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THE INFLUENCE OF THE MOMENT OF TRAINING OF FUTURE EARLY CHILDHOOD EDUCATION TEACHERS ON THEIR DIGITAL TEACHING COMPETENCIES

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Abstract

The technological training of Early Childhood Education students is essential for the development of their Digital Teaching Competences (DTC), and are crucial for their future work as teachers. The aim of the present study is to assess the level of digital competence of students and to analyze the differences between two universities that provide this training at different moments during the degree (1st and 4th years), considering variables such as sex, age, teaching experience, and the use of technology. The methodology used was quasi-experimental, with a pre-test and post-test design, using the DigCompEdu questionnaire to measure self-perception of DTC. The results showed that after the training, the students perceived themselves as having a lower level of digital competence as compared to their estimated level before the training. Likewise, it was found that the first-year students had a greater self-perception of their digital competence as compared to the fourth-year students. In addition, the previous teaching experience and the frequent use of technologies significantly influenced the perception of the students in their last year of the degree. In conclusion, the study highlights the importance of having didactic maturity, as well as training that includes both pedagogic and technological knowledge, so that future Early Childhood Education teachers fully develop their digital competences. This underlines the need for educational programs that into account the level of maturity of the students, and that promote technical and pedagogic skills that will result in the creation of enriching and meaningful learning environments.

Keywords – Digital competence, Early childhood education, ICT, Technological training, Higher education.

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1. Introduction

The social environment of children has undergone deep transformations, and technology has emerged as a key space for interaction, with direct effects on their social development (Garmendia, Jiménez, Casado & Mascheroni, 2016). Nevertheless, the prolonged use of technology of children between the ages of 3 and 6 has raised concerns, such as technological dependence and alterations in their behavior (Burns & Gottschalk, 2020). Recent research has indicated that children have become "quasi-dependent" on technology during their leisure time at home (Area-Moreira, Rodríguez-Rodríguez & Peirats-Chacón, 2022), which poses significant educational challenges due to the omnipresence of technology.

The responsibility of educating children in a highly technological environment falls primarily on families, who must exercise efficient parental mediation (Caldeiro-Pedreira, Castro-Zubizarreta & Havrankova, 2021). However, parents face dilemmas and lack clear guidelines to adequately manage the use of technology (Grané, 2021). Arnaiz (2023) underlines that it is "indispensable to guide and accompany families towards digital coexistence that respects the health, needs, and rhythm of children" (Arnaiz, 2023: page 41). Therefore, the collaboration between family, school, and society is shaped as a fundamental pillar to ensure a healthy digital education in early childhood. Open and constant communication between parents, educators, and the community promotes a deeper understanding of the individual needs of each child (Siraj-Blatchford & Romero-Tena, 2017).

In this context, there is an evident need for Early Childhood Education (ECE) teachers to receive adequate training in digital competences. Studies such as those by Masoumi (2015) and Nikolopoulou and Gialamas (2015) underline that the beliefs, knowledge, and digital knowledge of the teachers, as well as the obstacles perceived during the implementation of technology, are key factors in the integration of digital technologies in early childhood education. The study conducted by Romero-Tena, Barragán-Sánchez, Gutiérrez-Castillo & Palacios-Rodríguez (2024) before the pandemic revealed the limited use of technological resources by the ECE teachers in their pedagogic practices, in agreement with previous studies, such as those by Eckhaus & Davidovitch (2019) and Giang, Nguyen & Bower (2018).

1.1. Teacher's Training and Digital Competences

Countries such as Sweden have implemented diverse initiatives to improve the digital competences of early childhood education teachers, including investments in technology, the design of comprehensive policies and strategies to promote the innovative use of digital tools, and the development of digital competences of teacher's trainers (Bakir, 2015; Brown, Englehardt & Mathers, 2016). However, despite these efforts, the effective integration of digital technologies in the initial training of teachers is still a significant challenge (Instefjord & Munthe, 2017; Scherer, Tondeur, Siddiq & Baran, 2018; Brevik, Gudmundsdottir, Lund & Stromme, 2019).

Studies conducted by the OECD (2021, 2023), highlight the need for ECE teachers to possess digital skills. Romero-Tena et al. (2024) confirmed that an adequate digital literacy is fundamental for adapting to the new educational and social realities of children. The findings showed a greater incorporation of technologies in the ECE classrooms after the pandemic, improving educational attention to both students and their families. Nevertheless, although the teachers perceived themselves as having a moderate mastery of their digital teaching competences (DTC), their ability to develop these competences in students is still somewhat limited, especially in the area of digital pedagogy (Enochsson and Ribaeus, 2021; Sánchez-Cruzado, Santiago-Campión & Sánchez-Compaña, 2021; Baeza-González, Lázaro-Cantabrana & Sanromà-Giménez, 2022; Lena-Acebo, Pérez-Escoda, García-Ruiz & Fandos-Igado, 2023; Villén-Contreras, Agreda-Montoro & Rodríguez-Moreno, 2024; Romero-Tena et al., 2024).

The literature supports the finding that the integration of technology in teacher training programs has a significant influence on the degree to which the future teachers will use technology in their teaching practices (Kerckaert, Vanderlinde & van-Braak, 2015; Nikolopoulou & Gialamas, 2015). In this sense, the training programs must further digital competences that allow individuals to design and perform innovative practices, as already suggested by the UNESCO (2011). This implies not only mastering the use

of digital tools, but also fomenting the confidence of teachers on the use of technology as an educational resource (Brevik et al., 2019; Uerz, Volman & Kral, 2018). The development of digital competence must be understood as a process that enables future teachers to implement technological knowledge in their pedagogic practices (Romero-Tena et al., 2024).

When faced with this situation, it is indispensable for future ECE teachers, as well as those who are currently teaching, to receive adequate training that allows them to offer education adapted to the current demands. It is not only about introducing technology in the classrooms, but also developing digital competences in children between the ages of 3 and 6 (Romero-Tena, 2024). For teachers who are currently working, the Framework for Digital Competencies for Teachers (INTEF, Marco de Competencias Digitales Docentes, 2022), a national adaptation of DigCompEdu, provides a training and assessment framework to support the digitalization of the Spanish education system (Dardanou, Hatzigianni, Kewalramani & Palaiologou, 2023; Marimon-Martí, Romeu, Sofia-Ojando & Esteve-González, 2022; Silva-Quiroz, Rioseco-Pais & Aranda-Faúndez, 2023). This framework establishes the necessary digital competences needed by any teacher throughout their professional trajectory, independently of the level or type of teaching.

In the case of future teachers, ministerial orders ECI/3854/2007 and ECI/3857/2007 establish the requisites for the official degrees that enable teaching in ECE, including knowledge of the educational implications of the Information and Communication Technologies (ICT). Nevertheless, digital competence training is not addressed homogeneously at all universities. A study by Romero-Tena, Llorente-Cejudo and Palacios-Rodríguez (2021) showed that in 81.36% of the Spanish universities analyzed, technology was a mandatory subject in the curricula of the Early Childhood Education Degree, while in the rest it was offered as an elective, creating significant inequalities in the training.

Molina, Pérez and Antiñolo (2012) justify that future teachers in Spain are not yet trained for the effective adaptation of technologies in the classroom, among other reasons, because Spanish universities, despite the changes performed in the last few years, have yet to become equal to other European universities, with respect to the initial training of teachers.

According to the study by Romero-Tena, Llorente-Cejudo et al. (2021), the main inequality found in teaching curricula and course syllabi related with technology in the Early Childhood Degree is not due to the inexistence of related content or objectives, nor in their planning. In fact, almost all universities foment basic technology literacy, promoting the acquisition of fundamental competences to integrate technological tools in the curriculum, the methodology, and the classroom practices. The difference is found in the modality of the course: of the eight Andalusian universities analyzed, it is taught as a basic course in four of them, in two it is an elective, and in the remaining two, it did not exist as such. This panorama reflects the lack of consensus about the importance and the role of technologies in the Early Childhood Education Degree, as well as their curricular and pedagogic value.

Presently, the preliminary Report currently being developed on the White Paper on Early Childhood Education underlines that digital competence is one of the fundamental skills that will allow future teachers to adapt to future challenges, guaranteeing relevant and quality education (Grupo de trabajo CODE, 2024). In this sense, the course organization and structuring of the contents are determinant factors to achieve meaningful learning, as shown by cognitive psychology and neuroscience (McTighe & Willis, 2019; Novak, 2010; Sousa, 2017; Weinstein & Sumeracki, 2019). Without an adequate organizational foundation, it is difficult to design teaching processes that promote deep and meaningful learning (Darling-Hammond & Oakes, 2019).

It is therefore crucial to master the principles that underpin the subject matter content (SMC), including the dimensions of knowledge of the content (KC) and the didactic knowledge of the subject matter (DKSM), as both are interrelated (Copur-Genturk, Tolar, Jacobson & Fan, 2019). Recent studies (Moreno-Mediavilla, Palacios, Gómez-del-Amo & Barreras-Peral, 2023; Moral-Santaella & de-la-Herrán-Gascón, 2024) highlight the importance of designing didactic proposals that include content that

is appropriate for fomenting digital competences in children. These proposals must avoid assuming that future teachers, as digital natives, are automatically prepared to transmit these competences.

In addition, as Matengu, Ylitapio-Mäntylä and Puroila (2020) indicate, professional practices are essential for linking theoretical learning with educational practice. However, depending on the quality of the collaboration between universities and practice centers, these experiences can strengthen the theoretical-practical connections or widen the gap between them even more. Romero-Tena, Martínez-Pérez and Martínez-Navarro (2023), in a work about Practicum and technologies, point out that in the last ten years, the quality of the technology experiences lived by students during the Practicum have improved. These technological practices in the classroom are fundamental for consolidating the theoretical basis acquired in the faculty. «Everything learned in theory is put into action during practice, but if this does not happen, the training process can be considered failed» (Romero-Tena et al., 2023: page 65).

Lastly, considering the study that will be conducted, we believe that in addition to the variables described, another important one must be mentioned: the moment in which the training is provided. The previous knowledge of the students when taking a course can significantly influence their effective use of the subject matter.

For these reasons, a decision was made to analyze the digital teaching competences (DTC) of students enrolled in two different universities where the training is considered core and mandatory, but taught at different moments during the degree. One university teaches the technology in Early Childhood course in the first quarter of the fourth year (at the end of professional training), coinciding with the second period of practices (Practicum II). The other university offers it in the first quarter of the first year (at the start of professional training), when the students lack previous knowledge about education, pedagogy, didactics, and other subjects related with Early Childhood. These divergent contexts suggest possible differences in the use of technological training, which turns this variability into the focus of the study.

2. Methodological Design

2.1. Objective

The following general objective was proposed in the present study: to analyze if the academic year in which technological training is provided to future Early Childhood Education teachers has an influence on the development of Digital Teaching Competences (DTC). For its rigorous study, the following specific objectives were addressed:

- To study the level of digital competence, as well as to identify and analyze the respective differences between the universities based on the variables of sex, age, teaching experience, and use of technologies. (Obj. 1.1).
- To analyze the possible discrepancies between the level of competence before and after the training, in addition to examining possible relationships between self-perception of the level of competence, and the real level acquired, and the respective differences between the variables sex, age, teaching experience, and use of technologies. (Obj. 1.2).

For this, two universities will be compared. University 1 teaches the Information and Communication Technologies (ICT) applied to Early Childhood course in the fourth year of the degree, and university 2 does it in the first year. We believe that teaching the course in the first quarter, one in the first year and the other in the fourth year of the degree, could have an influence on the use and development of DTC, as those who take the course in their first year do not have any previous knowledge on general and specific didactics with respect to early childhood students.

2.2. Design and Participants

The research design was centered on a quantitative and quasi-experimental approach, with a comparative analysis component between two groups. This methodology is commonly used to study educational

interventions and their impact on specific variables (Hernández-Sampieri, Fernández-Collado & Baptista-Lucio, 2014; Reichardt, Storage & Abraham, 2023). The sampling was intentional and non-probabilistic, and was subjected to a pre-test and post-test study, which allowed comparing the results before and after the intervention. A total of 644 Early Childhood Education Degree students participated, who were enrolled in the ICT applied to Early Childhood Education course at two different Andalusian universities during the 2023-2024 academic year. Of these, 47.5% were enrolled in university 1 (fourth year), while 53.5% were enrolled in university 2 (first year). From the total, 94.2% were women, while the remaining 5.8% were men. By itemizing the data, it was observed that from the total sample from university 1, 95.5% were women and 4.5% were men, while in university 2, 92.9% were women and 7.1% were men.

The age intervals of the participants were: 18-20 years old, 24.4%, between 21-25 years old, 69.5%, between 26-30 years old, 4.2%, and between 31-50 years old, 1.9%. Of these, at university 1, the results were 10.1% (18-20 years old), 83.8% (21-25 years old), 2.8% (26-30 years old) and 3.4% (31-50 years old). In turn, at university 2, the participants were distributed in the following manner: 37.4% (18-20 years old), 56.6% (21-25 years old), 5.6% (26.-30 years old), and 0.5% (31-50 years old).

Aside from these data, the origin of the participants can also be indicated, with 58.1% living in urban areas, while 41.9% in rural areas. This distribution varied according to the university, as in university 1, 67.6% resided in urban areas, and 32.4% in rural areas. In turn, in university 2, 49.6% lived in urban areas, and 50.4% in rural areas.

Lastly, another data of interest that can be highlighted is the teaching experience, given that 82% of the total sample indicated not having any experience, while the remaining 18% did. Likewise, it can be indicated that all the participants used one or many social networks. In addition, it was observed that 21.5% had used ICT as educational tools for 1-3 years, 17.8% between 10-14 years, 4.2% between 15-19 years, 19.4% between 4-5 years, 20.2% between 6-9 years, and 11.7% less than one year, while 5.3% had never used them. The variables teaching experience and years of use of technology as educational tools will be the ones used, along with gender, to discover if they are influencing factors.

2.3. Instrument

To assess the level of competence of the students before and after the intervention, the «DigCompEdu Check-In» instrument for future teachers by Romero-Tena, Barragán-Sánchez, Puig-Gutiérrez and Llorente-Cejudo (2021) was utilized. This instrument is composed of 22 items and structured into 6 areas of competence: professional commitment (4) digital resources (3), digital pedagogy (4), assessment and feedback (3), empowering students (3) and facilitating the digital competence of students (5). Each item was scored through a Likert scale of 5 responses, and each participant had to indicate their self-assessment, to discover their own competence, which ranged from Novice (A1) to Pioneer (C2), after completing it. Likewise, a general section was also included to collect information on their sociodemographic characteristics, as well as some issues related with technological habits.

The instrument used was validated with 335 German students, obtaining a reliability coefficient of 0.934, considered high. In addition, validity was studied with Mann-Whitney's U test and a bivariate correlational study through Spearman's p correlations, to confirm the hypotheses that were initially posed in the level of competence study (Ghomi & Redecker, 2018). Likewise, the translation to Spanish was validated by 2262 teachers, obtaining a reliability coefficient of 0.967 (Cabero & Palacios, 2020).

2.4. Procedure

First, an explanation was provided to the students about the importance of possessing DC as future Early Childhood Education teachers, that its development was partly dependent on the course they were going to take and the contents that were going to be worked on, according to the Verification Report and the course program; and that assessing the advances in DC before and after taking the course will provide

information to improve and adapt them to the DTC that will be required as Early Childhood Education teachers. Afterwards, the data collection instrument was provided to the students as an online questionnaire (Pre-test DigCompEdu Check-In), in order to discover and assess their level of competence obtained as compared to the level of competence they themselves perceived. The courses are taught at both universities in the 1st quarter, trying, in all the theoretical-practical sessions, to focus the course to improve the 6 levels of digital competence, so that the students reach the C1 (Leader) or the C2 (Pioneer) levels, thus developing new digital competences. After the end of the course, the questionnaire was administered again (Post-test DigCompEdu Check-In) to discover the real level obtained after the intervention.

The data were stored in the professional statistical program SPSS v.29. Lastly, the following analyses were conducted: degree of reliability of the sample, descriptive statistical data of the pre-test and post-test, Student's t test to study the reliability of the tests applied, and an ANOVA analysis to investigate the possible relationships between the real levels of competence acquired, the self-perceived level, gender, age, and use of technology.

Cronbach's alpha and McDonald's Omega were used for the degree of reliability, with these indices being the most utilized to analyze reliability. Values higher than 0.7 are considered good, higher than 0.8 very good, and higher than 0.9 excellent. Nevertheless, values below 0.7 are considered moderate, and those lower than 0.4 are considered low (Cabero-Almenara, Barroso-Osuna, Gutiérrez-Castillo & Palacios-Rodríguez, 2020; Arias-Vargas, Vélez-Bernal, Gómez-Bayona & Rave-Gómez, 2024; Roco-Videla, Aguilera-Eguía & Olguín-Barraza, 2024).

3. Results

The analysis of the data that were compiled throughout the academic year between both universities was used to study the different approaches to meet the predetermined objective. In first place, the degree of reliability was studied, followed by the descriptive analysis of the nature of the data, the frequency, and the ANOVA to study the possible relationships, based on objectives 1.1 and 1.2.

3.1. Reliability Scale

Table 1 shows that both dimensions A and B possess moderate values, which suggests that the answers of the students must be revised to discard possible errors in the internal consistency or in the understanding of the items. In turn, dimensions C, D, and E possess a good reliability, which indicates that the items are consistent enough to study each of the variables included. In reference, dimension F obtained the highest score. As for the total instrument, it obtained a value of 0.927, close to a value of 1.

Variables	Cronbach's Alpha	McDonald's Omega
A. Professional commitment	.650	.662
B. Digital resources	.597	.603
C. Digital pedagogy	.759	.766
D. Assessment and feedback	.716	.722
E. Empowering students	.748	.756
F. Facilitating the digital competence of students	.870	.870
TOTAL	.927	.927

Table 1. Reliability statistics

3.2. Analysis of Obj. 1.1.

To provide an answer to Obj. 1.1, a study was conducted on the level of digital competence, to identify the differences between the universities, as well as the variables gender, age, and use of technology. The general mean level of the students from both universities was found to be between «B1: Integrator» and

«B2: Expert» after the intervention. This mean was obtained from the values given to each level, with 1 point awarded to A1 up to 6 points to C2.

In addition, it can be affirmed that the profiles of the students between the universities were slightly different, given that university 2 obtained a higher mean than university 1. Likewise, it was observed that the answers of the students from university 2 were more concentrated than university 1.

Although there were not many differences between the levels of competence developed, it was observed that the level of women was higher than the men, as their means were closer to the B2 level. This occurred in both universities. However, in university 1, the answers were more dispersed.

The results indicated that for the variable age, there were no significant differences between the groups from both universities, given that p (Sig.) obtained a value of 0.560, being higher than the level of significance of 0.05. Likewise, it was affirmed that there were no significant differences between the levels of competence acquired after the study of the subject matter with respect to teaching experience, as p (Sig.) was higher than 0.05, with a value of 0.824. However, and in contrast with the other two variables, the variable use of technology obtained a p-value (Sig.) lower than 0.001, which indicates that there are significant differences between one of the two university student groups.

ANOVA								
				Sum of squares	**gl**	**Quadratic mean**	**F**	**Sig.**
Age	Between groups	(Combined)		1.344	5	.269	.787	.560
		Linear term	Non-weighed	.224	1	.224	.655	.419
			Weighed	.209	1	.209	.613	.434
			Deviation	1.135	4	.284	.830	.507
	Within groups			100.453	294	.342		
	Total			101.797	299			
Teaching experience	Between groups	(Combined)		9.988	5	1.998	.435	.824
		Linear term	Non-weighed	2.431	1	2.431	.530	.467
			Weighed	8.132	1	8.132	1.772	.184
			Deviation	1.856	4	.464	.101	.982
	Within groups			1376.616	300	4.589		
	Total			1386.605	305			
Use of technology	Between groups	(Combined)		65.787	5	13.157	6.127	<.001
		Linear term	Non-weighed	.206	1	.206	.096	.757
			Weighed	54.645	1	54.645	25.448	<.001
			Deviation	11.141	4	2.785	1.297	.271
	Within groups			644.213	300	2.147		
	Total			710.000	305			

Table 2. ANOVA analysis of both universities in relation to age, teaching experience and use of technologies

In order to discover which university had a significant difference on the use of technology, an independent samples ANOVA was performed (Tables 3 and 4). Table 3 shows that there is a significant difference on the use of technology, with a very low p-value (<0.001) and a high F statistic (11.219). Likewise, it was observed that among the other two variables, no significant differences were observed, as the values were higher than 0.05. Likewise, Table 4 shows the existence of significant differences on the use of technology, given that the p-value was 0.001, and the F statistic 4.909. This indicates the existence of a significant difference in this variable, and not on the others. Although there are significant differences between the universities, it can be affirmed that there is a higher significance in university 1 as compared

to university 2, given that the p-values of university 1 were lower than university 2, as well as the F statistic, with it being higher in the first university as compared to the second.

ANOVA						
		Sum of squares	**gl**	**Quadratic mean**	**F**	**Sig.**
Age	Between groups	1.910	3	.637	2.581	.056
	Within groups	32.061	130	.247		
	Total	33.970	133			
Teaching experience	Between groups	9.730	3	3.243	.667	.574
	Within groups	642.152	132	4.865		
	Total	651.882	135			
Use of technology	Between groups	85.523	3	28.508	11.219	<.001
	Within groups	335.418	132	2.541		
	Total	420.941	135			

Table 3. ANOVA of University 1

ANOVA						
		Sum of squares	**gl**	**Quadratic mean**	**F**	**Sig.**
Age	Between groups	1.269	4	.317	.953	.436
	Within groups	39.979	120	.333		
	Total	41.248	124			
Teaching experience	Between groups	11.326	4	2.831	.551	.698
	Within groups	647.178	126	5.136		
	Total	658.504	130			
Use of technology	Between groups	46.038	4	11.509	4.909	.001
	Within groups	295.397	126	2.344		
	Total	341.435	130			

Table 4. ANOVA of University 2

3.3. Analysis of Obj. 1.2.

To obtain Obj. 1.2, the possible discrepancies of the level of competence before and after the training were studied, as well as the relationships between perception and the real level acquired and the variables studied. Table 5 shows the general frequency data obtained in the pre-test and post-test. It is observed that in the pre-test, the predominant level of competency obtained was «B2: Expert» (43.3%), followed by «C1: Leader» (31.3%). Nevertheless, after taking the course, the predominant levels decreased to «B1: Integrator» (40.4%) and «B2: Expert» (37.1%). This could be due to the students, before starting the course, perceiving themselves as using the ICT in the most adequate manner according to the DigCompEdu framework; however, after working with each of the competences of these instruments, they observed that their levels were not the same as they obtained initially; this is because levels B2 or C1 need a greater commitment of the use of technologies.

Another important piece of data that must be underlined was level «C2: Pioneer», given that 2.1% of the sample obtained this qualification in the pre-test; however, after the intervention, it decreased to 0%, as none of the students obtained this level based on the DigCompEdu instrument.

Given the results found, a Student's t test for related samples was used between the pre-test and post-test data obtained (Table 6). It was observed that the participants significantly improved their digital teaching competence after taking the course, that is, in the post-test, although the difference was small but

significant (0.166). In other words, it is confirmed that the students possessed a higher level of digital competence after the taking the course, implying that the questionnaire contributed to a positive reflection or re-assessment of their digital competence.

Competency Levels	General Pre-test Percentage	General Post-test Percentage
A1: Novice	1.3	.4
A2: Explorer	3.4	12.0
B1: Integrator	18.6	40.4
B2: Expert	43.2	37.1
C1: Leader	31.3	10.1
C2: Pioneer	2.1	0
Total	100.0	100.0

Table 5. Frequency of the competency level obtained in the pre-test and post-test

Paired sample test										
		Paired differences					t	gl	Significance	
		Mean	Std. Deviation	Mean standard error	95% confidence interval of the difference Lower	Upper			P of a single factor	P of two factors
Pair 1	Digital competence level	-.166	.557	.022	-.209	-.123	-7.575	643	<.001	<.001

Table 6. Student's t test for related samples

Likewise, Figure 1 shows the level of competence before and after the intervention according to university, to discover whether there are differences between them. The data allow us to confirm that in the pre-test, university 1 obtained B2 and C1 levels at similar percentages, although B2 was more predominant. However, level C1 abruptly decreases after the intervention, with a new predominance of B1 observed, followed by B2. In turn, B2 and C1 predominate in university 2, with B2 being the most predominant. After the intervention, it is observed that level C1 abruptly decreases while B2 slightly decreases, with B1 increasing in both universities. In addition, it is observed that while some users obtained a C2 level in the pre-test, in the post-test, it was 0%.

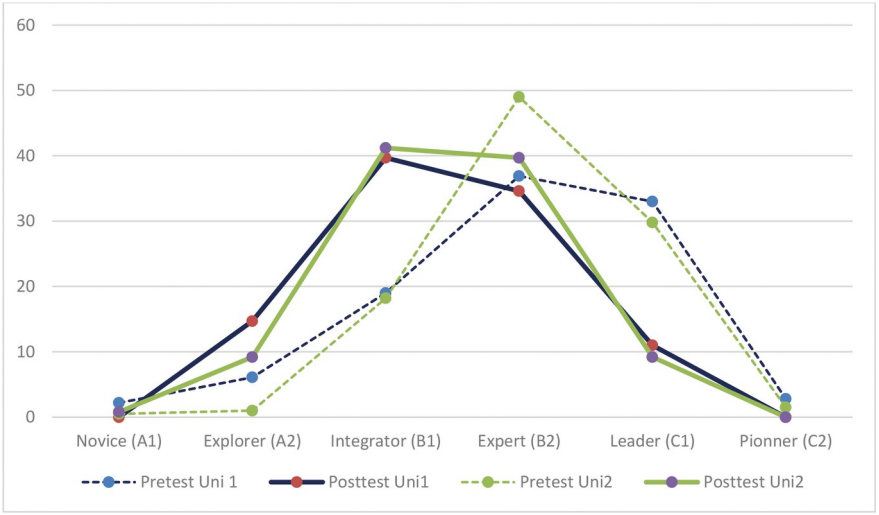
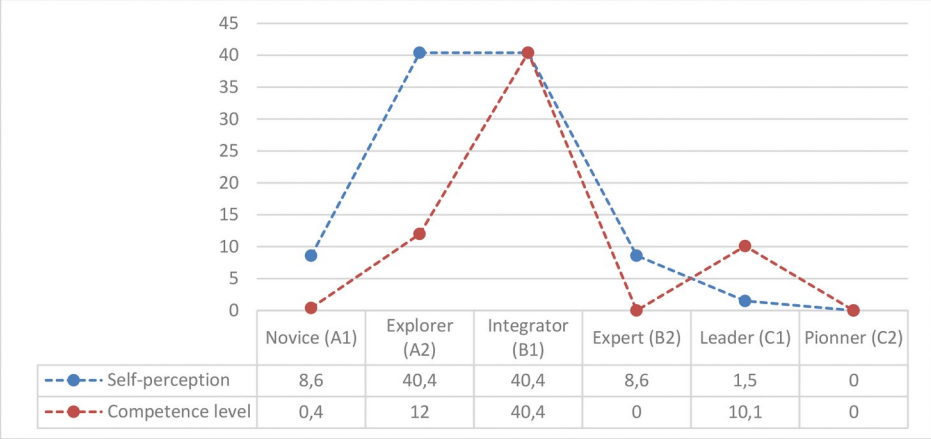


Figure 1. Frequency of the competency level obtained by university in the pre-test and post-test

Figure 2 analyzes the initial self-perception of the students before taking the course, in comparison with the level of real competence after the intervention. It is observed that the students self-perceived themselves as predominantly having A2 and B1 levels, with similar percentages. However, these perceptions changed throughout the sessions, as shown by the fluctuation in all the levels, although B1 remained the same and became predominant, just as B2. In turn, A2 descended abruptly. This is because the students consolidated each of the variables of the diverse levels until reaching the level achieved.



	Novice (A1)	Explorer (A2)	Integrator (B1)	Expert (B2)	Leader (C1)	Pionner (C2)
Self-perception	8,6	40,4	40,4	8,6	1,5	0
Competence level	0,4	12	40,4	0	10,1	0

Figure 2. Differences between self-perception and the competence level obtained

In addition, after performing complementary frequency analyses, it was observed that A2 predominated in the self-perception of university 1, followed by B1, while in university 2, the result was inverse. As for the level of competence acquired in university 1, B1 had the highest percentage, followed by B2. This also occurred in university 2. Moreover, it was observed that in university 1, 11% of the users possessed a C1 level of digital competence, as compared to 9.2% in university 2.

In addition, to establish a higher relationship between the variables and self-perception, an ANOVA was once again performed. The results showed that there was no repercussion on the self-perception of the level of competence, given that the p-value (Sig.) was higher than 0.05 (0.404). In turn, significant differences were found between the universities in teaching experience and the use of technology, as shown by a p-value lower than 0.001 for both cases. Also, a higher significance was observed in the use of technology, as the F statistic was higher (6.260), as compared to the F statistic of teaching experience (5.264).

Another aspect that must be underlined in university 1 is the significant differences found between teaching experience and use of technology in relation with the self-perception of the competence level, given that the p-value (Sig.) was less than 0.001 in both cases, while F was almost similar to the previous one. However, no significance was found for age. In turn, in university 2, no significant differences were found in teaching experience, as observed in university 1, although a significant difference persists in the use of technology, given that p (Sig.) was lower than 0.05, with a value of 0.043, while the F statistic was 2.516. When comparing both universities, there was a higher significance in university 1 than in university 2.

4. Discussion

The findings of the study reveal some significant conclusions that foment a continuous debate on the factors that have an influence on the self-perception of Early Childhood Education students, after receiving technological training in their respective universities to exert as specialized teachers in the education stage mentioned. These findings are closely related with the objectives proposed in the present study.

With respect to objective 1.1, it was verified that students improved their self-perception after completing the technological training in the course. Therefore, they became increasingly aware about what is implied by being a digitally-competent teacher. This was clearly observed in the changes in the levels of digital competence: «B1: Integrator» and «B2: Expert» after the intervention. However, a remarkable finding was observed: the students from university 2 (1st year) obtained a higher mean than university 1 (4th year). This could be explained by the lack of knowledge of the new students about the degree, and the overestimation of their digital competence, which may be due to the lack of experience and knowledge about the diverse subject matters taught in the degree.

As for the differences between the universities, the variables teaching experience and educational use of technology significantly influenced the self-perception of the different areas of competence of the DigCompEdu. These factors were more significant in university 1, thus suggesting the pedagogic and didactic maturity of the students. In fact, a study conducted by Moral Santaella and de-la-Herrán (2024) concluded that the training of future teachers who receive specific training on subject matter knowledge (SMK) showed a richer and more elaborate conceptual structure that will serve as the basis of meaningful learning.

Based on objective 1.2, the detailed analysis of the process of training revealed that after taking the Information and Communication Technologies Applied to Early Education course, the levels of competence decreased to «B1: Integrator» (4.04%) and «B2: Explorer» (37.1%). This is an important decrease, as the predominant levels in the pre-test were «B2: Expert» followed by «C1: Leader». In addition, level «C2: Pioneer» disappeared after the intervention. This is because none of the students achieved this level based on the DigCompEdu instrument. Likewise, in university 1, levels B2 and C1 obtained similar percentages, although B2 was the most predominant. However, level C1 decreased abruptly after the intervention, resulting in the predominance of level B1, followed by B2. In turn, levels B2 and C1 predominated in university 2, although level B2 was the most predominant. In other words, the initial self-perception of the students was observed in higher levels (A2 and B1) in the pre-test. This could be explained by the pre-conceived ideas of the future teachers. However, after finishing the training, fluctuations were observed in all the levels, which progressively decreased.

As discussed above, this means that although the subject matter is taught in similar programs, the level of maturity of the students is very different, as in university 1, the students only have to finish the Practicum II and the final degree project (FDP) to obtain their degree, indicating that they have acquired the general and specific competences of the Early Childhood Education Degree, while in university 2, the students have just began their university and Degree studies.

Before the pre-test completing the DigCompEdu questionnaire, without having a preconceived idea of what is asked from a future teacher. The data showed that the students perceived themselves as having an A2 or B1 level, much higher than the values obtained in the pre-test when they begin to answer questions from each area of competence about what they know about it. In addition, these perceptions changed once the training ended, as shown by the fluctuations in all the levels, with B1 staying the same, but becoming prominent, as well as B2. However, A2 decreased abruptly. In the self-perception of university 1, we found the predominance of A2, followed by B1, while in university 2, this was the opposite; in university 1, 11% of the users possessed a C1 of digital competence, as compared to 9.2% in university 2. In fact, it must be taken into account that these perceptions were mostly due to the particularities, characteristics, and needs of the students as a function of the style they follow when searching for information or using technology (Cañete, Torres-Gastelú, Lagunes-Domínguez & Gómez-García, 2022; García-Prieto et al., 2022; Sánchez-Caballé, Cela-Ranilla & Esteve-Mon, 2024).

In other words, and based on the general objective of the study, it can be affirmed that there are significant differences between the universities, between the teaching experience and the use of technology. In university 1, significant differences were observed between teaching experience and the use of technology with respect to the self-perception of the level of competence. However, in university 2,

there were no significant differences in teaching experience, although a persistence of a significant difference was observed in the use of technology.

Therefore, the staff is in responsible for constructing thinking schemes to attain meaningful, critical, and creative comprehension that allows students to think, feel, and act (Novak, 2010), choose to consider the SMC (course where it is taught), and dedicate its two basic dimensions (KC and DKSM) (Moreno-Mediavilla, et al., 2023; Moral-Santaella & de-la-Herrán, 2024), not only as an alternative, but as an obligatory step for designing meaningful and deep learning experiences (Moral-Santaella, 2019; Garzón-Artacho, Sola-Martínez, Trujillo-Torres & Rodríguez-García, 2021; Paz-Saavedra, Gisbert-Cervera & Usart-Rodríguez, 2022; Agustí-López, Martí-Aras, Rodríguez-Martín & Gabarda-Méndez, 2023).

5. Conclusion

The present study reveals the importance of the moment in which technology training is provided in the development of digital competences (DC) of future Early Childhood Education teachers, also detecting the relevance of pedagogic maturity and teaching experience as key factors for the effective and complete acquisition of said competences. The results underline the need to design educational programs that are not limited to teaching technical skills, but that also coherently integrate technology pedagogy. This will lead to the creation of more meaningful and enriching learning environments, for both future teachers and students in all stages of education, favoring teaching that is more adapted to the demands of digital era. In addition, the data obtained show that the differences in the level of pedagogic maturity between students at different points in the degree also have a significant impact on the self-perception and acquisition of digital competences, which evidences the need to adapt training strategies as a function of the profile and needs of the students. These differences invite us to reflect on the importance of personalizing the teaching of technology in diverse educational contexts, thus maximizing learning and promoting a more equal development of digital competences in university settings.

One of the limitations that was considered in the study was: the representative sample of two universities, limiting the generalization of the results to this educational context, not extending them to other Spanish universities, thus limiting the study to two cases. Another of the limitations was the curricular discrepancy observed between the universities, given that other curricular factors were not studied, with only the moment in which the ICT applied to Early Childhood course was taught being the object of study.

As future research lines, the following could be studied: the impact of the pedagogic maturity of the students; teaching strategies for effective technological training; the inequalities of technological training among students; the use of technology in professional practices, as well as the adaptation of educational programs for adequately developing digital competence.

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