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Teacher education in the face of new virtual teaching and learning opportunities from a technological, pedagogical and human perspective

La formación del profesorado ante las nuevas oportunidades de enseñanza y aprendizaje virtual desde una dimensión tecnológica, pedagógica y humana

面对来自技术、教学和人文层面的虚拟教学新机会的教师培训

Подготовка учителей в условиях новых возможностей виртуального преподавания и обучения с технологической, педагогической и человеческой точек зрения

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Abstract

COVID-19 has had an impact on the education of aspiring teachers, generating new ways of teaching and learning in which technologies have become our main resources. This article, based on empirical evidence, analyzes the importance of maintaining the pedagogical and human essence in an emergency remote teaching environment. Its main objective is to analyze the use, during the lockdown, of a series of digital resources and tools (Video classes, Blog, Digital Portfolio, virtual vole playing and online games) that, planned in a pedagogical way, foster motivation, collaboration and positive attitudes towards virtual learning. Through a mixed methodology and a pre-experimental design, data from 61 students for the Master's Degree in Teaching at the Universidad Rey Juan Carlos (Madrid) was analyzed quantitatively and qualitatively, using a questionnaire designed *ad hoc* and validated by experts, as well as testimonies, teaching evaluations and final grades. For this purpose, a frequency distribution analysis, a descriptive analysis and a comparison of the evolution of some variables, both before and after lockdown, were carried out. The main conclusion drawn was a resounding confirmation that it is possible to acquire knowledge, develop skills, in general; digital skills, in particular, and positive attitudes towards a virtual environment without sacrificing motivation and collaboration. The use of these tools and resources is transferable to other subjects and degree programs, with a minimum of technical and didactic knowledge and digital teaching competence. In addition, the results obtained may be useful for the designing of didactic strategies that connect the pedagogical, technological and human dimensions in the educations of tomorrow's teachers.

Key words: Digital tools, pedagogy, attitude, emergency remote teaching, teacher education.

Resumen

La COVID-19 ha impactado en la formación del profesorado generando nuevas formas de enseñar y de aprender donde las tecnologías se han convertido en nuestras principales aliadas. El presente artículo basado en evidencia empírica analiza la importancia de mantener la esencia pedagógica y humana en un entorno de enseñanza remota de emergencia. Para ello, se plantea como principal objetivo analizar el uso, durante el confinamiento, de una serie de recursos y herramientas digitales (Video clases, Blog, Portfolio digital, *Role playing* virtual y Juegos *online*) que, planificados de manera pedagógica, fomenten la motivación, colaboración y actitudes positivas hacia el aprendizaje virtual. A través de una metodología mixta y un diseño pre-experimental se analizan de manera cuantitativa y cualitativa datos de 61 estudiantes del Máster de Formación del Profesorado de una universidad pública española obtenidos en un cuestionario diseñado *ad hoc* y validado por expertos, así como en testimonios, valoraciones docentes y notas finales. Para ello, se ha realizado un análisis de distribución de frecuencias, un análisis descriptivo y se ha comparado la evolución de alguna variable, tanto antes como después del confinamiento. El principal resultado obtenido es la confirmación rotunda de que es posible adquirir conocimientos, desarrollar competencias en general, y la digital, en particular, y desarrollar actitudes positivas hacia un entorno virtual sin perder la motivación y la colaboración. El uso de dichas herramientas y recursos es transferible a otras asignaturas y titulaciones, con un mínimo de conocimiento técnico y didáctico, así como de competencia digital docente. Además, los resultados obtenidos pueden ser útiles para el diseño de estrategias didácticas que conecten la dimensión pedagógica, tecnológica y humana en la formación de las nuevas generaciones de profesores.

Palabras clave: Herramientas digitales, pedagogía, actitud, enseñanza remota de emergencia, formación del profesorado.

概要

新冠疫情对教师培训的影响反映在新的教学方式的产生，其中技术已成为了我们的主要盟友。本文基于经验证据分析了在紧急情况下远程教学环境中对保持教学和人文精华的重要性。为此，研究主要目标是分析一系列教学数字资源和工具（视频课程、博客、数字文件夹、虚拟角色扮演和在线游戏）在隔离期间的使用情况，这些教学工具可以增加学习兴趣，促进虚拟学习的协作并对虚拟学习产生积极的态度。通过混合方法和预实验设计，我们对西班牙公立大学教师培训硕士学位的 61 名学生的数据进行了定量和定性分析，研究使用了通过专门设计并经专家验证的问卷，并分析了教师评价和期末成绩。我们进行了频率分布分析、描述性分析，并比较了隔离前后某些变量的演变。最后主要的研究结果明确确认了学生可以在不失去动力和协作的情况下获得知识、发展常规能力，特别是数字能力，并培养对虚拟环境的积极态度。只需具有最基本的技术教学知识以及数字教学能力，这些工具和资源的使用就可以用到其他学科和学位上。此外，所获得的结果可有助于设计在新一代教师培训中将教学、技术和人文层面联系起来的教学策略。

关键词: 数字工具，教育，态度，紧急情况下远程教学，教师培训。

Аннотация

COVID-19 оказал влияние на подготовку учителей, создав новые способы преподавания и обучения, где технологии стали нашими главными союзниками. В данной статье на основе эмпирических данных анализируется важность сохранения педагогической и человеческой сущности в чрезвычайной дистанционной среде обучения. Основная цель - проанализировать использование во время заключения ряда цифровых ресурсов и инструментов (видеоуроки, блог, цифровое портфолио, виртуальные ролевые игры и онлайн-игры), которые, спланированные педагогическим образом, способствуют мотивации, сотрудничеству и позитивному отношению к виртуальному обучению. Используя смешанную методологию и и пре-экспериментальный метод, данные 61 студента магистратуры по подготовке преподавателей в государственном университете Испании, полученные из анкеты, разработанной специально и проверенной экспертами, а также из свидетельств, оценок преподавания и итоговых оценок, анализируются количественным и качественным образом. Для этого были проведены описательный анализ и сравнение эволюции некоторых переменных, как до, так и после заключения. Главный полученный результат - это подтверждение того, что можно приобретать знания, развивать навыки в целом и цифровые навыки в частности, а также формировать позитивное отношение к виртуальной среде без потери мотивации и сотрудничества. Использование этих инструментов и ресурсов может быть перенесено на другие предметы и степени при наличии минимальных технических и дидактических знаний, а также компетенции в области цифрового обучения. Более того, полученные результаты могут быть полезны для разработки дидактических стратегий, которые соединяют педагогическое, технологическое и человеческое измерения в подготовке новых поколений учителей.

Ключевые слова: цифровые инструменты, педагогика, отношение, экстренное дистанционное обучение, подготовка учителей.

Introduction

Ways of coping with the sudden explosion in the usage of technologies after the COVID-19 pandemic varied between individuals. This idea accords with what is known as “learning ecologies” in the digital era (González-Sanmamed et al., 2020). The au-

thors recognize that we are currently undergoing a period of transformation in ways of teaching and learning, i.e., now at a key juncture to develop alternative educational opportunities (OECD, 2020).

In this process of transition from face-to-face to virtual mode, it is not only a matter of enduring (and recovering), but also of improving and advancing (redesigning) (Ibáñez, 2020; SITEAL, 2020). However, this process is not simply about teaching and learning online, but also about emergency remote teaching, which, according to Hodges et al. (2020), was a temporary and sudden change in the educational process due to the special circumstance of the pandemic. Therefore, it is necessary to plan and evaluate it from the curricular and attitudinal point of view.

Technology floods our lives

Information and Communication Technology (hereinafter ICT) burst into all areas of our lives years ago, but it was the closure of educational institutions due to the pandemic, and the limitations it entailed on face-to-face attendance, rendered ICT essential for everyone thereafter.

In the Adams et al. (2017), 78 experts mapped out a five-year outlook for higher education institutions in relation to technology integration worldwide, recognizing that online and blended learning would be inevitable in the future. A year later, the European Commission's Digital Education Action Plan (2018) highlighted the opportunities for digital transformation in education. Despite all this, UNESCO's Assistant Director-General for Education claimed that we were not prepared for such a major disruption (IESALC, 2020). The emergency plans designed by universities have followed similar guidelines (OECD, 2020): training and advising the educational community to teach and learn virtually and shift teaching towards the online modality. This is a transition that requires ensuring quality and access to virtual teaching/learning, constituting a challenge for all (Quintana, 2020).

Technology with Pedagogy

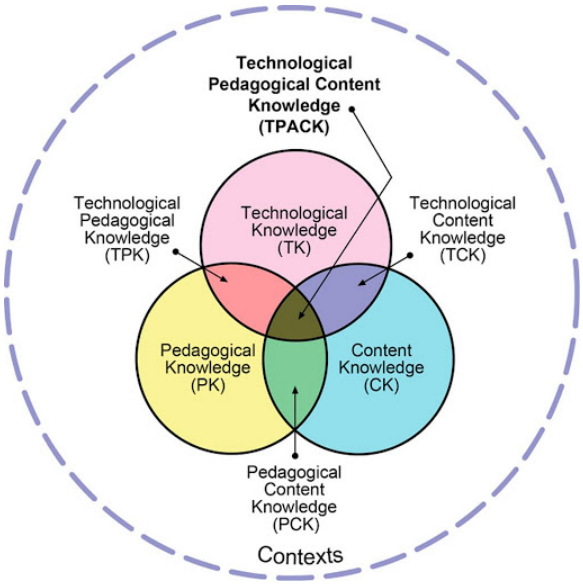
The pedagogical role of ICTs as catalysts of educational innovation and quality had already been considered for some time (SITEAL, 2019). This transition in modalities reminds us that technology must revolve around an underlying pedagogical intention. This idea is justified by the methodological scheme known as the Technological Pedagogical Content Knowledge or TPACK model (Koehler & Mishra, 2008), which asserts that the most effective way to integrate technology is through the interaction of three key factors (Figure 1).

During emergency remote teaching we were able to verify the importance of having advanced knowledge about the content to be taught (discipline), the digital tools to be used (technology) and their didactic application (pedagogy). Connecting the three dimensions is a challenge for teachers (Piñón et al., 2019). The study by Cejas et al. (2016) states that to assess the three dimensions among trainee or practicing teachers, it is necessary to have validated instruments (Cabero et al., 2017; Chai et al., 2011; Schmidt et al., 2009). The first step in this area is to adapt the current curricula to the needs of today's digital society. One experience can be found in the Early Childhood and Primary Education Degrees at the Universidad Rey Juan Carlos (hereafter, URJC) in Madrid (Santacruz-Valencia et al., 2019), where an *ICT in Education* course has been adapted to

the current Common Framework of Digital Teaching Competence designed by Spain's National Institute of Technology and Professional Development (INTEF, 2017).

Figure 1

TPACK model



Note. Retrieved from "Introducing Technological Pedagogical Content Knowledge (TPACK)", por J. Koehler & Mishra, P., (2008). *The handbook of technological pedagogical content knowledge for educators* (pp. 3-28), 2008, Routledge.

In the context of emergency remote teaching, the National Agency for Quality Assessment and Accreditation (ANECA) in Spain, with the aim of guaranteeing the quality of university education, offered guidelines through the redesigning of teaching guides and the roles of teachers and students (Siles, 2020). Its director stated that the suspension of face-to-face classes could lead to difficulties in the acquisition of knowledge, the development of competences, the planning of methodology, evaluation, and in communication processes and relationships with students.

However, invisible learning can also emerge in this environment (González-Sanmamed et al., 2020). This approach takes into account "the impact of technological advances and transformations in formal, non-formal and informal education, in addition to those meta-spaces in between" (Cobo & Moravec, 2011, p. 23). Therefore, the acquisition and development of knowledge, competencies and attitudes can also be possible, thanks to the ubiquity of technologies, since we can learn with them, from them and through them.

The human dimension of the teaching and learning process

This dimension is an important element in an e-learning environment (SITEAL, 2019), such that it is in teacher training it is necessary to take it into account and strive to

develop interpersonal skills that enhance the relationships between and the engagement of teachers and students (Torquemada & Jardínez, 2019).

During lockdown, many discovered the vital need to socialize (IESALC, 2020). In fact, UNESCO recognizes that the loss of socialization routines can impair the development and attitudes of students, leading to a certain social isolation (Schleicher, 2020), so we should not overlook the social function of the university.

The study by Farjon et al. (2019), based on Knezek and Christensen's (2008) Will, Skill and Tool (WST) Model describes the existence of influential factors affecting the integration of technology by teachers, highlighting attitudes, beliefs and competencies as the factors that contribute most to the successful incorporation of ICT (Piñón et al. 2019). Along this line, the study by González-Sanmamed et al. (2020) reminds us of the importance of attending to personal and human issues such as students' characteristics, needs and expectations, essential during the pandemic; hence the need to take care of the emotional health of the educational community (IESALC, 2020; OECD, 2020).

Therefore, we have before us the challenge of learning how to use technology to teach online and to involve and motivate our students by fostering academic relationships (Domingo et al., 2019). This objective is based on pedagogical theories such as Constructivism, and Neuroeducation, that remind us that the brain learns better if there is emotion and motivation involved (Mora, 2017). Moreover, within the current integrative perspective on learning ecologies (González-Sanmamed et al., 2020), interaction and connection between people is vital in order to advance academically. It is, therefore, a matter of rendering the invisible face of learning visible (Cobo & Moravec, 2011).

Methodology

After the sudden closure of face-to-face classrooms as a result of the COVID-19 lockdown, a process of adaptation of in-person teaching/learning methodologies to a virtual environment was carried out in the course in question. To this end, in the first video class, students were openly asked about the type of methodology they wished to follow, as well as their degree of knowledge of some digital tools and resources to be used. In this first contact, most of the students (studying for university degrees other than or not very similar to Education) stated that they knew some tools, resources and methodologies that were going to be used, but most of them had never used them, or very seldom, in academic contexts. Therefore, the commitment was to make these tools known and to expand their knowledge from an academic point of view (and not only social, as could happen with blogs, forums...) focusing, above all, on their pedagogical value.

Objectives

The General Objective (GO) is to use digital tools and resources that, planned in a pedagogical way, and with a clear didactic methodology, favor involvement, collaboration and academic relationships in an emergency remote teaching environment. The research question we proceeded from is whether this way of teaching/learning makes it possible to connect the technological, pedagogical and human dimensions in a virtual context.

The Specific Objectives (SO) are based on the pillars of Education (Delors, 1996) in relation to technology:

- SO1 (learning to know): to introduce, from a pedagogical point of view, digital tools and resources (forums, online games, videos for virtual role playing, blogs and digital portfolios) and active methodologies (cooperative and collaborative learning, game-based learning and Design Thinking) for students to learn in an online environment.
- SO2 (learning to do): analyze their use during lockdown (March-June 2020).
- SO3 (learning how to be): to help them develop during the course, and through the use of these tools, resources and methodologies, positive attitudes towards remote learning.

Sample

The study was carried out with 61 students from four specialties of the URJC's Master's Degree in Teaching in Secondary School, Vocational Training and Language Educators, as part of a compulsory class. The students were distributed into two groups: (1) Spanish Language and Literature majors (22.2% of the sample) + Hospitality and Tourism (16.4%) and (2) Business Administration and Management and Economics majors (31.1%) + Job Training and Orientation (26.2%).

The type of sampling was non-probabilistic, and intentional or by convenience (Bisquerra, 2004), since the selection of informants depended on accessibility and proximity. The distribution by gender was 68.8% women, 27.8% men and 3.2% who preferred not to answer.

Didactic methodology, digital tools and research methodology.

Didactic methodology and digital tools used

A theoretical/practical methodology was followed, with a commitment to collaborative and cooperative learning that allowed for teamwork and the development of autonomous learning in an online context. Likewise, Game Based Learning served to motivate and involve students. All this has contributed to the development of general and transversal competences in the course.

Many of the digital tools and resources used are covered in the CRUE report (2020) on non face-to-face evaluation procedures in emergency education:

- The Moodle virtual classroom has made possible teaching and learning in a flexible way (in space and time), with the main resources used having been:

  1. Forums for questions and debate on the topics, and work forums to facilitate teamwork.
  2. Videoconferences using Blackboard Collaborate to explain the contents through enriched PowerPoint, designed especially for remote teaching. Private "rooms" were used to follow up on the groups, with a subject review video class through: (1) Game-Based Learning, where well-known board games (Alphabetical, Password, Taboo, etc.) were adapted to reinforce contents in an

enjoyable way, and (2) the Design Thinking technique, which allowed for joint reflection on the meaning and contributions of the course to the training of the future teacher.

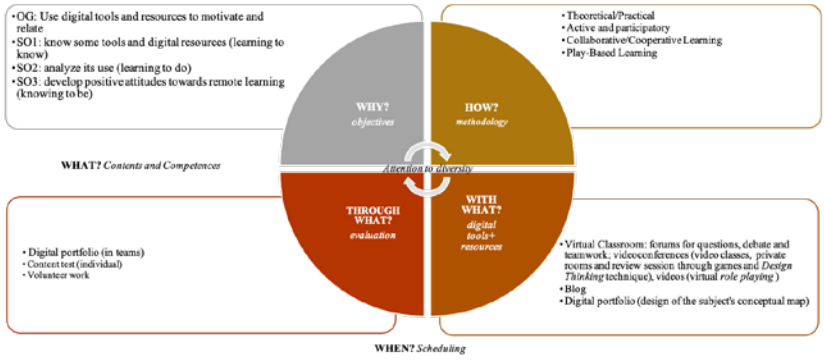
3. Knowledge test in Moodle, with sequential navigation and random questions of different types obtained from a large bank of questions and with a videoconference to answer questions in a synchronous way.

- The video: on a voluntary basis, students were able to perform a virtual role-play to simulate a mentoring session with parents based on an assigned case study. Students assumed the roles of parent and/or teachers in different and creative ways. Afterwards, feedback on the mentoring was provided through a videoconference.
- The class's Blog (Gómez-Gómez, 2020) became a space where students, without knowing each other, exchanged information and opinions about the course and what was happening in the educational environment as a result of the lockdown. Its simple design, organized into three sections (agenda, news/images and videos), made it possible to generate a virtual learning community through which ties began to be forged between students.
- The digital portfolio is proposed as a teamwork activity in which students reflect on the contributions of the syllabus's key ideas to their training as future teachers. In addition, they are asked to create a concept map, or mind map (depending on their preferences) to develop digital competence using a specific mapping program, such as Cmap Tools or others. Online resources and programs such as One Drive, Dropbox, virtual classroom forums, Teams, and Skype, etc. were used to this end.

A summary of the curricular elements planned in the study conducted is shown in Figure 2 below.

Figure 2

Summary of the study's curricular elements



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Methodology and research design

The research methodology was mixed. Through a quantitative methodology, the objective of the study was of an exploratory nature, as it is an initial approach to the subject in question, in order to be able to address it later in a broader way (Bisquerra, 2004). Therefore, this pre-experimental study does not intend to offer conclusive solutions, but simply to better understand the subject from the perspective and experience of its protagonists, in order to be able to produce future didactic proposals applied to virtual environments.

The analyses from the quantitative point of view were carried out using the Microsoft Excel statistical package, since it was sufficient to meet our objectives, performing a frequency distribution analysis and a descriptive analysis of the most relevant variables.

From the qualitative point of view, testimonies were analyzed in different information gathering instruments in order to complement the information obtained quantitatively and, thus, be able to understand the reality in depth.

Data collection procedure and instruments

The study has been endorsed by the URJC Ethics Committee, which issued a report guaranteeing compliance with the data protection law.

A few months after the end of the Master's degree program (September 2020), the students who took the course were contacted by e-mail to inform them of the study and request their prior consent.

The research technique used was a survey, and the questionnaire was the main instrument employed to gather information. This was designed *ad hoc*, and the contents were validated by seven experts: two pedagogues, one from the URJC and the other from the Universidad Complutense de Madrid, a psychologist from the Universidad Pontificia de Comillas, and four professors from the URJC Master's Degree in Teaching (one from each participating specialty). The approximate duration was 5 minutes, and it was created through Microsoft Office's Forms online application. For its configuration, preceding works were taken as reference points (Cabero et al., 2017; Schmidt et al., 2009) and key elements were also included on openness towards learning (motivation, attitude...) and the online learning process (academic relationships, resources used, etc.), considered by González-Sanmamed et al. (2019) essential to the structure of current digital learning ecologies.

To measure the reliability of the questionnaire, Cronbach's alpha coefficient was calculated, yielding = .93, which entails excellent reliability (> .9), thus confirming that the questionnaire has very good internal consistency (George & Mallery, 2003).

In order to verify that the questions were understood, a pilot test was carried out with a small group of students representing the four specialties. After receiving their feedback, some questions were refined, and the final version was sent to the rest of the students.

The questionnaire consisted of 23 questions on a Likert-type scale (from 1, minimum value, to 5, maximum value), distributed in various blocks according to the different

variables studied: 4 context questions (gender, specialty, ICT resources and internet connection at the lockdown location); 5 questions on attitude and motivation towards remote work and towards the virtual modality; 3 questions on knowledge acquisition and development of competences; 8 questions on use/participation, usefulness, and interest aroused in the digital tools and resources used; 2 questions on teamwork and collaborative learning, and 1 open and voluntary question to make a comment.

In addition, the teaching evaluations completed by students under the Support Program for Teaching Activity Assessment (DOCENTIA) are shown. These surveys external to the class provide valuable information about their degree of satisfaction with the online teaching and learning process. In addition, the final average grades of both groups will also be shown, and some digital tools will be used as instruments to collect qualitative information, through testimonials.

Analysis and results

Analysis from a quantitative point of view

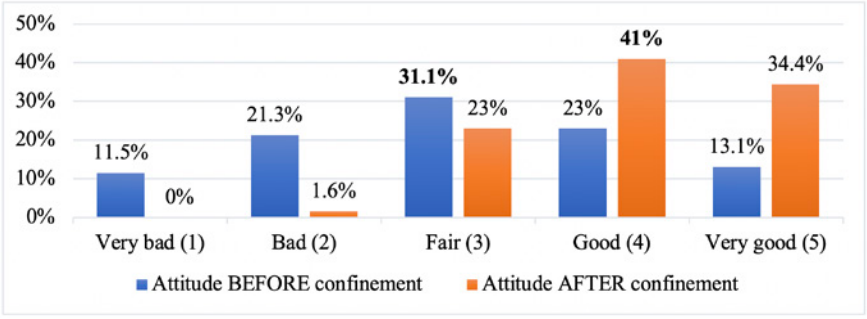
The following is a statistical analysis of frequency distribution in relative terms of the different blocks of the questionnaire, as well as a descriptive analysis of the variables studied, identifying the most relevant central tendency measures (mean and mode) and dispersion measures (standard deviation):

-Context: 96.7% of the participants had sufficient digital resources to follow the online classes, with the mean and mode of the Internet connection at the lockdown sites being 4 out of 5, in both cases.

-Attitude and motivation: When performing a frequency analysis, Figure 3 shows that overall attitudes towards the online modality before lockdown featured high ratings (focusing on response options 3, 4 and 5), at 67.2%, which increased considerably after lockdown, following the use of digital tools and resources, up to 98.4%.

Figure 3

General attitude towards the online modality before and after lockdown



A descriptive analysis of this block shows very high scores in the variables studied, as shown in Table 1.

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Table 1

Mean, mode and standard deviation of the variables related to attitude and motivation.

N= 61	Minimum	Maximum	Mean (*M*)	Fashion (M_o)	Standard deviation (*DT*)
General attitude towards the online modality BEFORE lockdown.	1	5			1.2
General attitude towards the online modality AFTER lockdown	1	5			.7
Development of attitudes and values of the subject	1	5	3.8		.9
Motivation towards the subject	1	5	3.8		.9
Time dedicated	1	5	3.9		.8

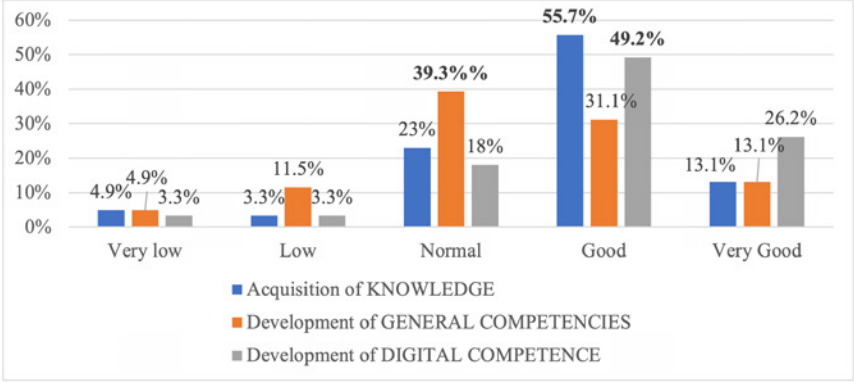
As for the average general attitude towards the online modality before and after lockdown, there was a clear increase of 1 point (M=3 and M=4, respectively), with a smaller deviation between answers after having taken the course (SD=1.2 and SD= .7, respectively). Specifically, the development of good attitudes and values in relation to the subject (such as responsibility, commitment, involvement, punctuality in the delivery of work, etc.) following the methodologies and digital tools used, reaches an average of 3.8/5, coinciding with the average of their motivation level during the classes ($_{Mo=}$ 4) and with a high dedication time of 3.9/5.

To compare the general attitude towards the virtual modality at the two junctures, the Student's T-test was used, obtaining an extremely significant difference: 95%, with a p-value of $^{<}$ .0001. This is so because, as Figure 3 shows, before lockdown the ratings were high ($_{Mo=}$ 3) and after lockdown, they were *very* high ($_{Mo=}$ 4). With these data, it is not surprising that 50.8% of the participants preferred a mixed modality teaching/learning process, followed by almost 46% who still prefer the face-to-face modality, and just 3.3% who prefer a completely online system.

Knowledge acquisition and competency development: Figure 4 shows the distribution of frequencies regarding the level of knowledge acquisition and development of general and specific competences in the class, and digital competence in particular, after taking it online.

Figure 4

Level of knowledge acquisition and the development of skills, in general, and digital skills, in particular, in an online environment



As can be seen, the degree of knowledge acquisition and development of general competencies (teamwork, planning a tutorial with parents, etc.) and digital competence during remote learning was very positive despite the unexpected change in modality. The figures were very close, although the development of digital competence stands out above other general competences in the class, as well as the acquisition of knowledge, since almost 75.5% of the total sample recognized that this type of competence had increased quite a bit, or a lot, with respect to its initial level, prior to the lockdown. Table 2 shows a descriptive analysis of the variables.

Table 2

Mean, mode and standard deviation of the degree of knowledge acquisition and skill development, in general, and digital skills, in particular

N= 61	Minimum	Maximum	Mean (*M*)	Mode (M_o)	Standard deviation (*DT*)
Knowledge acquisition	1	5	3.6		.9
Development of competencies in general	1	5	3.3		1
Development of digital competence	1	5	3.9		.9

As can be seen, the variable showing the greatest variety, or dispersion, with respect to the mean, as well as a somewhat lower mode (3), is the development of competencies and skills in general. However, digital competence is the one featuring the highest mean (*M*=*3*.9) with a mode, or most repeated option, that is also quite high ($M_{o=4}$).

Digital tools and resources used. Three variables were analyzed for each of them: the level of participation or use, the degree of usefulness in their learning, and the degree of interest aroused as a didactic tool to acquire knowledge and develop skills and

attitudes. Table 3 shows the mean, mode and standard deviation of each of them to compare the students' self-perceptions in each of these variables.

Table 3

Mean, mode and standard deviation of the digital tools and resources used in e-learning.

	VARIABLES								
	Participation			Utility			Interest		
Digital tools and resources	*M*	M_o	*DT*	*M*	M_o	*DT*	*M*	M_o	*DT*
Videoconferences/Video classes	4.3	5	.9	4.2	5	1	4.2	5	1
Forums	2.9		1.3	3.8		1	3.7	5	1.1
Blog		1, 4	1.5	3.5	5	1.2	3.4	5	1.3
Videos for virtual role playing	2.2	1	1.4	3.6	5	1.2	3.6	5	1.2
Digital portfolio	4.4	5	.9	4.3	5	.9	4.3	5	1
Online games		5	1.2	4.4	5	.9	4.4	5	.9
Design thinking			1.1	3.9	5	1.2	3.9	5	1.2

As shown in Table 3, the digital tools and resources most used by students were, in this order: the Digital Portfolio for teamwork (85.2% participated quite a bit or a lot), the Video classes/videoconferences to explain the syllabus (85.2% used them quite a bit or a lot) and the online games to review the subject (77.1% participated quite a bit or a lot). Along the same lines, these are the three considered the most useful for students and the ones that sparked the most interest as a learning tool. Of the rest, the least used was the Video for virtual role playing (50.8% did not use it), despite the fact that 62.3% considered it useful or very useful, and 85.2% stated that it is a very interesting tool. Following the video were the forums for questions and debates, with 32.1% never or almost never participating, although their usefulness and interest were positively evaluated. The Blog was the fourth tool in which they participated the most, but the variety of responses varied greatly, as the participation levels were widely distributed between the different response options, with the most used being "I have never used it" and, in sharp contrast, "I have used it very often" (*SD*= 1.5), making it a bimodal variable.

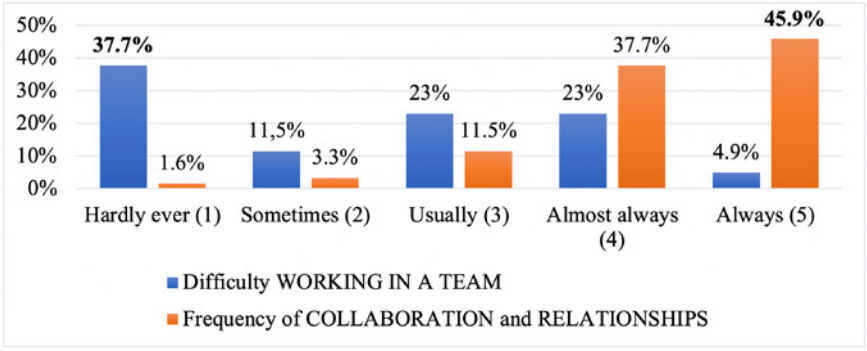
The Design Thinking technique to review the subject, although it was not the most used, was one of the most positively assessed in terms of its usefulness (72.1% quite or very) and interest (70.5% quite or very).

In general, all the tools and resources received high scores from the participants, since in all the variables (except participation in the videos) the average score (higher than 2.5/5) was easily exceeded. In addition, 65.6% of the participants rated the knowledge test carried out online through Moodle good or very good, while just 6.6% of the participants rate it very poor or very poor, and 27.9% expressed a more neutral opinion.

Teamwork and collaborative/cooperative learning: 37.7% of the participants stated that they did not encounter any difficulties when working on a team in an online environment, with a mean of 2.4/5. And, although the mode was 1 (no difficulty), the responses are distributed among all the options (*SD*= 1.3) as shown in Figure 5. Despite the sudden change in modality, the students managed to learn in a collaborative and cooperative way, being able to relate to each other academically in an online environment. Hence, 83.6% of the participants rated very highly (almost always and always) their levels of collaboration, cooperation and academic relationships with their classmates.

Figure 5

Frequency levels of difficulty in teamwork and degree of collaboration/cooperation and academic relationships in an online environment



Finally, the students' enjoyment and motivation are also reflected in their academic performance, with quite high final average grades: Spanish Language and Literature (8.5/10), Hotel Management and Tourism (8.3/10), Business Administration and Management and Economics (8.7/10) and Labor Training and Orientation (8.6/10).

Analysis from a qualitative point of view

Student comments on some of the tools used, in the open-ended question of the educational Questionnaire and Assessments

After reading and classifying all the comments, the most significant ones are shown below, organized by category:

Attitude: "We enjoyed the course" (subject 1, blog; group 3, portfolio); "Thank you for your empathy, understanding, commitment and, above all, for making me want to connect every afternoon. They were very fun, interesting and thought-provoking classes" (subject 3, blog); "I really enjoyed the class; and I think you provided a good example of how to maintain enthusiasm for teaching in these difficult times" (subject 3, questionnaire); "I believe that the effectiveness of online teaching depends largely on the attitude, enthusiasm and teaching ability of the teacher. That is the secret of the teacher's success" (subject 20, questionnaire).

Motivation: "Thank you for motivating us, despite the distance" (subject 4 blog; group 6, portfolio); "Thank you for creating that motivation, despite the lockdown" (subject

7, blog); "The people's involvement was fundamental, and this has made the level of teaching/learning higher" (subject 25, questionnaire).

Digital tools and competencies: "This year I learned a lot in relation to the use of ICT tools and resources" (subject 46, questionnaire; group 9, portfolio); "The digital resources used have motivated me a lot, I have learned things about the subject and also tools that I will use in the future as a teacher" (subject 55, questionnaire).

Transition from face-to-face to virtual mode: "You were able to reach the students, even through a screen" (subject 8, blog); "I think that the intimacy of face-to-face learning is irreplaceable, but it would be beneficial to combine it with blended learning to be able to form face-to-face groups of fewer people" (subject 5, questionnaire); "The rapid adaptation by the teaching staff to remote teaching was surprising" (subject 17, questionnaire) "and also that of the students" (subject 40, questionnaire); "In the process of adapting to the new circumstances it has been shown which teachers were more or less capable, and their motivation " (subject 38, questionnaire).

Link: "You have managed to weave a bond despite the distance, and that is very difficult" (subject 2, blog); "It was special how you transmitted so much to us, even from a distance" (subject 6, blog); "Being attentive to 'everything' and 'everyone', always helping us and giving us a much-needed example" (subject 9, blog).

At the end of the course, students answered an online questionnaire external to the class in which they evaluated its planning and organization, the fulfillment of formal obligations and the teaching methodology, yielding these averages: (1) Group 1 of Spanish Language and Literature + Hospitality and Tourism: 4.8/5, with a participation of 97.6% and (2) Group 2 of Business Administration and Economics + Labor Training and Orientation: 4.7/5, with a participation of 89.7%.

Teacher ratings

- Positive aspects: (1) the satisfaction felt upon seeing that the time invested, the work done and the commitment to maintain the students' motivation in a virtual context, under delicate circumstances, has been so appreciated; (2) the feeling of belonging to a virtual group, or community, where a bond was generated amongst everyone; (3) the high motivation shown by both parties, avoiding possible abandonment through a flexible handling of the situations; (4) the development of the students' critical, reflective and creative capacity; (5) the development of their digital competence (upon having to use more digital resources than in the face-to-face modality), etc.
- Aspects to improve: (1) the management of the time devoted to the subject, as it was much greater than in a classroom context, due to the adaptation of the methodology, material and activities, training in record time on evaluation resources and tools, feedback and the monitoring of online activities, etc.; (2) the assignment and distribution of tasks to students to get them more involved in the design and development of classes, etc.

Discussion and conclusions

The study we present has answered the research question formulated by showing that, in an emergency remote teaching scenario, it is possible to teach and learn suc-

cessfully if the technological, pedagogical and human dimensions of the educational process are taken into account. We only need to rethink the process from a perspective of change in which technologies become our decisive resources. As in other studies (Guillén et al., 2020), to evaluate the level of ICT integration and the development of competencies, such as digital ones, it is essential to assess the degree of knowledge acquisition, the use of the digital tools and resources used, as well as other non-curricular factors, such as attitudes towards the online modality. These have been, precisely, the objectives of this study.

From the *technological dimension*, as in the study by Domingo et al. (2019), it has been shown that in the integration of digital tools and resources in the curricular planning of the subject it is important to make a commitment to the methodological use of ICTs. This has been very satisfactory for the participants, as it has allowed them to achieve the class's objectives, of special note being the increase in self-perceptions of digital competence when working in an online modality, compared to more general and specific competences. As the participants were already familiar with the tools, when evaluating their use the results depart slightly from those of other studies (Cabero et al., 2017; Domingo et al., 2019; Guillén et al., 2020), in which, in general, greater knowledge (learning to know) than usage (learning how) of 2.0 tools, such as the Blog, and the virtual classroom (Moodle), is perceived. Although in this study digital competence seems to increase with respect to the initial level, there is still much room for improvement.

Of all the digital tools and resources used, the Digital Portfolio, the video classes and online games were the most used and commended in terms of their usefulness and interest. This indicates that the students, even in emergency remote learning environments, need to collaborate and work on teams, understand the explanations of the syllabus, and reinforce knowledge through games. The fact that the use of some tools was voluntary may have led to somewhat lower participation and evaluation, but the above-average evaluation of the three variables evaluated in all the tools stands out.

From a *pedagogical point of view*, the results reveal not only excellent academic performance, but also positive perceptions of the skills acquired (especially digital), good attitudes, strong motivation, and a high level of dedication to this way of teaching/learning; in other words, Delors' (1996) learning to know, learning to do, and learning to be, using ICT. Therefore, it can be stated that the study serves to dispel the stigma that distance learning cannot offer a teaching and learning process of the same quality as in the face-to-face modality (Hodges et al., 2020). Furthermore, the results challenge the initial idea of Siles (2020) that distance learning can hinder students' acquisition of knowledge and development of competencies, as the results exhibit no notable difficulties.

Finally, along the lines of Torquemada and Jardínez (2019), the study shows that, apart from the more academic or curricular sphere there is a *more personal and human dimension* that, in a virtual context such as the current one, because of the pandemic, also exerts a great influence.

With the methodology based on cooperative and collaborative learning, and the use of the digital tools employed, it was possible to foster academic relationships and student involvement, as proposed by Domingo et al. (2019), OECD (2020), Piñón et al. (2019) and Schleicher (2020). And, although difficulties in teamwork are detected in this environment, the collaboration amongst students was very positive. In addition, their perceptions of their attitudes towards the virtual modality, and improving

their digital competence, etc., were very positive, with highly significant differences between their attitudes towards this modality before and after taking the course. Along this line, Farjón et al. (2019) recognized that beliefs and attitudes are the most influential elements affecting the integration of technology, so it would be relevant to investigate this construct and take it into account in curriculum planning in the virtual environment.

The main contribution of the study is to present a work based on empirical evidence in which the unexpected transition in the modality of teacher education was a success, by basing it on the TPACK model and covering different dimensions of the educational process (Cejas et al., 2016; Koehler & Mishra, 2008). The transferability of this research to other classes and degree or Master' programs is one of its main strengths, although it is necessary for the teacher to possess certain technical and didactic knowledge of digital tools and resources, as well as a minimum level of digital teaching competence. In addition, it contributes to achieving, on a small scale, one of the objectives of the Digital Education Action Plan (European Commission, 2018) of making pedagogical use of ICT and developing digital competences for the proper development of students and future teachers.

With respect to the limitations of the study, a sample that is not statistically significant of the population is recognized, since the students participated three months after finishing the Master's degree program, and it was difficult to reach them.

As future lines of research, we intend to expand the sample to the 14 specialties that make up the Master's program, and to carry out a comparative study with results from the current academic year, 2020-2021, comparing the variables studied at two different times: (1) emergency remote teaching, totally unexpected and (2) blended teaching, with contingency plans. The study could be further expanded if we had other universities in the Community of Madrid, or even students from the Early Childhood and Primary Education Degrees, to analyze possible differences between the profiles of future teachers.

The conclusions drawn from the study allow us to consider educational actions in virtual or mixed contexts, giving rise to an interactive dialogue between the pedagogical, technological and human dimensions of the teaching and learning process in teacher education.

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