

Diagnostic and educational self-assessment of the digital competence of university teachers

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Abstract

The importance of promoting digital transformation processes in higher education has been increasing over in the last decade. Recently, the impact of the health crisis experienced in 2020 due to the COVID-19 pandemic on educational activity has further accelerated this transformation. In order to take advantage of the potential of digital tools in educational processes, as well as to manage these new learning situations, it is essential for university faculties to have an adequate level of digital teaching competence (DTC). This article aims to explore this competence in depth, by analysing the self-perceived level of DTC of university teaching staff and their assessment in each of the areas that comprise it. The research was carried out in a Spanish public university with a sample of 61 university teaching staff, following the methodological approach of educational design research (EDR), through quantitative and qualitative instruments for collecting information from a sample of key informants and potential users. The results suggest that the questionnaire has validity for its function, and detects those areas of digital competence in which participants need to improve, and those in which their level of competence is optimal. As for the evaluation of the university faculty, the results show a medium-to-high level of competence, and when evaluating the tool, they have highlighted its usefulness. In conclusion, the need to have DTC assessment tools in higher education that allow faculties to reflect on their own digital competence is essential today, in order to carry out quality teaching and learning processes adapted to the needs of students.

Keywords

digital teaching competence, higher education; self-assessment, pedagogical competences, professional development

Introduction

In the last 30 years, higher education has undergone a profound process of digitalization. Information and communication technologies (ICTs) have delocalized and globalized information, leading to the emergence of new training scenarios and new teaching and learning opportunities (Katić, 2008; Selwyn, 2012). In recent years, universities have updated their management processes, incorporated technologies on campus, developed virtual learning platforms, and experimented with various digitization initiatives (Marshall, 2018).

While even though the importance of driving digital transformation processes in higher education has been highlighted in the last decade (García-Aretio, 2019; Prendes et al., 2018), the health crisis experienced in 2020 due to the COVID-19 pandemic has accelerated this transformation, not only in the teaching field but in the rest of the university environments (Crawford et al., 2020). In terms of educational activity, the abrupt closure of physical classrooms in universities, as well as the confinement of all faculty and students, has led to numerous disruptive situations in teaching and learning processes (Area-Moreira et al., 2020), in terms of blended, hybrid, or online teaching.

As highlighted by various authors (Durán et al., 2019; Tejada & Pozos, 2018), in order to exploit the full potential of digital tools in educational processes, as well as to manage these new learning situations enriched by ICT information and communication technology (ICT), it is necessary for university faculty to have adequate digital teaching competence (DTC). DTC allows teaching staff not only to respond to the current challenges of the digital society and improve the teaching and learning process, but also to continue developing professionally, collaborating with other colleagues, and updating their knowledge base. DTC additionally allows them to increase students' digital competence, a key competence that is essential for their empowerment and digital citizenship (Esteve-Mon et al., 2020). This digital competence is not only key to maximizing the educational possibilities of ICT, but also meets the institutional priorities of international and European bodies (European Commission, 2021; G20 Research Group, 2017; OECD, 2018).

However, when trying to delve deeper into the conceptualization of DTC, we find that there is no single definition. Rather, there are various frameworks and models that attempt to describe it (Caena & Redecker, 2019). Moreover, although in recent years there has been an increase in the number of researchers centered on the university setting (Durán et al., 2016), most research has focused on basic and pre-university levels of education (Mattila, 2016). We recently found more research in this regard (Cabero-Almenara et al., 2020), but there is still little evidence regarding the level of DTC of university teachers, something that would allow universities to review their digital training policies. According to the existing literature, university teachers do not have an adequate DTC level in all the areas that comprise it (Deumal & Guitert, 2015; Orozco et al., 2016b; Rangel & Peñalosa, 2013), which further reinforces, if possible, how current and relevant this issue is.

This article is part of a research project that aims to design and develop a diagnostic and educational self-assessment instrument for the DTC of university teaching staff. More specifically, in addition to presenting the diagnostic tool, it intends to explore this competence in depth from the analysis of the self-perceived level of DTC of the university teaching staff and its assessment in each of the areas that comprise it.

Theoretical framework

Teacher Digital Competence

The inclusion of digital technologies in the educational field has increased the demand for teachers to adapt and develop new skills. One of the main skills required has been DTC, which encompasses the need to develop their own digital competence (DC), as well as that of their students (UNESCO, 2013). In general terms, DTC includes the set of skills, attitudes, and knowledge that teachers must put into play to facilitate student's learning, and DC development, through the design and application of training practices adjusted to the digital context (Gisbert et al., 2016).

Krumsvik (2012), defined DTC as the teacher's ability to use ICT in a professional context with good pedagogic-didactic criteria, and awareness of its implications for learning strategies and digital training of students. According to Hall et al. (2014), DTC refers to the skills, attitudes, and knowledge required by educators to support student learning in a rich digital world. Educators should be able to use technology to improve and transform classroom practices and enrich their own development and identity, as well as be able to think critically about the why, how, and when to learn new aspects related to technology and teaching (Fraser et al., 2013). As Koehler and Mishra (2008) argue, this process is not easy, and requires the correct combination of three fundamental components: instruction or content knowledge, pedagogical knowledge, and technological knowledge.

There are different conceptual frameworks at the international level that have tried to define digital teaching competence (DTC). However, most of them have a clear focus on pre-university teachers (Durán et al., 2016). This project is based on the DigCompEdu framework of the Joint Research Center (JRC) of the European Commission (Redecker & Punie, 2017), which defines this competence in 6 areas: (1) professional engagement, (2) digital resources, (3) teaching and learning, (4) assessment, (5) empowerment learners, and (6) facilitating learners' digital competence. Although it is a framework initially developed for non-university levels, it was recently used as a reference by Spanish government.

Despite the fact that this topic has been present on the educational agenda for the last 15 years, a consensus has not yet been reached regarding a single definition or model to understand DTC. This is due to the fact that it is a dynamic and complex concept that has evolved alongside digital technology and society (Castañeda et al., 2018).

The Evaluation of DTC in the University Environment

Table 1 contains a summary of the different publications about the DTC level of higher education teachers based on previous research (Esteve-Mon et al., 2020). It includes the type of instrument used (questionnaire, interview, focus groups), the type of methodological approach (quantitative or qualitative), the areas of the DTC that are contemplated, and the level of DTC.

Table 1 Level of digital teaching competence in higher education teaching staff

Author/s	Year	Instr.	Appr.	Areas	DTC Level		
					Low	Medium	High
Alejaldre & Álvarez	2019	Q	QT	General level of DTC		X	
Cabero-Almenara et al.	2020	Q	QT	General level of DTC		X	
Deumal & Guitert	2015	Q, I	QT, QL	General level of DTC Security Students' DC ICT for personal use	X X	X X	
Hinojo et al.	2019	Q	QT	General level of DTC	X		
Orozco et al.	2016a	Q	QT	General level of DTC Technical aspects Pedagogical aspects Professional development	X X	X X	
Orozco et al.	2016b	Q	QT	General level of DTC Technical aspects Pedagogical aspects Professional development	X	X X	X
Pérez-Escoda et al.	2020	Q	QT	General level of DTC Information Communication Content development Security Problem solving	X X	X X X	
Pozos & Tejada	2018	Q, I, FG	QT, QL	General level of DTC Educational planning Teaching experiences Orientation & assessment Research & innovation Ethics Health & security	X X X	X X	X X
Rangel & Peñalosa	2013	Q	QT	General level of DTC Technology Information Pedagogy	X	X	X X
Revelo-Rosero et al.	2018	Q	QL	General level of DTC Information Communication Content development Security Problem solving	X	X X X X	X
Ríos et al.	2018	Q	QT	General level of DTC Technology Information Pedagogy		X X	X X
Zempoalteca et al.	2017	Q	QT	General level of DTC		X	

Note: Appr.: Approach; FG: Focus group; I: Interview; Instr.: Instrument; Q: Questionnaire; QT: Quantitative; QL: Qualitative.

The analysed studies show that the vast majority of teachers have a medium or medium-to-high level regarding their basic technological skills, as well as those more informational and communicative aspects of this competence (Orozco et al., 2016a & 2016b; Rangel & Peñalosa, 2013). The areas related to security, data protection or intellectual property manage-

ment seem to obtain somewhat lower competence results (Deumal & Guitert, 2015; Revelo-Rosero et al., 2018).

Lower results are found in the pedagogical dimension of digital teaching competence, with medium and low levels. According to Pozos and Tejada (2018), the ability to plan and design learning experiences, carry them out, and monitor and evaluate students' learning using ICT is at a basic level, observing significant training deficiencies. In relation to the competence of using digital tools for their own professional development, the studies show that teachers also have a medium-to-low level. According to Orozco et al. (2016b), the participation of teachers in forums and professional networks, the use of educational repositories, and the membership and sharing of experiences with ICT in innovation groups, are especially underdeveloped areas.

Method

The present research is methodologically framed within the educational design research (EDR), which proposes a systematic process of designing, developing and evaluating a specific educational intervention, often in relation to technology, as a solution to a complex problem (Plomp & Nieveen, 2009). EDR consists of three main phases: preliminary research, prototype design and evaluation. This paper is focused on the prototype design phase. It aims to design and develop a platform for diagnostic and educational self-assessment of the DTC of university faculty members. In addition to presenting the diagnostic tool, this research intends to explore this competence in depth, from the analysis of the self-perceived level of DTC of the university teaching staff and its assessment in each of the areas that comprise it. This is done through an iterative and participatory process that brings together different assessment instruments and participants, as described below. The research questions to be answered are as follows:

1. Is the tool, designed to self-assess DTC level, perceived as useful among university teachers?
2. What is the self-perceived level of DTC among university teachers?
3. Which areas of DTC show the highest and lowest levels of development?

Following the characteristics of this type of study, instruments gathering quantitative and qualitative information were used during the process, based on a sample of key informants and potential users.

Context and Participants

The research was carried out during the 2019/2020 academic year, in a medium-sized Spanish university. A total of 61 university teachers participated (54% women) with an age range comprised between 29 and 57 years. Of these, 67% correspond to permanent and full-time teachers (tenure track), while 33% were temporary or part-time teachers (non-tenure track). According to the areas of expertise, 15% belonged to Arts and Humanities, 15% to Science, 16% to Engineering, 16% to Health Science, 20% to Social Science, and 18% to Law and Economics. The study was approved by the Ethics Commission of the university and participation was voluntary, with prior informed consent given of the purpose and its confidentiality.

Instruments and Data Analysis

DTC Diagnostic and Educational Self-assessment Platform

The main instrument, designed ad-hoc in this research, is the DTC diagnostic and educational platform for university faculty members. It is a self-perception questionnaire, developed online with the LimeSurvey tool and installed on a university server (available at <http://cdd.uji.es>). At the end of the self-evaluation, the platform shows teachers: (1) their general and specific level of DTC, represented in a visual and understandable way; and (2) a series of recommendations and training resources offered by the university to improve those areas with a lower score. Figure 1 shows a screenshot of the results as an example.

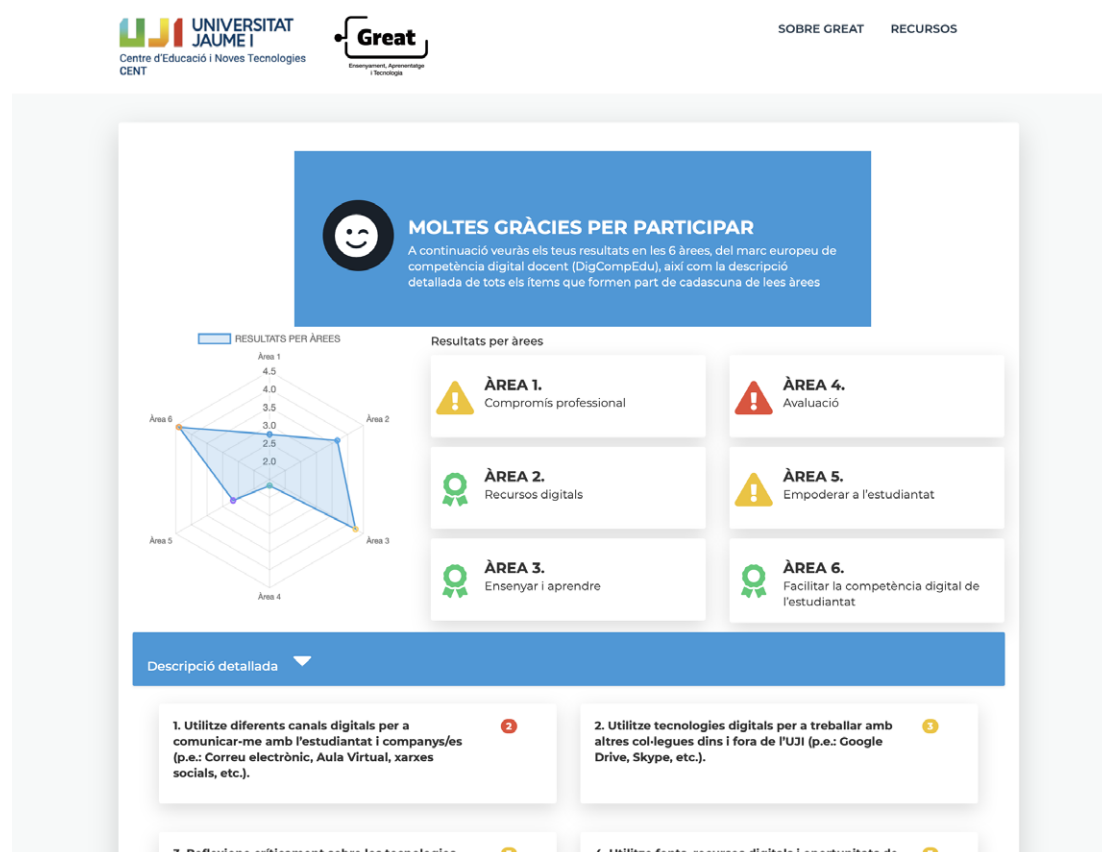


Figure 1 Screenshot of the results section of the DTC platform

The design of the questionnaire is based on the European DigCompEdu framework (Redecker & Punie, 2017), as well as on the versions made by the JRC in the DigCompEdu Check-In, adapted to the context of the university. In addition to a first section in which personal data are collected, the questionnaire has 22 items, divided into sections according to the 6 areas of the DigCompEdu model, and evaluated with a Likert-type scale from 1 (never) to 5 (always). These 6 areas, previously described in the theoretical framework, are in turn grouped into 3 larger blocks: (1) professional engagement (area 1), pedagogical competences (areas 2, 3 and 4), and students' competences (areas 5 and 6), which will be used to describe the results in this research.

Focus Group

A focus group formed by eight university teachers, belonging to different professional categories and different fields of expertise, was then held. During this session, the results were contrasted by asking the participating teachers about the adequacy, relevance, and degree of agreement with the results obtained in each of the items and areas as well as the possible value of the questionnaire and its implications.

Procedure and data analysis

First, the wording of the questionnaire items was reviewed by a group of experts in educational technology, and subsequently administered in a pilot test to a small sample of university teachers to ensure that it was understood by potential users.

Secondly, the questionnaire was administered to a sample of 61 teachers, obtaining (a) descriptive results and (b) statistical validation results (presented below), which were contrasted with the comments of the focus group. After the corresponding reliability analyses, an excellent Cronbach's alpha value was obtained ($\alpha = 0.94$). Quantitative data were analysed using SPSS software (version 25).

Finally, the focus group session was conducted in person, lasted 60 minutes, and was recorded in audio, transcribed and encoded, following a simultaneous encoding method (Saldaña, 2015) and a deductive approach (Benaquisto, 2008), using qualitative analysis software MAXQDA (2018 version).

Results

The total results of the DTC of the university teaching staff are described below, as well as the details of the three main blocks described above (professional engagement, pedagogical competences, and students' competences). The quantitative descriptive results of the questionnaire are shown integrated with fragments and quotes from the focus group, in a contextualized and interpreted way (Rodríguez et al., 1999).

Descriptive Results of the Teacher Digital Competence

The university faculty obtained a general mean score of 3.76 out of 5 in DTC, this being considered a medium-to-high value. As we can see in Figure 2, the highest results correspond to area 1 (professional engagement), with a mean of 4.25. The block of pedagogical competences obtained intermediate values (3.98, 3.89 and 3.92, respectively). The lowest scores correspond to the block that has a direct impact on students' competences, such as their empowerment (3.26) and their digital competence (3.25).

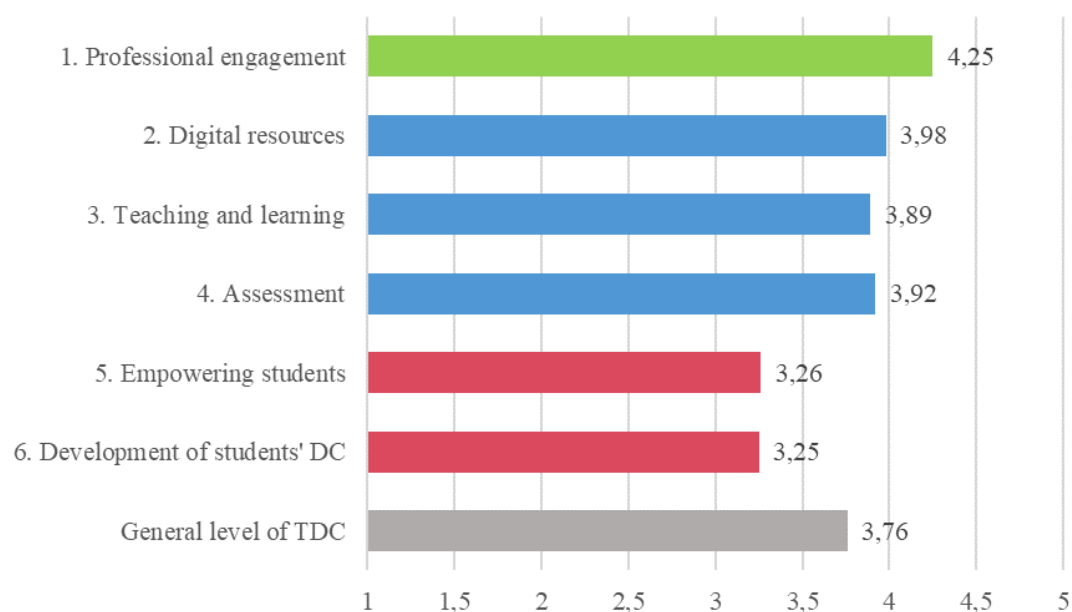


Figure 2 Mean scores of the DTC in its different areas.

Professional engagement

As can be seen in Table 2, a mean of 4.25 and a deviation of 0.57 was obtained in the area of Professional engagement, which suggests that this is the area with the highest level.

Table 2 Descriptive results of the professional engagement area

Area and items	M	SD
Professional engagement	4.25	0.57
1. Digital communication	4.54	0.70
2. Collaborative work with ICT	4.61	0.61
3. Critical reflection on ICT	3.77	0.96
4. Digital professional development	4.10	0.96

The results show that teachers perceive their use of digital technologies for communication and coordination, as well as for their own professional development to be at a high level.

When looking at the items that compose this block separately, we can observe that faculty members feel more confident in Collaborative work with ICT, with a mean of 4.61 and a deviation of 0.61, and Digital communication, with a mean of 4.54 and a deviation 0.70, where they obtain the highest results. It is followed by Digital professional development, with a mean of 4.10 and a deviation of 0.96.

Even though a high level is perceived with regard to the use of ICT, the Critical reflection on ICT, with a mean of 3.77 and a deviation of 0.96, reflects a lower level.

The opinions of the participating teachers in the focus group coincide with these mean scores which show how these types of skills or abilities are considered to be mastered. Teachers especially emphasize the resistance or conditions that often arise that prevent them

from adequately applying these practices. One of the basic conditions is the availability of adequate ICT resources to carry out their work.

Subject 5: One thing I was thinking about is the connectivity we have: if we have good facilities, we can use the technologies and if we do not have good facilities, we cannot use them. Within the University we will be able to do some things and outside others, and then each teacher has a different level.

Subject 6: Sometimes we can't connect with a colleague via Skype because we don't have the means in the office. I think it happens to most of us and we have to resort to other means.

On the other hand, there is a diversity of opinions regarding other conditions, such as the field of expertise or the number of students. More specifically, some of the teaching staff point out that certain areas are more apt for using technologies to generate conversation with students.

Subject 2: I have a group of 12 students and the relationships are a certain way, and the needs are different from when I had 80.

Subject 4: It is also a question of critical mass, or proximity. If I had the student body next to me, I would not use social networks but would prefer direct communication.

One element in which there is a discrepancy between the participants is in analyzing whether the level of competence in the professional field varies according to age, or is rather a matter of attitude.

Subject 1: The digital barrier is more a question of age than of professional category or years of experience.

Subject 2: I think I am the oldest one in this room and I cannot live without the internet. It is more a question of attitude.

Pedagogical competences

Regarding Digital Resources, the teachers have a medium-to-high level of competence (mean 3.98, deviation 0.75), showing that they feel more confident in the use of already existing materials (Table 3). They present a high level in Location and selection (mean 4.54, deviation 0.62), compared to the level that they present in the preparation and creation of resources (mean 3.70, deviation 1.07). They have also demonstrated a similar level of competence when it comes to sharing open content, in which they obtained a mean of 3.69 with a deviation of 1.26.

Table 3 Descriptive results of the pedagogical competences area

Area and items	M	SD
Digital resources	3.98	0.75
5. Location and selection	4.54	0.62
6. Resource creation	3.70	1.07
7. Sharing open content	3.69	1.26
Teaching and learning	3.89	0.84
8. Educational planning	4.13	0.81
9. Tutoring and interaction	4.11	0.93
10. Promotion of collaborative learning	3.77	1.06
11. Promotion of reflection	3.49	1.19
Assessment	3.92	0.93
12. Use of ICT in evaluation	4.03	1.08
13. Collection of digital evidence	3.77	1.08
14. Use of ICT for feedback	3.95	1.00

In regard to the area of Teaching and learning through digital technologies, teachers perceive their use of digital technologies at different moments of the learning process at a medium-to-high level (observing a mean of 3.89 and a deviation of 0.84). Teachers feel more competent in Planning (in which they obtained a mean of 4.13 and a deviation of 0.81) and in Tutoring the student in online spaces (mean of 4.11 and a deviation of 0.93). Regarding activities to promote collaborative learning in students, a lower score of 3.77 with a deviation of 1.06 was obtained, and in the promotion of activities that involve the use of technologies for reflection on the process of learning by the student, a lower level was obtained, with a mean of 3.49 and a deviation of 1.19.

In the digital evaluation, they obtained a medium-to-high level, with a mean of 3.92 and a deviation of 0.93. They showed that they felt more secure about the use of digital technologies in the evaluation (mean 4.03, deviation 1.08), as well as for feedback (mean 3.95, deviation 1). On the other hand, in the collection of evidence, a lower level was perceived with a mean of 3.77 and a deviation of 1.08.

Regarding the qualitative analysis of the opinions of the teaching staff participating in the focus group, it stands out that their level of use and development of digital resources, and their integration in the teaching and learning processes in a planned way is adequate, as shown by the following extract:

Subject 5: For the 1st, 2nd and even 3rd years we decide beforehand what tools they will have to use to learn to present the documentation, everything is already written down. In the first year, prepare a PowerPoint, second a web page, third they will write a blog, or use any other social network, therefore, we have already planned in advance.

Subject 4: I usually have everything planned. In the Virtual Classroom everything is up, resources, contents, videos, links to YouTube and practical work, for example if I ask them to listen to the podcast, or if they have to present something, everything is usually planned ahead.

However, where there seems to be a little more discrepancy is in the processes of evaluation, monitoring, and tutoring of students.

Subject 7: For the practical work of the subject in the bachelor's degree, I ask my students to do a self-assessment. I have a shared document for each student and they have to do a self-evaluation and a self-reflection. What mistakes they have made, why, and how they will not make them again.

Subject 2: Do I tutor in collaborative online environments? Well, no. I tutor in collaborative face-to-face environments. So, I have given this question a 2 to say something, not because I don't do it but because I do it in another way.

Similarly, there are uncertainties regarding what each participant considers to be digital evidence of student progress and learning.

Subject 1: So, if they upload a project to the virtual classroom. Is that digital evidence of the teaching-learning process?

Subject 4: If you open up a forum to talk about anything, there is digital evidence that certain people have answered and certain people have not answered.

Students' Competences

Regarding the empowerment of students in the use of technology to encourage their participation, the teaching staff obtained a medium-to-high level, with a mean of 3.26 and a deviation of 0.95 (Table 4). In all items, a medium-to-high perceived level of competence has been demonstrated, both in the use of digital resources that promote accessibility for all students (mean 3.31, deviation 1.22), in the use of technologies that allow personalized learning (mean 3.12, deviation 1.17), as well as in the promotion of active digital participation by students (mean 3.39, deviation 1.19).

Table 4 Descriptive results of the students' competences area

Area and items	M	SD
Empowering students	3.26	0.95
15. Accessibility	3.31	1.22
16. Personalized learning	3.12	1.17
17. Promoting digital participation	3.39	1.19
Development of students' DC	3.25	1.07
18. Provide information	3.80	1.17
19. Support communication	3.31	1.32
20. Support content creation	2.85	1.42
21. Support well-being and safety	3.00	1.34
22. Support problem solving	3.29	1.27

When analyzing the extent to which the development of students' DC is encouraged, teachers perceive themselves with a medium-to-high level (mean 3.25, deviation 1.07). It is in this area that we find the lowest scores and the greatest deviations.

The aspects of student competences in which teachers perceive themselves as having a lower level are: supporting students' content creation (mean 2.85, deviation 1.42) and supporting well-being and a healthy and safe use of technology (mean 3, deviation 1.34). On the other hand, higher scores are observed in the items that refer to solving problems through digital technology (mean 3.29, deviation 1.27), supporting the use of digital media (mean 3.31, deviation 1.32) and promoting the search, selection, and evaluation of relevant information in their field (mean 3.80, deviation 1.17).

Regarding the perception of the teaching staff about the dimension of empowering the student, the debate focuses on the terms of accessibility and whether it should be addressed by the university or by the teaching staff:

Subject 4: This is an issue that has more to do with the institution than with the teacher, right? They are the ones that should guarantee that students have access to all the resources. What can a regular teacher do about all this? I understood it more as an obligation of the institution than of the teacher.

Subject 7: I think of the universal design for learning, that you are providing students with different methods so that they can access information. There are students who read the book in preparation for the class and then try to do the exercises and only watch the video if they need to, and other students watch the video first. Each one works in their own way. I provide different ways of accessing knowledge and they can express themselves in different ways too.

Furthermore, regarding the development of the digital competence of their students, there seems to be a certain consensus that they work especially on collaboration and the search for information and specialized resources in their particular field of knowledge. However, in other fields of this competence, such as the healthy and safe use of technologies, there is disparity of opinion:

Subject 2: I have marked this one with a 2 because I do not think it is part of our competence.

Subject 8: To have healthy use is to enter a website and not spend more hours than necessary, healthy, relating to health. I have never taught my students to use the web safely, for example. (...) But the reflection is if we really have to go there. I have marked this one with a 1 because I do not do it, but possibly I should do it, I had never thought about it.

Beyond the Digital Competence of Teachers

As explained above, this information was cross-checked with a focus group to gain a deeper understanding of the results, as well as the possible value of the questionnaire and its implications.

One of the main topics highlighted by the participants in the discussion group refers to the educational value of the questionnaire, beyond assessing a given level of competence, as we can see in the following paragraph:

Subject 4: From this I would take one thing, and that is that this questionnaire is useful for us, to reflect, not only for an evaluation of what you are doing but to question things that you may not have asked yourself earlier.

Likewise, another outstanding aspect of the questionnaire was the value of this tool in the design of strategies and practices for the digital training of university teachers, highlighting the shortcomings of the institution itself in this matter:

Subject 2: Digital resources are not only for teaching. Where is our own training so that we are digitally competent? According to this questionnaire, nobody cares to train us in digital competence, even for those of us who are older (he refers to himself).

Discussion

The urgent need generated by COVID-19 to take face-to-face teaching to the online field has accelerated digital transformation processes in higher education and has placed the focus of attention on the digital competence of university teachers (García-Peñalvo & Corell, 2020).

The scarce research conducted in the field of DTC in higher education seems to suggest that although in general university teaching staff show a certain level of technological knowledge, they also reveal evidence of training gaps, especially when it comes to the pedagogical field (Deumal & Guitert, 2015; Orozco et al., 2016a; Rangel & Peñalosa, 2013).

This research presents a self-diagnostic and training tool for DTC at the higher education level. In addition, through the validation process of the tool and its pilot test, a preliminary analysis of the level of competence of the participants is carried out, based on their self-perception, as well as their assessment of each of the areas that comprise it.

Regarding the first question about the usefulness of the tool in relation to the object for which it was designed, that is, self-diagnosis of the digital teaching competence of university teachers, the results obtained suggest that the questionnaire effectively fulfills its purpose, and detects those areas of digital competence in which participants must improve, and those in which their competence is optimal. The value of a reflective and formative nature given to the instrument during the validation process is worth highlighting.

The second research question, referring to the exploration of the digital teaching competence of the participants, shows that, regarding the level of digital competence, in general, university teaching staff show adequate competence, with a medium-to-high level, coinciding with the results presented by several authors (Cabero-Almenara et al., 2020; Deumal & Guitert, 2015; Revelo-Rosero et al., 2018).

The third question, regarding which areas show the highest and lowest levels of development, one of the areas that especially stands out is the area of professional engagement, although this score is conditioned both by the number of students and by the availability of technological resources in the workplace. This is in line with the results from Orozco et al. (2016b) and Pozos & Tejada (2018) who found a medium-to-high level of development in this area.

In terms of pedagogical competences, the evidence shows a medium-to-high level in this domain. In this line, Ríos et al. (2018) have found similar results, however other authors (Orozco et al., 2016a & 2016b; Rangel & Peñalosa, 2013) have found low levels in technopedagogical skills.

The strongest points have been the location and selection of resources, as well as educational planning. On the other hand, the areas related to reflection on the use of ICT in the learning process would be less developed areas, such as those related to digital assessment. The teachers, on this last point, question the adequacy of the evaluation of students through technological strategies.

The findings show that this is the area in which teachers can improve the most, especially in terms of encouraging the creation of digital content by students and promoting healthy and safe use of ICT. Regarding the latter, the recognition of not having raised this question and the reflection on whether or not it corresponds to the university faculty to explicitly encourage the responsible use of technology is striking. These results coincide with those presented by several authors (Deumal & Guitert, 2015; Pozos & Tejada, 2018) who have found low levels in the areas of development and empowerment of the student body, also coinciding with the perception that it is not part of their role as teachers.

In conclusion, these results highlight the need for DTC assessment tools in higher education, that allow teaching staff to reflect on their own digital competence. Especially when considering essential aspects to carry out quality teaching and learning processes adapted to the needs of students.

Beyond its contributions, this research also has some limitations. Firstly, given the fact that we are still in the validation phase of the instrument, it is not yet possible to have results based on a large population sample. This fact limits the statistical treatment of the data and the generalization of the results. At this stage, the existence of significant differences based on variables such as gender, age or professional category has not yet been sought, a fact that will be addressed in the next phase.

Another limitation is related to the general difficulty of assessing and measuring competencies. Considering that competency is expressed by putting a skill or ability into practice, it is assumed that assessing the frequency of use is equivalent to manifesting or expressing the assessed competency (Tejada & Pozos, 2018). However, we are aware of the subjective element that a self-perception scale entails, therefore, limitations are considered when expressing that the frequency indicated in the questionnaire corresponds to the user's actual level of digital competence. In future lines of work, it would be appropriate to complement this analysis with other elements of assessment, such as real outcomes of teachers' performance, or the assessment or opinion of students in this regard.

Understanding the digital competence of teaching staff should lead university institutions to rethink their training methods so as to not ignore the need, or rather the duty, to support and encourage the improvement of the digital competence of their teachers. In this way, is it possible to become a university in line with the current context, not only in relation to the specific moment that we are living, generated by the pandemic, but also in tune with the current social reality, increasingly surrounded by technology.

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References

- Alejaldre, L., & Álvarez, E. (2019). La competencia digital docente del profesor universitario 3.0. *Caracteres. Estudios culturales y críticos de la esfera digital*, 8(2), 205-235. <https://dialnet.unirioja.es/servlet/articulo?codigo=7323501>
- Area-Moreira, M., Bethencourt-Aguilar, A., & Martín-Gómez, S. (2020). De la enseñanza semipresencial a la enseñanza online en tiempos de Covid19. Visiones del alumnado. *Campus Virtuales*, 9(2), 35-50. <http://uajournals.com/ojs/index.php/campusvirtuales/article/view/733>
- Benaquisto, L. (2008). Coding Frame. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (pp. 88-89). SAGE Publications.
- Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (DigCompEdu). *European Journal of Education*, 54(3), 1-14. <https://doi.org/10.1111/ejed.12345>
- Cabero-Almenara, J., Gutiérrez-Castillo, J., Palacios-Rodríguez, A., & Barroso-Osuna, J. (2020). Development of the Teacher Digital Competence Validation of DigCompEdu Check-In Questionnaire in the University Context of Andalusia (Spain). *Sustainability*, 12(15), 6094. <https://doi.org/10.3390/su12156094>
- Castañeda, L., Esteve, F., & Adell, J. (2018). ¿Por qué es necesario repensar la competencia docente para el mundo digital? *RED. Revista de Educación a Distancia*, 56. <http://dx.doi.org/10.6018/red/56/6>
- Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P., & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, 3(1), 1-20. <https://doi.org/10.37074/jalt.2020.3.1.7>
- Deumal, G., & Guitert, M. (2015). Digital competence in design education. Case Study of BAU Design College of Barcelona (UVic). *Revista Latinoamericana De Tecnología Educativa-Relatec*, 14(2), 51-65. <https://doi.org/10.17398/1695-288X.14.2.51>
- Durán, M., Gutiérrez, I., & Prendes, M. (2016). Análisis conceptual de modelos de competencia digital del profesorado universitario. *RELATEC: Revista Latinoamericana de Tecnología Educativa*, 15(1), 97-114. <https://doi.org/10.17398/1695-288X.15.1.97>
- Durán, M. C., Prendes, M.P., & Gutiérrez, I. (2019). Certificación de la Competencia Digital Docente: propuesta para el profesorado universitario. *RIED. Revista Iberoamericana de Educación a Distancia*, 22(1), 187-205. <http://dx.doi.org/10.5944/ried.22.1.22069>
- Esteve-Mon, F.M., Llopis-Nebot, M.A., & Adell-Segura, J. (2020). Digital Teaching Competence of University Teachers: A Systematic Review of the Literature. *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje*, 15(4), 399-406. <https://doi.org/10.1109/RITA.2020.3033225>
- European Commission (2021). Digital Education Action Plan (2021-2027). Resetting education and training for the digital age. <https://bit.ly/3lmHQth>
- Fraser, J., Atkins, L., & Richard, H. (2013). DigiLit Leicester. Supporting teachers, promoting digital literacy, transforming learning. Leicester City Council.
- G20 Research Group (2017). G20 Digital Economy Ministerial Declaration: Shaping Digitalisation for an Interconnected World. <https://bit.ly/3fjsQmb>
- García Aretio, L. (2019). Necesidad de una educación digital en un mundo digital. *RIED. Revista Iberoamericana de Educación a Distancia*, 22(2), 09-22. <http://dx.doi.org/10.5944/ried.22.2.23911>
- García-Peñalvo, F. J., & Corell, A. (2020). La CoVid-19: ¿enzima de la transformación digital de la docencia o reflejo de una crisis metodológica y competencial en la educación superior? *Campus Virtuales*, 9(2), 83-98. <http://hdl.handle.net/10366/144140>
- Gisbert, M., González, J., & Esteve, F. (2016). Competencia digital y competencia digital docente: una panorámica sobre el estado de la cuestión. *Revista Interuniversitaria de Investigación en Tecnología Educativa*, 0, 74-83. <https://doi.org/10.6018/riite2016/257631>

- Hall, R., Atkins, L., & Fraser, J. (2014). Defining a self-evaluation digital literacy framework for secondary educators: The Digilit Leicester project. *Research in Learning Technology*, 22. <http://dx.doi.org/10.3402/rlt.v22.21440>
- Hinojo-Lucena, F. J., Aznar-Diaz, I., Caceres-Reche, M. P., Trujillo-Torres, J. M., & Romero-Rodriguez, J. M. (2019). Factors Influencing the Development of Digital Competence in Teachers: Analysis of the Teaching Staff of Permanent Education Centres. *IEEE Access*, 7, 178744-178752. <https://doi.org/10.1109/ACCESS.2019.2957438>
- Katić, E. K. (2008). Preservice teachers' conceptions about computers: An ongoing search for transformative appropriations of modern technologies. *Teachers and Teaching: theory and practice*, 14(2), 157-179.
- Koehler, M. J., & Mishra, P. (2008). Handbook of technological pedagogical content knowledge (TPCK) for educators. New York: Routledge.
- Krumsvik, R. (2012). Teacher educators' digital competence. *Scandinavian Journal of Educational Research*, 58(3), 269-280. <https://doi.org/10.1080/00313831.2012.726273>
- Marshall, S. J. (2018). *Shaping the University of the Future*. Springer. <https://doi.org/10.1007/978-981-10-7620-6>
- Mattila, A. (2016). The future educator skills in the digitization era: Effects of technological development on higher education. *Proceedings of 2015 5th International Conference on e-Learning, ECONF 2015* (pp. 212-215). <https://doi.org/10.1109/ECONF.2015.18>
- Organisation for Economic Cooperation and Development [OECD]. (2018). *Teaching for Global Competence in a Rapidly Changing World*. OECD. <https://doi.org/10.1787/9789264289024-en>
- Orozco, G. H., Cabezas, M., Martínez, F., Delgado, J. E., & Solís, M. E. (2016a). Determining factors in acceptance of ICT by the University faculty in their teaching practice. *ACM International Conference Proceeding Series, 02-04-November-2016* (pp. 139-146). <https://doi.org/10.1145/3012430.3012509>
- Orozco, G. H., Cabezas, M., Martínez, F., & Mercado-Varela, M. A. (2016b). Digital competence of the University faculty: Case study of the Universidad Nacional de Chimborazo. *ACM International Conference Proceeding Series, 02-04-November-2016* (pp. 147-154). <https://doi.org/10.1145/3012430.3012510>
- Pérez-Escoda, A., García-Ruiz, R., & Aguaded, I. (2019). Dimensions of digital literacy based on five models of development. *Cultura y Educación*, 31(2), 232-266. <https://doi.org/10.1080/11356405.2019.1603274>
- Plomp, T., & Nieveen, N. (2009). *An introduction to educational design research*. Netherlands Institute for curriculum development (SLO).
- Pozos, K., & Tejada, J. (2018). Competencias Digitales en Docentes de Educación Superior: Niveles de Dominio y Necesidades Formativas. *Revista Digital de Investigación en Docencia Universitaria*, 12(2), 59-87. <https://doi.org/10.19083/ridu.2018.712>
- Prendes, M.P., Gutiérrez, I., & Martínez, F. (2018). Digital competence: A need for university teachers in the 21st century. *Revista de Educación a Distancia*, 56. <https://doi.org/10.6018/red/56/7>
- Rangel, A., & Peñalosa, E. A. (2013). Alfabetización digital en docentes de Educación Superior. Construcción y prueba empírica de un instrumento de evaluación. *Pixel-Bit-Revista de Medios y Educación*, 43, 9-23. <https://doi.org/10.12795/pixelbit.2013.i43.01>
- Redecker, C., & Punie, Y. (2017). *European Framework for the Digital Competence of Educators. DigCompEdu*. European Commission, Joint Research Centre (JRC).
- Revelo-Rosero, J. E., Revuelta, F. I., & Gonzalez-Perez, A. (2018). Modelo de integración de la competencia digital del docente universitario para su desarrollo profesional en la enseñanza de la matemática – Universidad Tecnológica Equinoccial de Ecuador. *Edmetic*, 7(1), 196-224. <https://doi.org/10.21071/edmetic.v7i1.6910>

- Ríos, J., Gómez, E., & Rojas, M. (2018). Valoración de competencias TIC del profesorado: un caso en Chile. *Pixel-Bit. Revista de Medios y Educación*, 52, 55-65. <http://dx.doi.org/10.12795/pixelbit.2018.i52.04>
- Rodríguez, G., Gil, J., & García, E. (1999). *Metodología de la investigación cualitativa*. Málaga: Ediciones Aljibe.
- Saldaña, J. (2015). *The Coding Manual for Qualitative Researchers*. SAGE Publications.
- Selwyn, N. (2012). Social media in higher education. *The Europa world of learning*, 1(3), 1-10.
- Tejada, J. & Pozos, K. V. (2018). Nuevos escenarios y competencias digitales docentes: Hacia la profesionalización docente con TIC. *Profesorado*, 22(1), 25-51. <https://recyt.fecyt.es/index.php/profesorado/article/view/63620>
- UNESCO (2013). *Guidelines on adaptation of the UNESCO ICT Competency Framework for teachers*. Moscow: UNESCO Institute for Information Technologies in Education (IITE).
- Zempoalteca, B., Barragán, J. F., González, J., & Guzmán, T. (2017). Formación en TIC y competencia digital en la docencia en instituciones públicas de educación superior. *Apertura*, 9(1), 80-96. <https://doi.org/10.18381/ap.v9n1.922>