	Around the average
	How many youth adults attain tertiary education?	Bottom 20%	Bottom 20%–40%
Using skills effectively	How well are skills activated in the labor market?	Bottom 20%	Bottom 20%
	How inclusive is the labor market?	Bottom 20%	Around the average
	How well aligned are skills with the labor market?	Top 20%	Bottom 20%
	Is skills' use stimulated by innovation?	Bottom 20%	Bottom 20%

Source: OECD [29].

For these reasons, the workshop course termed Technological Innovations in the Educational Field is designed for students to incorporate these tools into their daily activities. This will allow students to strengthen their skills for academic exchange with the help of digital platforms.

The intervention we investigated arises precisely from international educational action, the EMINUS course, through which teachers from various countries collaborated to design transversal educational modules. In this context, the course proposed collaboration between teachers from different fields as a means of enhancing innovation. The course was conducted online, which made it easier for teachers to become familiar with the tools that facilitate distance learning.

3.1.2. Second Stage: Design. In order to apply the intervention, the instructional design of a virtual course was carried out. For this, the following steps were followed (Figure 2):

(a) An agreement was made between the Public University of Navarra in Spain and the Veracruzana University in Mexico.

(b) The dates and times to carry out the intervention were defined according to the teachers' calendars.

(c) A flexible and easily accessible platform, where students could interact, was sought.

(d) Topics and subtopics related to the content of Instruction 4.0 were defined.

(e) Didactic/pedagogical activities were designed according to each content unit (diagrams, mind maps, databases, forums, photographs, etc.).

(f) A schedule was made with the activities to be carried out per week.

(g) The evaluation criteria of each activity carried out by the students were defined.

(h) Finally, a quantitative evaluation was administered to the students to obtain their impressions regarding the virtual workshop course and the competencies they gained therefrom. The questionnaire was made up of 43 questions, in which 4 categories were formed, in order to measure (1) which competencies were the most developed and (2) which were the ones that cost them the most work or simply could not be carried out. Table 2 shows how the questions were organized.

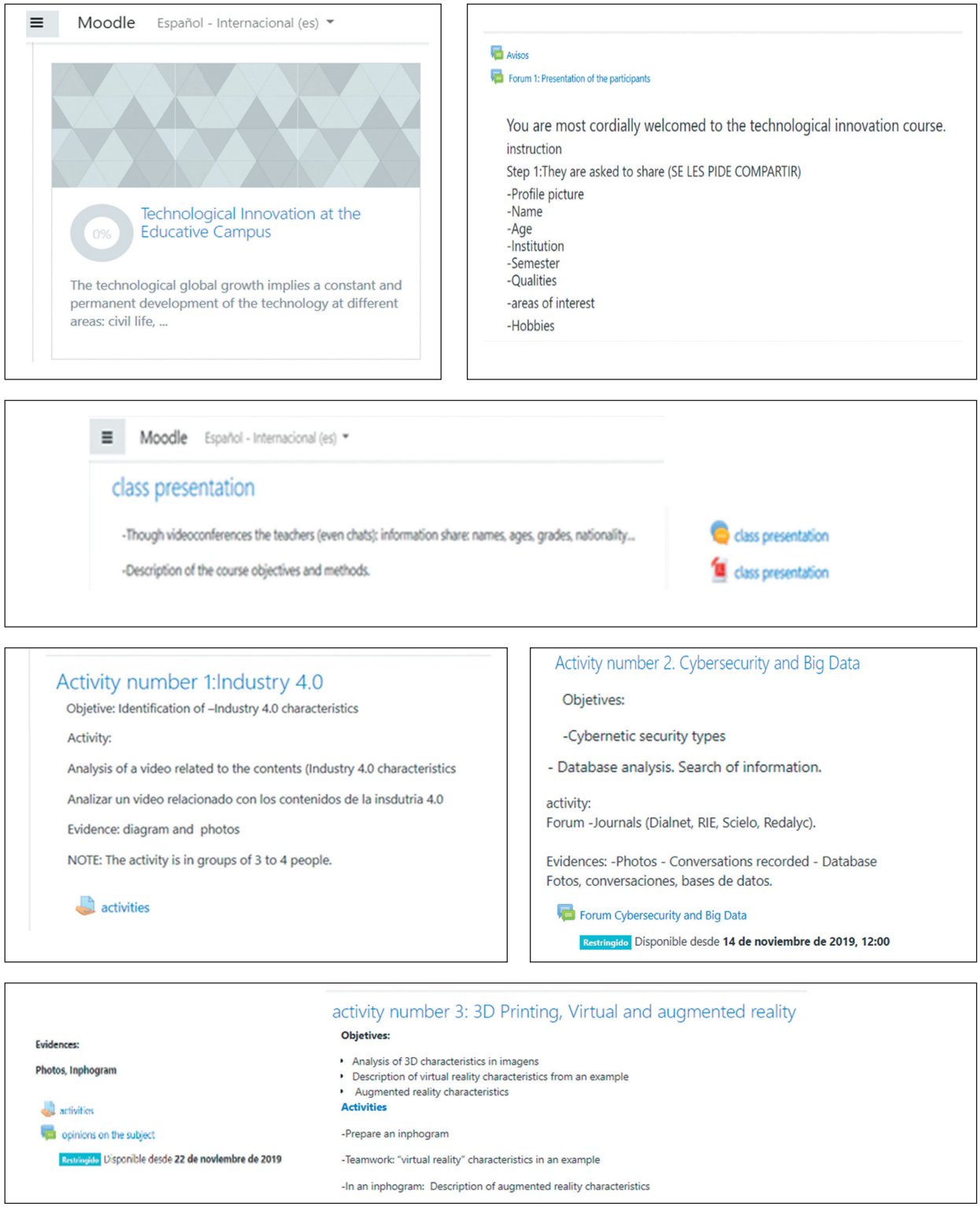
The workshop course, Technological Innovation in the Educational Field, was designed to be taught on the virtual platform entitled "A Thousand Classrooms" (part of the platform Moodle). This is a free digital tool that allows the creation of courses. It is characterized by a free structure that facilitates teacher-student and student-student interactions.

The course was designed to run for 5 weeks. It is important to underscore that the requirement was to teach it in English (in order to promote the learning of another language). The themes of each axis are related to Industry 4.0, as described below (Table 2).

3.2. Participants. Three groups of students ($N = 85$) participated in the study (Table 3). Fifty-nine students were from the Public University of Navarra, Spain. All were enrolled at the Faculty of Economic and Business Sciences. Of them, 30 students were studying for the International ADE degree (21 Spanish students and 9 from other countries). Another group of participants were taking the International ADE and Economics degree (22 Spanish students and 7 international students); 26 were attending Veracruzana University in Mexico, enrolled in the Bachelor of Pedagogy program, with a specialization in the Teaching Laboratory. The age of the students ranged from 19 to 26 years (Table 4).

3.3. Data Description. The platform and the activities carried out by the students are described below. Moodle is a web application developed as an LMS (learning management system) platform in which students and teachers can generate learning communities and interact publicly and securely (by logging username and personal password). Among its main functions, the following can be mentioned: managing all the entries; facilitating the publication of material; managing communication through forums, chats, and videoconferences; and scheduling the delivery of evaluative activities (University of Antioquia).

These features allowed us to design an educational platform, integrate the activities and products that they had to deliver, make communication between the students themselves in forums. Each participant offered their own points of view and received follow-up of the teachers, in addition to providing feedback on individual participants and the group.



(a)

Figure 1: Continued.

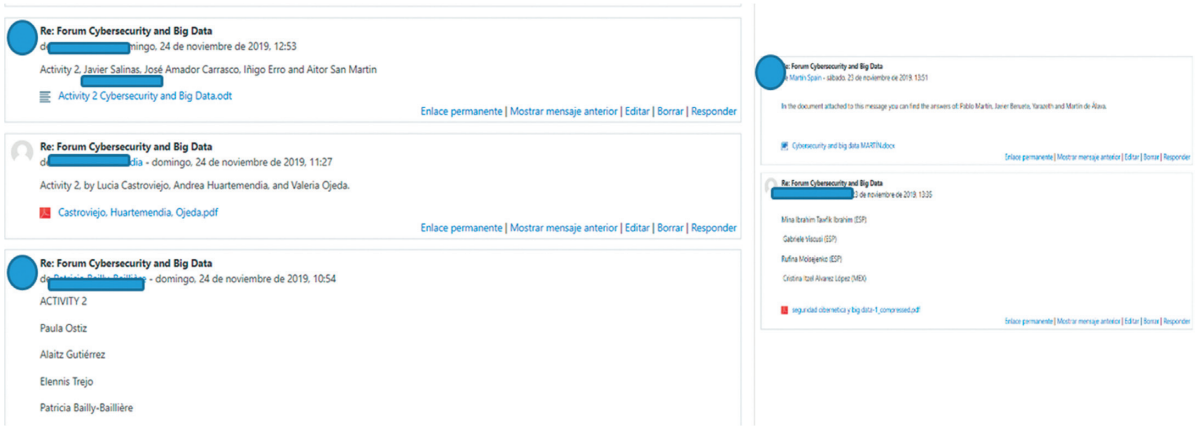
Objetives:

Activity number 4: Forum Experiences

Experiences forum Which competences should I have in the context of these changes (Industry 4.0, 3D Printing...?

Activity number 1. Industry 4.0

Activity number 2.
Cybersecurity and big data.

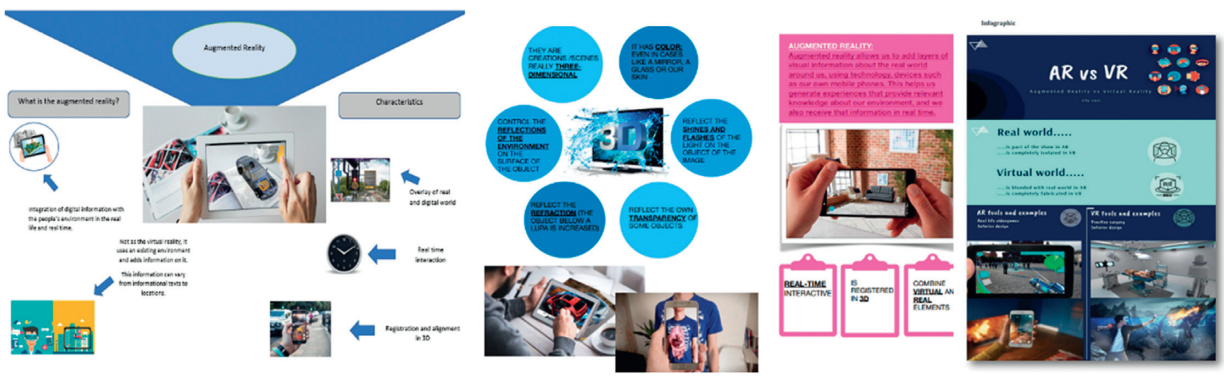


(b)

Figure 1: Continued.

Activity number 3. 3D Printing, virtual and augmented reality.

Activity number 4. Forum Experiences



Re: Forum Experiences
de H[redacted]iernes, 13 de diciembre de 2019, 11:47

It is essential to understand educational technology as a tool for teaching, an additional benefit for education that, next to quality pedagogical content and good professionals, improves the distribution of knowledge and makes the student go even further in their learning

Enlace permanente | Mostrar mensaje anterior | Editar | Borrar | Responder

Re: Forum Experiences
de [redacted] iernes, 13 de diciembre de 2019, 11:42

Educational technology is a tool that has transformed the exchange of experiences between those who teach and those who learn. With it, teaching is integrated into daily life through the computer, tablets and even the phone we have in hand all the time.

I take new experiences, knowledge and friends with this course

Enlace permanente | Mostrar mensaje anterior | Editar | Borrar | Responder

Re: Forum Experiences
de Breton España - jueves, 12 de diciembre de 2019, 03:13

In this series of activities related to the new technologies and the computer science, we have had to put in use our competences at the time of organizing a group work in which, in addition, we participated people of Mexico and Spain.

Besides learning about the topics mentioned above, we have experienced about how to really organize a group work, its benefits and difficulties so I think it has been a good way to learn how groups work beyond what we have studied in class.

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(c)

Figure 1: Screenshots from the Moodle platform and the activities of the students.

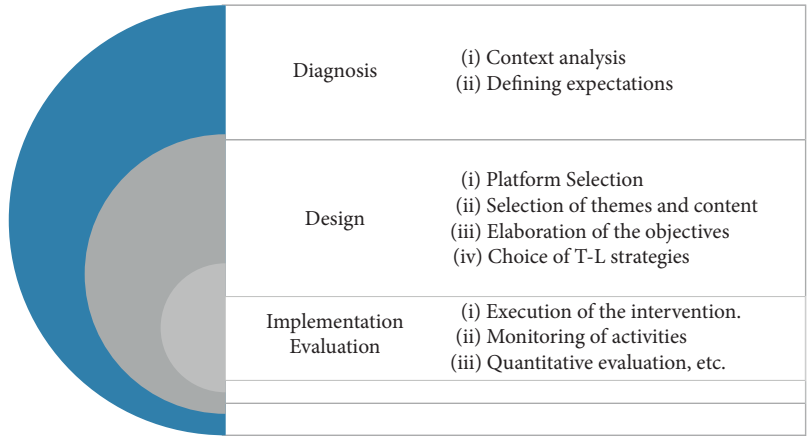

Figure 2: Instructional design of the technological innovation course.

Table 2: Planning of activities.

Week/content	Objectives	Activity	Evidence
Week 1 Presentation of the participants 7/8 November	(i) To get to know the members of each group through the videoconference session, in order to interact and identify themselves. (ii) Choose a partner to discuss your expectations for the course.	(i) Through a videoconference session (or chats), we will share names, ages, careers, nationality, and the objectives and ways of working will be described (in addition to the expectations that I have in this course)	(i) Photos (ii) Save conversations (iii) Conversation in the chat **Group activity**
Week 2 Industry 4.0 8/14 November	(i) Identify the characteristics of Industry 4.0	Review a video related to the topic and create a diagram with the characteristics of industry 4.0	(i) Diagram (ii) Photos **Group activity**
Week 3 Cybersecurity Big data: 22 November	(i) Recognize the different types of cybersecurity. (ii) Know the different databases where you can get information.	Information search and analysis of databases (Dialnet, Redalyc, Scielo, RIE).	Photos (i) Conversations (ii) Databases **Group activity**
Week 4 3D printing, virtual and augmented reality 28 and 29 November	(i) Analyze the images to point out the characteristics of 3D printing. (ii) Describe the characteristics of "virtual reality" through an object.	(i) Make an infogram (ii) In teams, investigate virtual reality and mention characteristics through an example or object.	(i) Infogram (ii) Save the forum conversations **Group activity**
Week 5 Forum experiences 1/10 December	(i) Express through the forum the experience that this course has given you.	(i) Experiences forum What did I feel? What did I like the most?	Conversations (i) Carry out the survey

Resources and materials: platform thousand classrooms, Internet, computers

Table 3: Results of developed and not developed skills.

Digital skills	Developed	Undeveloped
Indicators: (i) Interaction (ii) Communication (iii) Empathy (iv) Motivation (v) Collaboration	(i) Adaptability. (ii) Decision-making capacity. Communication between us has been fluid and continuous, although we were not all present. (iii) We believed that we could do a good job as a group. (iv) We have quickly agreed on working rules. In general we have been very satisfied with the work done in this group. (v) We have been an effective group.	(i) Ability to interact with peers. (ii) Capacity for empathy. (iii) Motivational ability to carry out the activities. (iv) Collaboration capacity. (v) Ability to communicate with colleagues. (vi) The group has worked in a coordinated way. (vii) As a group, we have made very few mistakes about what needed to be done.
Indicators:	(i) Ability to understand the content (cognitive).	(i) I have information about a part of the job that no other person in the group has.

Table 3: Continued.

Digital skills	Developed	Undeveloped
(i) Cognitive development (ii) Content mastery	(ii) Content synthesis capacity. (iii) Each of the group members has sufficient information on the aspects of the work. (iv) Each of the members of the group has sufficient prior knowledge to carry out the work. (v) I feel good accepting suggestions from other people in the group about how to carry out the group task. (vi) I trust the information provided by the other people in the group. (vii) I take into account and act on the information that other members of the group contribute to the group debate. (viii) We have exceeded the objectives of the entrusted work.	(ii) The specific knowledge of each of the group members has been necessary to do the group work. (iii) I know which member of the group has knowledge of a specific aspect of group work. (iv) When other colleagues provide information, I need to contrast or verify it. (v) I do not have much confidence in the knowledge and information of the rest of the people in the group.
Indicators: (i) Use of the platform (ii) Use of language	(i) Ability to navigate the virtual platform. (ii) Ability to search for information.	(i) Ability to master the English language. (ii) Ability to use teaching resources.
Indicators: Decision-making	(i) We have done the job smoothly and efficiently (ii) We have agreed very quickly on what our objectives were. (iii) We have agreed on the assessment of our skills and knowledge (iv) We have quickly agreed on how to work, although one of the people in the group was not present. (v) We have approached the case in a very similar way and we have agreed very quickly on the analysis of the situation. When different points of view have appeared, we have listened to each other, understood them, and acted accordingly as a group. (vi) We have immediately agreed on what we could do given the allotted time frame. (vii) We have finished the task in the allotted time. (viii) We have reacted quickly and efficiently when problems have arisen.	(i) We have needed to return to aspects already discussed or redo some things. (ii) We have had quite a lot of confusion and doubts about how to carry out group work (iii) The fact that the members of the group were not present has clearly influenced the results of the group.

Table 4: Structure of the working groups.

Groups	**Spain Public University of Navarra** Faculty of Economics and Business Administration	**30 students** 21 local 9 exchange **29 students** 22 local 7 exchange	**Course** Business Administration
	México Veracruzana University Faculty of Pedagogy	**26 students**	**Course** Teaching Laboratory
	Total, students	**85 students**	

4. Results

This section shows the results obtained from the statistical analysis of the student questionnaire responses (by category).

Figure 3 shows a scatter graph that displays results obtained from the questionnaires. There were three categories: interaction-communication-empathy, motivation, and collaboration, each consisting of 14 items. In the first category, interaction-communication-empathy, the minimum score was 351 and the maximum 386. For motivation, the minimum score was 368 and the maximum 408. For collaboration, the minimum score was 359 and the highest 414. According to these data, the mean was 385 of a total of 490 points.

The students affirmed that the skills they developed the most were (1) effective group, (2) group work, and (3) decision-making. Those that needed to be reinforced or improved were (1) interaction capacity, "we have believed

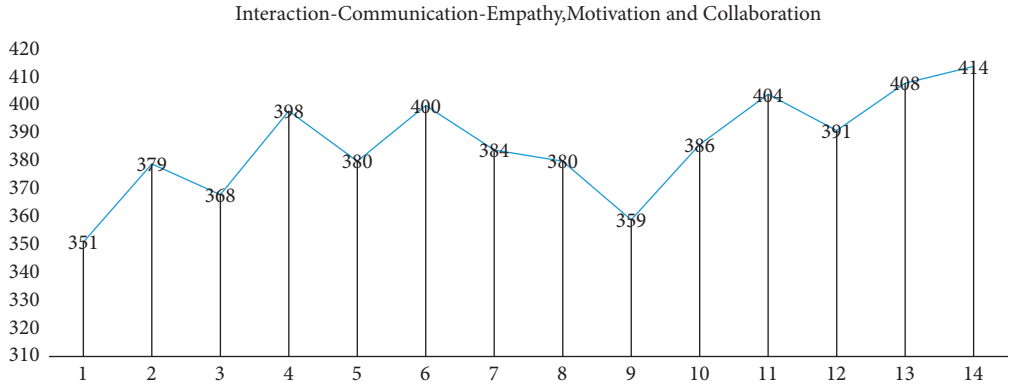

Figure 3: Category I: interaction-communication-empathy, motivation, and collaboration.

that we could do a good job as a group"; (2) capacity for empathy; and (3) capacity for motivation.

In order to make the analysis of the students' responses clearer for the reader, a scale was estimated where (1) is low, (2) is medium, and (3) is high. In category I, graph 1 shows that 71.43% of the students consider they have reached a high level in the development of competencies; 26.53% mention having developed a medium level; and only 2.04% considered reaching a low level. The above reflects that the competencies that were promoted in category I have been favorable in the development of this course, we can interpret that communication, interaction, empathy, motivation, adaptation, collaboration, and coordination to the realization of the activities for the majority of the students were achieved.

Figure 4 shows the second category titled "cognitive development-content domain." It consists of 13 items; as indicated, the lowest possible score was 214 and the highest was 435. According to these data, the mean is 360 of a total of 490 points.

Students mentioned that (1) they do not have confidence in the knowledge or information of the rest of the people within the group and (2) when a partner provides information, they need to contrast or verify it. On the positive side, (1) they show the ability to understand the content, (2) each member has sufficient information, (3) they have exceeded the work objectives.

Figure 5 shows a bar graph that displays results obtained from the scale. In category II, graph 2 shows that 59.18% of students consider having reached the development of competencies a high level, 40.82% mention having developed a medium level, and none consider having reached a low level.

Figure 6 shows the third category, "use of the platform, search for information, use of teaching resources, and language proficiency," consisting of 4 items. The lowest score is in English language proficiency (385 points), followed by the ability to use teaching resources (395 points); navigating the platform (399 points); and, at the high end, applying teaching resources (419 points). We can see that the lowest score was 385 and the highest was 419. According to these data, the mean is 399 of a total of 490 points.

Figure 7 shows a bar graph that displays results obtained from the scale.

In category III, graph 3 shows that 77.55% of the students consider that they have reached the development of skills at a high level, 22.45% mention that they have developed a medium level, and none consider having reached a low level.

Figure 8 shows the fourth category: "decision-making." It consists of 12 items. The lowest-rated items are Question 1 (258 points): "They needed to redo some work." Question 3 (280 points) follows with "They had confusion and doubts about how to carry out group work" and Question 12 (293 points) "The fact that the group members were not present has clearly influenced the group's results." Question 5 presents an average score of 385 points "Assessment of skills and knowledge" followed by Question 4 "They agreed very quickly on what their objectives have been" (399 points) and "They carried out the work smoothly and efficiently." Finally, the highest score obtained (407 points) was received on Question 7: "We approached the case in a very similar way and agreed very quickly in the analysis of the situation." Question 6 (415 points) followed: "We quickly agreed on how to work, although one of the people in the group was not present." The following two items received 418 points: Question 8: "We immediately agreed on what we could do given the allotted time frame" and Question 9: "When different points of view appeared, we have listened, understood, and acted consequently as a group, and Question 11: "We reacted quickly and effectively when problems have arisen." Finally, Question 10 (424 points) was "We have finished the task in the allotted time." We can see that the minimum score was 258 and the maximum was 424. According to these data, the average was 376 of a total of 490 points.

In category IV, Figure 9 shows that 65.31% of the students consider that they have reached the development of competencies at a high level, 32.65% mention that they have developed a medium level, and 2.04% consider that they have reached a low level (Figure 10).

5. Discussion

According to the results obtained and taking the mean of the scores for each category, we can see which competencies were developed and which were not.

According to Table 3, it can be seen that category IV, was the most developed; that is, the students had the ability to decide as a group, organize, expose their points of view, solve problems, and be efficient. It is followed by category II, the ability to understand the content, information, and prior knowledge of each student; they consider they have exceeded

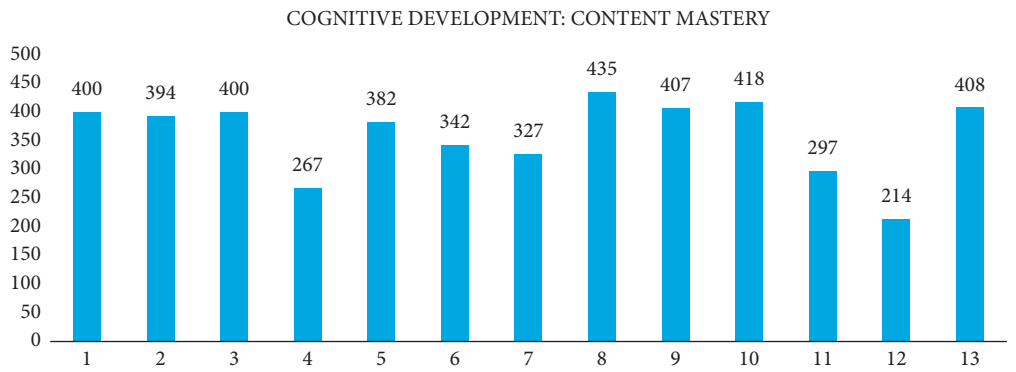

Figure 4: Category II: cognitive development-content mastery.

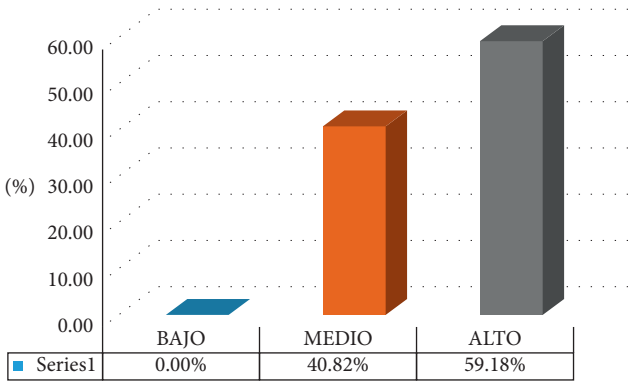

Figure 5: Category II: cognitive development-content mastery: results.

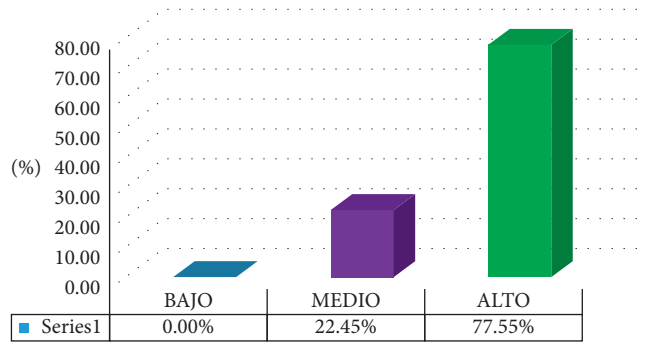

Figure 7: Category III: use of the platform, search for information, use of resources, and language proficiency and decision-making: results.

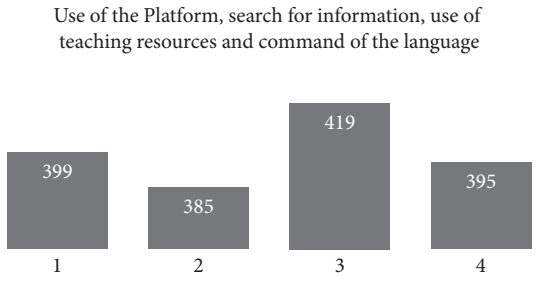

Figure 6: Category III: use of the platform, search for information, use of resources, and language proficiency.

the work objectives. The next was category I: the ability to adapt and do good work as a group and satisfaction and effectiveness among group members. Finally, in category III, the students felt they reached the ability to navigate the platform and search for information. Undoubtedly, the skills that were not developed must continue to be promoted, creating new teaching-learning strategies that allow them to develop since they are essential for one's professional future and the global context in which we live.

Finally, there were several obstacles faced during the intervention:

(i) Time difference: Between Spain and Mexico, there is a difference of 7 hours. Therefore, we selected the connection times to coincide with their communication via videoconference. However, at some points, the quality of the network was not effective and we had to constantly be reconnecting. Therefore, in some sessions, each group was instructed to carry out the activities; in such cases, participation was made through the group forum.

(ii) Language: Some students in Mexico had a hard time due to a poor command of the English language (it was not a criterion for participation). These students had to support translators, study vocabulary, and listen to videos to understand and participate in the conversations. This was a limiting factor that had an impact on the development of the activities. In the case of the Spanish students, they dominated the English language at a medium–high level; the foreign students generally spoke two or more languages.

(iii) Cultural training: Although Spain and Mexico speak the Spanish language and share a common history, each has a different educational, cultural, economic, political, technological, and educational context. When students communicated with each other, we observed that some did not have a grasp of some concepts and/or lacked historical references. The international students tended to hold a more global vision.

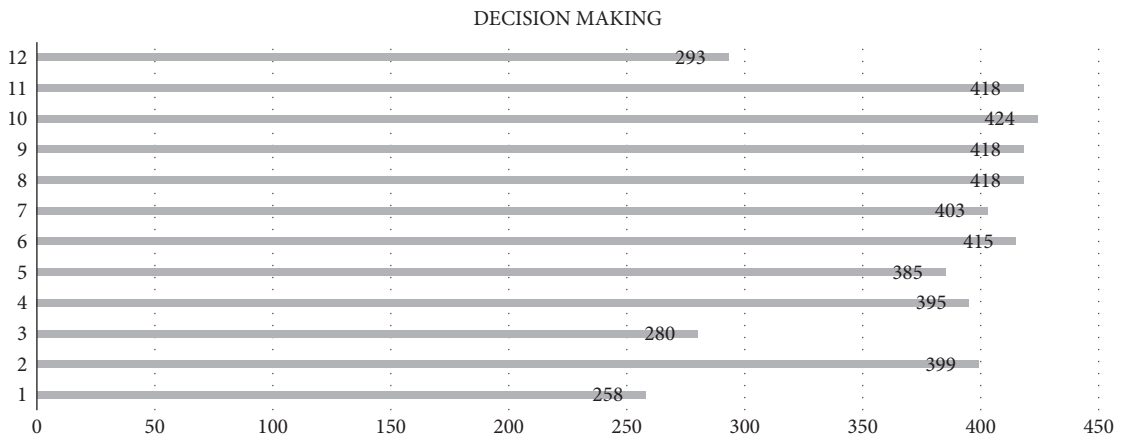

Figure 8: Category IV: decision-making.

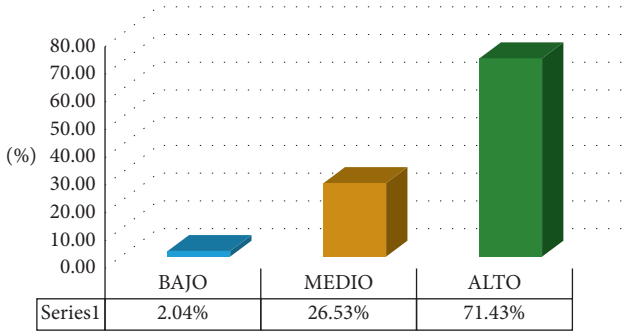

Figure 9: Category I: interaction-communication-empathy, motivation, and collaboration: results.

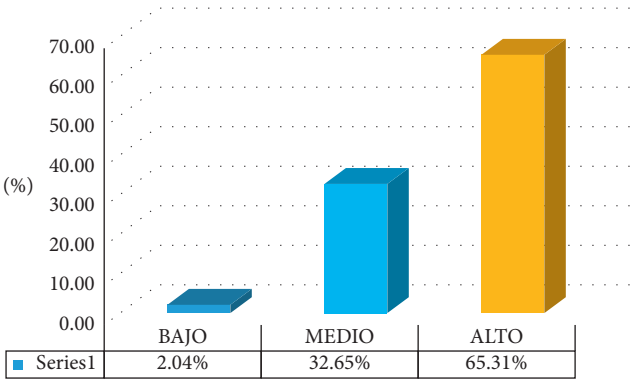

Figure 10: Category IV: decision-making: results.

(iv) Different disciplinary areas: Students from Spain were from the business economics area; those from Mexico were studying humanities, both are familiar with concepts and different approaches; however, the topic of technology is global and implies that students develop skills that allow them to incorporate into their workplace. We can say that the students learned from both areas, and each one applies them to their disciplinary context.

(v) The remote connection by videoconference was slow, and sometimes we had to constantly be reconnecting. This took time, but we tried to adjust so that the protocol for conducting the activities proceeded according to plan.

It is worth mentioning, based on these results, that digital skills were necessary for virtual work and allowed a better development for carrying out activities. Therefore, they bring us closer to the objectives set at the beginning of the intervention.

This intervention allowed promoting digital skills with university students and learning about the skills that they developed the most and those that they lacked to strengthen. Relating them to the theory, we can see that students face a global digital context that requires the development of various capacities that allow them to enter the labor field in the disciplinary areas where they operate.

In line with [10], not only must the learning elements be linked, but also new changes must be generated, which generate a new way of learning. Our experiment supports this affirmation by creating new changes that should be solved by the use of digital skills.

In addition, it can be observed that digitization implies no longer teaching or learning in the same way. As a result, the teacher reflects the learning outcomes on the strategies and methods used, as mentioned by Viñals and Cuenca [35]. The constant development of digital technologies and the Internet has caused us to live in a digital context based on connections. The way of learning has changed and, therefore, the way of teaching. Knowledge is networked and the teaching staff must be the one who accompanies the students in their learning process.

Therefore, we teach in a digital context, where the development of various competencies is required, Castells [36]. As he proposed, technological tools and virtual space have given rise to new forms of communication, work, information, fun, and, in general, participation and living in a network society.

All these challenges described are faced by the new generations of students and justify why our intervention focuses on promoting the various tools in an international digital context. Not only knowledge but also the way to communicate, interact, exchange ideas and points of view,

make decisions, work collaboratively, designate responsibilities, have empathy, use interactive platforms, know how to handle information, research, and use another language is important. Therefore, it is not an easy task for those who teach.

Returning to Viñals and Cuenca [35], learning in the digital age can be defined as diverse, messy learning, far removed from traditional knowledge, perfectly packaged, and organized. Networked knowledge is based on creation, which implies a change in mentality and attitude: going from being mere consumers of the content produced by other people to being the experts and amateurs who are the co-creators of knowledge.

To conclude, teachers are invited to reflect on breaking with paradigms and traditional schemes and meditate on the fact that the forms of teaching must be changed. The adaptation to the new digital educational context that higher education requires, where students are the central axis of the educational process and the teacher guides them, provides them with tools to build their knowledge and develop skills and capacities that allow them to function in the socio-educational context where they operate.

6. Conclusions

Echeverría [37] affirmed that the virtual context implies a new identity (E3, digital identity) that coexists with the generic identity (E1) and social identity (E2). Individuals should act in the three dimensions. The OECD [29] reinforces this affirmation by recognizing that, to prosper in the digital workplace, not only e-skills but also cognitive and socioemotional competencies are required. The present research contributes to this literature by elaborating this idea in an international experiment. According to our results, decision-making and cognitive development competencies were the most developed competencies in a semionsite course based on Industry 4.0 and digital transformation concepts. In this sense, our results present empirical evidence that seeks to contribute to the definition of 21st-century digital skills [38] in an educational context.

Based on the data collected and analyzed and the student participants' perceptions, it can be mentioned that the majority expressed a favorable position on the course's impact. This was followed by a neutral impact. Fewer than 30% of students mentioned a negative impact. Therefore, it can be concluded that the objectives of the study were achieved. In general, the main results of the investigation were as follows:

At first, it allowed us to know the competencies and skills that students developed to the greatest extent in implementing Industry 4.0 and which ones they needed to improve. At the same time, the dynamic and didactic activities contributed to the achievement of the activities; this was reflected in the students' comments.

In another regard, remote communication between students allowed working in a consensual and collaborative way. The students agreed on their style of connecting with each other to carry out the activities (in late hours), which implied responsibility and decision-making to achieve the objective, upload their comments, and work in established times.

In the third respect, interacting with students from another country and other academic areas allowed students to have a different vision of the concepts and themes and how they are applied in various contexts. It is important to mention that the follow-up in the forums enabled the students to express their points of view and analyze, criticize, compare, and reflect on each of the topics.

The main implications for practice derive from the opportunity of reapplying the experiment in different universities. By so doing, the international experiment facilitates a collaborative learning scenario. This is even more relevant since the pandemics make the international mobility of students difficult. The experiment supports the creation of multicultural teams of students from different countries that work together using the technology. In addition, the DigComp framework fosters the development of digital competencies in the educational process [39]. This experiment helps students to reinforce their digital competencies.

Regarding future research, it is important to mention that the virtual classroom is a space where not only knowledge is transmitted but also experiences are shared. Communication, interactive, collaborative, motivational, and decision-making skills are developed; empathy and adaptability are fostered, as well as the capacity to exchange ideas in a language other than their own. Altogether, it is important to generate activities that allow the student to develop competencies to be applied in their daily lives and professional development.

Based on our conclusions, we define the main directions for future research. Firstly, by increasing our international collaborations, the experiment can be replied at universities from different countries, and, therefore, the sample will increase and reinforce our findings. Secondly, the experiment can be complemented by including role-playing interactions. Both managers and employees' responses to ICTs can be considered in future experiments. Finally, digital competencies before and after the experiment can be measured by the DigComp test to analyze the role of the experiment to improve students' digital competencies.

In summary, this intervention seeks to promote further advances in this area. In so doing, additional courses of this nature can be applied as a means of promoting virtual learning and the development of digital skills in students, thereby creating positive virtual spaces for learning.

Data Availability

Data are available on request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] M. Castells, "The information age: economy, society and culture," *The Rise of the Network Society*, Wiley-Blackwell, Chichester, UK, 2010.

[2] D. C. Cristina, "Acquiring autonomy at school and in work group through information and communication technologies," in *Proceedings of the 10th International Technology, Education and Development Conference*, pp. 1359–1363, Valencia, Spain, March 2016.

[3] J. Picatoste, L. Pérez-Ortiz, S. M. Ruesga-Benito, and I. Novo-Corti, "Smart cities for wellbeing: youth employment and their skills on computers," *Journal of Science and Technology Policy Management*, vol. 9, no. 2, pp. 227–241, 2018.

[4] F. Goldhammer, G. Gniewosz, and J. Zylka, "ICT engagement in learning environments," in *Assessing Contexts of Learning*, pp. 331–351, Springer, Cham, Germany, 2016.

[5] D. Martinovic, V. Freiman, C. S. Lekule, and Y. Yang, "The roles of digital literacy in social life of youth," in *Advanced Methodologies and Technologies in Library Science, Information Management, and Scholarly Inquiry*, pp. 103–117, IGI Global, Harrisburg, PA, USA, 2019.

[6] L. Holt and R. G. Brockett, "Self direction and factors influencing technology use: examining the relationships for the 21st century workplace," *Computers in Human Behavior*, vol. 28, no. 6, pp. 2075–2082, 2012.

[7] B. Lachmann, C. Sindermann, R. Y. Sariyska et al., "The role of empathy and life satisfaction in internet and smartphone use disorder," *Frontiers in Psychology*, vol. 9, p. 398, 2018.

[8] F. Mishna, C. Regehr, A. Lacombe-Duncan, J. Daciuk, G. Fearing, and M. Van Wert, "Social media, cyber-aggression and student mental health on a university campus," *Journal of Mental Health*, vol. 27, no. 3, pp. 222–229, 2018.

[9] H.-Y. Wang, L. Sigerson, H. Jiang, and C. Cheng, "Psychometric properties and factor structures of Chinese smartphone addiction inventory: test of two models," *Frontiers in Psychology*, vol. 9, p. 1411, 2018.

[10] A. Hart, "Living and working in paradise: the rise of the 'digital nomad," *The Telegraph*, vol. 17, 2015.

[11] D. Schweer and J. C. Sahl, "The digital transformation of industry—the benefit for Germany," *The Drivers of Digital Transformation*, Springer, Cham, Germany, pp. 23–31, 2017.

[12] M. Kotarba, "Measuring digitalization—key metrics," *Foundations of Management*, vol. 9, no. 1, pp. 123–138, 2017.

[13] International Federation of Robotics, https://ifr.org/, 2019.

[14] ECORYS (Firm), "Danish technological institute (DTI)," *The Impact of ICT on Job Quality: Evidence from 12 Job Profiles*, Publications Office of the European Union, Luxembourg, Luxembourg, 2016.

[15] Eurofound, "Sixth European working conditions survey: overview report," 2016, https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys/sixth-european-working-conditions-survey-2015.

[16] J. Sánchez-Navarro and D. Aranda, "Messenger and social network sites as tools for sociability, leisure and informal learning for Spanish young people," *European Journal of Communication*, vol. 28, no. 1, pp. 67–75, 2013.

[17] E. Middaugh, L. S. Clark, and P. J. Ballard, "Digital media, participatory politics, and positive youth development," *Pediatrics*, vol. 140, no. S2, pp. S127–S131, 2017.

[18] E. Pacheco, M. Lips, and P. Yoong, "ICT-enabled self-determination, disability and young people," *Information, Communication & Society*, vol. 22, no. 8, pp. 1112–1127, 2019.

[19] E. J. Helsper and A. J. A. M. Van Deursen, "Digital skills in Europe: research and policy," *Digital Divides: The New Challenges and Opportunities of E-Inclusion*, vol. 195, p. 125, 2015.

[20] M. Pienimäki, "Improving the wellbeing of at-risk youth through media participation," *Media Practice and Education*, vol. 20, no. 4, pp. 364–377, 2019.

[21] L. Pagani, G. Argentin, M. Gui, and L. Stanca, "The impact of digital skills on educational outcomes: evidence from performance tests," *Educational Studies*, vol. 42, no. 2, pp. 137–162, 2016.

[22] N. S. Hawi and M. Samaha, "To excel or not to excel: strong evidence on the adverse effect of smartphone addiction on academic performance," *Computers & Education*, vol. 98, pp. 81–89, 2016.

[23] A. D. Benson, S. D. Johnson, and K. P. Kuchinke, "The use of technology in the digital workplace: a framework for human resource development," *Advances in Developing Human Resources*, vol. 4, no. 4, pp. 392–404, 2002.

[24] P. D. Christofides, J. F. Davis, N. H. El-Farra, D. Clark, K. R. D. Harris, and J. N. Gipson, "Smart plant operations: vision, progress and challenges," *AIChE Journal*, vol. 53, no. 11, pp. 2734–2741, 2007.

[25] L. M. Romero-Rodríguez and I. Aguaded, "Consumo informativo y competencias digitales de estudiantes de periodismo de Colombia, Perú y Venezuela," *Convergencia*, vol. 23, no. 70, pp. 35–57, 2016.

[26] D. P. Ausubel, "The facilitation of meaningful verbal learning in the classroom1," *Educational Psychologist*, vol. 12, no. 2, pp. 162–178, 1977.

[27] OECD, *Higher Education In Mexico: Labour Market Relevance And Outcomes, Higher Education*, OECD Publishing, Paris, France, 2019.

[28] OECD, *OECD Skills Strategy Diagnostic Report: OECD Skills Studies*, OECD Publishing, Paris, France, 2017.

[29] OECD, *OECD Skills Strategy 2019: Skills to Shape a Better Future*, OECD Publishing, Paris, France, 2019.

[30] J. M. Touriñán López,, "Intervención educativa, intervención pedagógica y educación: La mirada pedagógica. Revista portuguesa de pedagogía," *Revista Portuguesa de Pedagogia*, pp. 283–307, 2011.

[31] M. Fandos, "Training based on information and communication technologies," *Didactic Analysis of the Teaching-Learning Process*, Tarragona, Spain, 2003.

[32] R. Hernández, *Investigation Methodology*, McGraw Hill Education, New York, NY, USA, 2010.

[33] R. Hernández, C. Fernández, and P. Baptista, *Investigation Methodology: Federal District, Mexico*, McGraw Hill Education, New York, NY, USA, 2010.

[34] J. Rueda, "Technology in 21 st centrury society: dawn of a new industrial revolución," *Journal of Social Sciences*, vol. 32, 2007.

[35] A. Viñals, J. Cuenca, The role of teachers in the digital age," *Interuniversity Magazine of the Teacher Training*, vol. 30, no. 2, pp. 103–114, 2016.

[36] M. Castells, "La Sociedad en Red: Una Visión Global," *No. U10 1087*, 2006.

[37] J. Echevarría, "Conocimiento en el medio ambiente digital," *Nueva Revista*, vol. 70, pp. 25–29, 2000.

[38] E. Van Laar, A. J. A. M. Van Deursen, J. A. G. M. Van Dijk, and J. De Haan, "The relation between 21st-century skills and

digital skills: a systematic literature review," *Computers in Human Behavior*, vol. 72, pp. 577–588, 2017.

[39] A. Ferrari, B. N. Brečko, and Y. Punie, *DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe*, Vol. 7, JRC Publications, , Ridgefield, CT, USA, 2014.