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ICT competences of university students in the education field and their relation with learning strategies

Interpretaciones no intencionadas e intencionadas y usos de los resultados de PISA: Una perspectiva de validez consecuencial

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Abstract

This study was conducted in the university context with students as they are the main actors in their learning process. The objective was to focus on analysing the (technological, pedagogical and ethical) ITC competences of university students in the education field and their relation with learning strategies. This work also considered certain key personal and contextual variables. The reference population was made up of university students studying degrees in Education at the University of Valencia. The information was collected by questionnaires. We demonstrated that students' learning strategies influenced their technological, pedagogical and ethical ICT competences, especially those related with Information Processing. The obtained results allowed us to examine the relation between the ICT competences and learning strategies that students put into practice in teaching-learning processes, and the influences of key personal and contextual variables.

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Resumen

Este estudio se enmarca en el contexto universitario, y concretamente en los estudiantes, ya que son los actores principales de su proceso de aprendizaje. El objetivo se centra en analizar las competencias en TIC (tecnológicas, pedagógicas y éticas) de estudiantes universitarios del ámbito de la Educación y su relación con las Estrategias de Aprendizaje. Además, se tienen en cuenta en el planteamiento desarrollado determinadas variables personales y contextuales claves. La población de referencia la constituyen los estudiantes universitarios de titulaciones pertenecientes al ámbito de la Educación de la Universidad de Valencia. La información se ha recogido a través de cuestionarios. Se ha demostrado que existe una influencia de las Estrategias de Aprendizaje del estudiante en su competencia respecto a las TIC (tanto tecnológicas como pedagógicas y éticas), muy especialmente las relacionadas con el procesamiento de la información. Los resultados obtenidos nos permiten ahondar en la relación entre las competencias en TIC y las estrategias de aprendizaje que los estudiantes ponen en marcha en los procesos de enseñanza-aprendizaje y la influencias de las variables personales y contextuales clave

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It would be true to state that, in recent years, university students require a well-established level of competence in the information and communication technologies (ICT) area if they are to meet today's Knowledge Society demands. Students find themselves in a highly technological, interactive and collaborative society where computer applications, especially of the Web 2.0 type, allow them entertainment,

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to be trained and to communicate (Enlaces, 2013).

In the new European Higher Education Area (EHEA), university training not only addresses the specific training received in each knowledge area, but goes beyond as it entails acquiring other more general competences, e.g., ICT competences (Redondo & Perales, 2011). It is a matter of university students being capable of acquiring the knowledge required to perform well in the Knowledge Society and being able to use ICT suitably to locate, evaluate, use and communicate information in any specialised setting (CRUE & REBIUN, 2009, 2012).

As a response to the need to integrate ICT into educational contexts, the International Society for Technology in Education (ISTE, 1998, 2007) has developed a series of standards and indicators of competence in ICT that are a clear reference for preuniversity levels.

In our university context, two proposals of standards of ICT competences can be found for university students: CertiUni (2012a, 2012b) and CI2 (the Spanish acronym of Computer Studies and Information Competences).

CertiUni is a project that CRUE (Conference of Rectors from Spanish Universities) promotes in collaboration with the Spanish Ministry of Education and the Spanish Confederation of Business Organisations (CEOE). CertiUni allows universities to offer accreditation systems in some of the most demanded competences in the EHEA. It is a step forward in the process by which the Spanish university comes close to society and to adapting university studies to the working world reality. CertiUni (2012a and b) enables universities to use a common system to evaluate some competences by providing procedures devised by universities themselves with the collaboration of expert organisations in each evaluated field. This platform offers the possibility of obtaining certifications in several transversal competences, which are considered training aspects that affect all careers and knowledge areas. There are three ICT certification levels for *computer sciences competences* (CertiUni, 2012a, 2012b) depending on the objectives and domains that university students wish to accredit: desktop certifications (Microsoft Office), certifications of the associated level (Adobe flash, photoshop, dreamweaver, illustrato, AutoCAD, Autodesk, etc.) and technical certifications (Microsoft Technology Specialist, LPI, Zentyal, etc.).

In the university setting, the computer sciences competence concept is dealt with from the mixed intersectorial CRUE-TIC Committee (Sectorial Committee of ICT) and REBIUN (Network of Spanish Libraries) and is understood as: "the set of knowledge, skills, dispositions and conducts that enable individuals the capacity to know how ICT work, what they are for and how they can be used to achieve specific objectives" (CRUE and REBIUN, 2012, p.6). What this Committee intends to achieve is the progressive incorporation of Computer Studies and Information Competences (CI2) into Spanish universities as part of degree studies.

Therefore, this study centres on the influence that certain learning strategies have on university students who study degrees in the Education area and them acquiring (technological, pedagogical and ethical) ICT competences. In this context, a technological competence is understood as the knowledge and skills that students acquire from technological resources. Pedagogical competences refer to the way that students integrate technological resources to conduct academic and/or training tasks. Finally, an ethical competence refers to students' legal use of applications and acknowledging authorship in academic and/or training tasks (Almerich, Suárez, Orellana & Díaz, 2010; Díaz, 2015; Suárez et al., 2010, 2012a and 2012b).

In order to centre the reference context adopted herein as regards learning strategies, they are defined as "*a conscientiously and intended organised series of what a learner does to efficiently meet a learning objective in a given social context"* (Gargallo, Suárez-Rodríguez & Pérez-Pérez, 2009:1). This concept assumes a dynamic perspective that places emphasis on the *strategic* use of different

procedures that are put into practice to learn (Gargallo et al, 2012). It is noteworthy that learning strategies are one of the most powerful constructs when it comes to explaining students' learning processes.

Gargallo's et al. classification (2009) of learning strategies defines two scales: *Affective strategies, of support and control* and the *Strategies related to information processing*. Different strategies exist in them both –see the Method section (Figure 1)- with up to 25 strategies at this level.

As the study carried out by García-Valcárcel and Tejedor (2015) well points out, the university students who are more successful academically acknowledge in ICT a greater support potential in their learning strategies as they help them with their academic assignments. The biggest differences between students with high and normal performance lie in the evaluations that they make of ICT to improve preparing assignments, organising their academic activity, their revision work, work with classmates and seeking resources. This implies that ICT should become a key factor for academic success.

Therefore, it is important to relate the cognitive strategies (related with information processing) that students put into practice when acquiring ICT competences. Mastering these skills entails students acquiring specific information strategies that relate with the use of these technologies (García-Valcárcel & Tejedor, 2015).

In short, students' learning strategies having an influence on their technological, pedagogical and ethical ICT can be expected, especially those related with information processing.

Method

Participants

The present study is based on a survey design whose population was university students who studied the following Education degrees: Pedagogy, Psychopedagogy, Social Education, Teacher Training, Speech Therapy, Physical Activity and Sports Sciences, and the Master's Degree in Secondary Education Teaching of the University of Valencia. The sample, which was obtained by accidental sampling, was made up of 646 university students, whose characteristics are found in Table 1.

Table 1. Characteristics of the sample in the key personal and contextual variables

Gender	Males (27.6%) | Females (72.4%)
Age	Mean age, 24.38 years [range 18-56] standard deviation: 7.055
Area the degree covers	Education (39.3%) • Primary education teaching (13.3%) • Pedagogy (13%) • Social Education (13%) Closest to education (41%) • Psychopedagogy (25.1%) • Master's degree in Secondary Education Teaching (15.9%) Furthest from education (19.7%) • Physical Activity and Sports Sciences (13.8%) • Speech Therapy (5.9%)
Having a computer at home	The whole sample had a computer with Internet connection at home.
Frequency of using a computer at home with Internet connection	• Never / Almost never (2.5%) • Sometimes (4.6%) • Almost always (23.5%) • Always (69.3%)

Instrument

The instrument employed to collect information was a questionnaire with two parts; part one was based on the Protocol to Evaluate Technological and Pedagogical Competences and in the personal and academic use of technological resources. This protocol was developed and analysed by Almerich, Suárez, Orellana and Díaz (2010a and 2010b) and by Suárez et al. (2010, 2012a and 2012b). This part was used to analyse university students' ICT competences from the technological, pedagogical and ethical competences areas (Díaz, 2015) to relate them with learning strategies, and in detail with those related with information processing and use. This instrument has two sections: students' characteristics, accessibility to computer equipment, ICT (technological, pedagogical and ethical) knowledge. The technological competences section (knowledge and skills in technological resources) comprises 44 items (Cronbach's α = .98). It is divided into four basic dimensions: Handling and Using a Computer, Basic Computer Applications, Presentations and Multimedia application, and ICT. The pedagogical competences section comprises 32 items (Cronbach's α = .92) and contains five dimensions: seeking information, work-production, communication, managing information, and collaboration. It is worth pointing out that the overall ethical competence is formed by five items (Cronbach's α = .85), and that the ethical and legal aspects that intervene in the training tasks students do by ICT are considered. In each dimension, items are arranged progressively, where the former correspond to more basic knowledge, and the latter to more advanced knowledge about technological resources. Items are measured on a 5-point Likert scale, whose meaning slightly adapts depending on the dimension.

The second part of the protocol corresponds to the Questionnaire to Evaluate University Students' Learning Strategies (CEVEAPEU in Spanish) of Gargallo et al. (2009). This instrument is arranged on two scales: one is based on Affective Strategies of Support and Control; the other is based on Information Processing strategies. The two scales are broken down into six subscales (motivational strategies, affective components, metacognitive strategies, context-based control strategies, information seeking and selection strategies, and information processing and use strategies), and into 25 strategies. This questionnaire comes as a Likert-type scale with five response options that range from "Completely disagree to "Completely agree".

Its structure, and the item number of each scale and subscale, are collected with the corresponding reliability data (see Table 2). The reliability of the complete questionnaire is α= 0.897. The Cronbach α of the first scale reliability is = 0.819, and is 0.864 for the second scale. The reliability of the 25 strategies used in the analyses ranges between 0.500 and 0.810, which is acceptable given the number of items in these strategies as many have a small number of them.

It presents suitable construct validity, as verified by two procedures; evaluation by experts and factorial analyses. It is true that the solutions in the latter for the two scales are probably not the most parsimonious from a methodological viewpoint if we bear in mind that the numerous factors obtained in some cases have a small number of items. This questionnaire has a good temporary consistency-stability index and a good predictive value of performance.

Table 2. Structure of the CEVEAPEU and the internal consistency data of the scales

Scale		Subscale	Strategies
Learning Strategies	Affective, support and control (or self-regulation) strategies (α=0.819) (53 items)	**Motivational Strategies** (α=0.692) (20 items)	Intrinsic Motivation (MOTIN) (α=0.500)
			Extrinsic Motivation (MOTEXT) (α=0.540)
			Task value (VALTAR) (α=0.692)
			Internal Attributions (ATRINT) (α=0.537)
			External Attributions (ATREXT) (α=0.539)
			Self-Efficacy and expectations (AUTOEFIC) (α=0.743)
			Conception of Intelligence as Modifiable (INTMOD) (α=0.595)
		Affective components (α=0.707)(8 items)	Positive physical state and mood (ESFIAS) (α=0.735)
			Anxiety Control (ANS) (α=0.714)
		Metacognitive strategies (α=0.738) (15 items)	Knowledge about objectives and evaluation criteria (CONOBJ) (α=0.606)
			Planning (PLAN) (α=0.738)
			Self-assessment (AUTOEV) (α=0.521)
			Control, self-regulation (CTLAUTRG1) (α=0.660)
		Strategies of context-based control, social interaction and handling resources (α=0.703) (10 items)	Context-based control (CRTLCTX) (α=0.751)
			Social interaction and learning with classmates' skills (HABIS) (α=0.712)
	Strategies related to information processing and use (α=0.864) (35 items)	**Information seeking and selection strategies** (α=0.705) (8 items)	Knowledge of sources and seeking information (CFBI) (α=0.685)
			Selecting information (SELINF) (α=0.630)
		Information processing and use strategies (α=0.821) (27 items)	Information acquisition (ADQINF) (α=0.677)
			Preparation (ELABINF) (α=0.739)
			Organisation (ORGINF) (α=0.810)
			Personalisation and creativity, critical thinking (PERCRE) (α=0.771)
			Storage. Mnemomics. Using mnemomic resources (ALMMEM) (α=0.765)
			Storage. Simple repetition (ALMSR) (α=0.691)
			Transfer. Using information (TRAUSOIN) (α=0.656)
			Handling resources to use acquired information (MANREC) (α=0.598)

Source: Taken from Gargallo et al., 2012, p.5

Procedure

The statistical analyses were done with the SPSS 17.0 software. We did univariate descriptive statistics to describe the general sample characteristics, and multiple regression analyses to establish the influence of the technological, pedagogical and the overall ethical competences of the four subscales on the Affective, Support and Control Strategies Scale and the ten Information Processing–related strategies on the dimensions. Finally, a categorical principal components analysis (CATPCA) was done to obtain a synthesis of the set of considered dimensions.

Results

The obtained results were arranged into three sections. In the first part, the characteristics of the analysed variables are described. In the second part, an explanation of the dimensions of the technological, pedagogical and global

ethical competences is provided with the four strategy subscales and the ten Information Processing-related learning strategies. The influence of the personal variables (Gender and Age) and the key contextual variables (area of the degree and Frequency of using a computer at home with Internet connection) was also considered.

Finally by means of a CATPCA, the dimensional structure reduced with the dimensions of the learning strategies and the indicators of competence were determined. The personal and key contextual variables considered are found here.

Basic characteristics of the considered dimensions

We found that the university students who studied degrees in the Education area (see Table 3) had a mean level of technological, pedagogical and ethical competences. The lowest levels went to ethical competences, at around level 3 on the scale. Their mastering of the four subscales of the learning strategies and of the Information Processing-related strategies was also of a mean level, and did not generally exceed 4 on the scale.

The dispersion of these dimensions was relatively moderate, except for Maintaining and Using a Computer (Technological Competence-TC), Basic Computer Applications (TC), Managing Information (Pedagogical Competence-PC), overall ethical competence, Preparing Information, Storage by Simple Repetition-Mnemomics and Using Mnemomic Resources.

Table 3. Descriptive characteristics of the dimensions of the Information Processing strategies (at the first level) and the other strategic dimensions (second level), along with the dimensions of the technological, pedagogical and overall ethical competences

	Mean	**Stand.Dev.**
Maintaining and using a computer (Technological Competence: TC)	3.39	.902
Basic computer applications (TC)	3.25	.802
Multimedia presentations (TC)	2.95	.756
ICT (TC)	3.09	.636
Seeking information (Pedagogical competence: PC)	4.06	.728
Work and production (PC)	3.30	.701
Communication (PC)	3.11	.763
Information management (PC)	3.49	.931
Collaboration (PC)	2.47	.752
Overall ethical competence	3.07	.916
Knowledge of sources and information seeking	3.36	.669
Selecting information	3.52	.564
Information acquisition	3.41	.740
Preparation	4.14	.785
Organisation	3.77	.702
Personalisation and creativity, critical thinking	3.61	.618
Storage. Mmemomics. Use of mnemomic resources	2.46	1.025
Storage. Simple repetition	3.71	.862
Handling resources to use acquired information	3.72	.750
Motivational strategies	3.68	.346
Affective Components	3.46	.545
Metacognitive strategies	3.60	.473
Context-based control, social interaction and handling resources strategies	3.84	.503

Explanation of the technological competence for Maintaining and Using a Computer (MANUSO) with learning strategies, and the key personal and contextual variables.

The prediction was significant ($p<0.01$) and explained 27.4% of the differences observed for the maintenance and using a computer dimension (with the adjusted R^2).

The learning strategies that contributed to the proposed model (see Table 3) were Knowledge of sources and Seeking Information, Selecting Information, Storage by Simple Repetition and Metacognitive Strategies. It is worth stressing that Gender, Age and Frequency of using a computer with Internet connection contributed to the key personal variables.

Frequency of using a computer with Internet connection, Knowledge of Sources, Seeking Information and Selecting Information contributed the most and directly to the prediction. Conversely, Gender, Age and the Metacognitive and Storage by Simple Tepetition strategies were found. To interpret gender, it was necessary consider that the coding value in the database, which was determined for male students, was lower than the value for female students. So the negative sense in this case indicated that male students showed greater technological competence in maintaining and using a computer.

Table 4. The regression model components for learning strategies, and the personal and contextual variables in the MANUSO dimension of the Technological Competence

	Technological competence dimension (Maintaining and Using a computer)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.205	4.359	**.000**
Selecting information	.144	3.209	**.001**
Information acquisition	.008	.188	.851
Preparation	-.094	-1.852	.065
Organisation	.030	.675	.500
Personalisation and creativity, critical thought	.061	1.252	.211
Storage. Simple repetition	-.107	-2.593	**.010**
Storage. Mnemomics. Using mnemonic resources	.046	1.053	.293
Handling resources to use acquired information	-.40	-.929	.354
Transfer. Using information	-.030	-.633	.527
Motivational strategies	.027	.624	.533
Affective components	-.062	-1.510	.132
Metacognitive strategies	-.120	-2.344	**.019**
Strategies of context-based control, social interaction and handling resources	.050	1.003	.317
Gender	-.294	-7.043	**.000**
Age	-.123	-3.045	**.002**
Area the degree covers	-.013	-.331	.740
Frequency of using a computer with Internet connection	.295	7.577	**.000**

Explaining the technological competence about Basic Computer Applications (APLIBAS) with learning strategies, and the key personal and contextual variables.

A significant model (P<0.01) was obtained for the prediction for the basic computer applications dimension, which explained 14.2% of the differences observed (with the determination coefficient).

The variables that significantly contributed to the proposed model (see Table 5) were Knowledge of Sources and Seeking Information, Selecting Information, Gender and Frequency of using a computer with Internet connection. Knowledge of sources and Seeking Information, Frequency of using a computer with Internet connection and selecting information contributed the most to the prediction, as did Gender, but inversely (see Table 5).

Table 5. Components of the regression model in learning strategies, and the personal and contextual variables in the APLIBAS dimension of technological competence

	Technological competence dimension (Basic Computer Applications)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.197	3.861	**.000**
Selecting information	.117	2.405	**.017**
Information acquisition	-.021	-.434	.665
Preparation	-.051	-.931	.352
Organisation	.084	1.721	.086
Personalisation and creativity, critical thinking	-.033	-.614	.540
Storage. Simple repetition	-.034	-.760	.448
Storage. Mnemomics. Using mnemonic resources	.086	1.792	.074
Handling resources to use acquired information	-.010	-.217	.829
Transfer. Use of the information	.055	1.054	.292
Motivational Strategies	-.033	-.687	.492
Affective Components	-.022	-.496	.620
Metacognitive strategies	-.033	-.593	.554
Strategies of context-based control, social interaction and handling resources	.049	.904	.366
Gender	-.221	-4.872	**.000**
Age	-.013	-.295	.768
Area the degree covers	.019	.444	.658
Frequency of using a computer with Internet connection	.192	4.539	**.000**

Explaining the technological competence about Multimedia Presentations (MULTPRES) with learning strategies and the key personal and contextual variables

For the prediction of the technological competence dimension Multimedia Presentations, a significant model was obtained (p<0.01) that explained 23.2% of the differences found (with the adjusted R^2).

The variables that significantly contributed to the proposed model (see Table 6) were Knowledge of Sources and Seeking Information, Selecting Information, Storage-Mnemomics-Using Mnemonic Resources,

Gender, Age and Frequency of using a computer with Internet connection.

The variables that directly contributed to the model (see Table 6) were Frequency of using a computer with Internet connection, Knowledge of Sources, Seeking Information, Selecting Information and Storage-Mnemomics-Using Mnemonic Resources. Variables Gender and Age contributed inversely to the prediction of the competences area of Multimedia Presentations (which implied a greater level of competence in male and younger students).

Table 6. The regression model components for learning strategies, and for personal and contextual variables, on the MULPRES dimension of the technological competence

	Technological competence dimension (Multimedia Presentations)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.224	4.640	**.000**
Selecting information	.137	2.963	**.003**
Information acquisition	-.035	-.772	.440
Preparation	-.035	-.667	.505
Organisation	.085	1.836	.067
Personalisation and creativity, critical thinking	-.027	-.529	.597
Storage. Simple repetition	.034	.807	.420
Storage. Mnemomics. Using mnemomic resources	.111	2.439	**.015**
Handling resources to use acquired information	-.029	-.636	.525
Transfer. Using information	.065	1.333	.183
Motivational strategies	-.002	-.042	.966
Affective Components	-.060	-1.431	.153
Metacognitive strategies	-.070	-1.340	.181
Strategies of context-based control, social interaction and handling resources	.025	.488	.625
Gender	-.198	-4.604	**.000**
Age	-.241	-5.791	**.000**
Area the degree covers	.028	.684	.494
Frequency of using a computer with Internet connection	.238	5.935	**.000**

Explaining the technological competence about ICT (MULTPRES) with learning strategies and the key personal and contextual variables

For the prediction of ICT competence dimension, a significant model ($p<0.01$) was obtained that explained 22% of the differences found (with the adjusted R^2).

The variables that significantly contributed to the prediction (see Table 7) were Knowledge of Sources and Seeking Information, Selecting Information, Storage-Mnemomics-Using Mnemomic Resources, Affective Components, Gender, Age and Frequency of using a computer with Internet connection.

Table 7. The regression model components for learning strategies, and for personal and contextual variables, on the ICT dimension of the technological competence

	Technological competence dimensión (ICT)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.215	4.421	**.000**
Selecting information	.128	2.756	**.006**
Information acquisition	-.006	-.136	.892
Preparation	-.007	-.141	.888
Organisation	.074	1.592	.112
Personalisation and creatity, critical thought	-.075	-1.489	.137
Storage. Simple repetition	-.014	-.319	.750
Storage. Mnemomics. Using mnemomic resources	.118	2.585	**.010**
Handling resources to use acquired information	-.015	-.337	.736
Transfer. Using information	.023	.469	.639
Motivational strategies	.041	.906	.366
Affective components	-.106	-2.499	**.013**
Metacognitive strategies	-.108	-2.037	**.042**
Strategies of context-based control, social interaction and handling resources	.015	.288	.773
Gender	-.185	-4.265	**.000**
Age	-.226	-5.372	**.000**
Area the degree covers	.018	.427	.670
Frequency of using a computer with Internet connection	.250	6.194	**.000**

The learning strategies that directly contributed were: Knowledge of Sources and Seeking Information, Selecting Information and Storage-Mnemomics-Using Menomic Resources. Similarly, Frequency of using a computer with Internet connection contributed to the prediction. Age, Gender and Metacognitive Strategies contributed to the proposed model, but inversely.

Explaining the pedagogical competence about Seeking Information (CP_BI) with learning strategies and the key personal and contextual variables

For the prediction of the Seeking Information competence area (CP_BI), a significant model was obtained ($p<0.01$), which explained 7.3% of the differences observed (from the coefficient of determination).

Gender, Age and Frequency of using a computer with Internet connection were those that significantly contributed to the prediction of the seeking information competence dimension (see Table 8). Indeed it was Frequency of using a computer with Internet connection that contributed the most to this prediction. Both Gender and Age did so, but inversely (this meant that females showed greater competence and older students presented a lower level of competence in Seeking Information).

Table 8. The regression model components for learning strategies, and for personal and contextual variables, on the CP_BI dimension of the pedagogical competence

Dimension	Pedagogical competence dimension (Seeking Information)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.038	.709	.479
Selecting information	-.030	-.600	.549
Information acquisition	.070	1.407	.160
Preparation	.067	1.164	.245
Organisation	.082	1.625	.105
Personalisation and creatity, critical thought	.057	1.039	.299
Storage. Simple repetition	.020	.429	.668
Storage. Mnemomics. Using mnemomic resources	.061	1.230	.219
Handling resources to use acquired information	.070	1.413	.158
Transfer. Using information	.024	.437	.663
Motivational strategies	.003	.055	.956
Affective components	.022	.475	.635
Metacognitive strategies	-.058	-1.000	.318
Strategies of context-based control, social interaction and handling resources	.049	.884	.377
Gender	-.142	-3.002	**.003**
Age	-.108	-2.358	**.019**
Area the degree covers	-.050	-1.101	.271
Frequency of using a computer with Internet connection	.103	2.348	**.019**

Explaining the pedagogical competence about Work and Production (CP_TraPro) with learning strategies and the key personal and contextual variables

For the prediction of the Work and Production competence, a significant model $p<0.01$) was obtained that explained 15.5% of the differences found (with the adjusted R^2).

The learning strategies that significantly contributed (see Table 9) to the prediction were Knowledge of Soruces, Seeking Information, the Strategies of Context-based Control, Social Interaction and Handling Tesources. Age (see Table 9) also contributed, but inversely (the older students were, the lower their level of competence).

Table 9. The regression model components for learning strategies, and for personal and contextual variables, on the CP_TraPro dimension of the pedagogical competence

	Pedagogical competence dimension (Work and Production)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.137	2.698	**.007**
Selecting information	.046	.939	.348
Information acquisition	.048	1.016	.310
Preparation	.000	-.014	.989
Organisation	.052	1.071	.285
Personalisation and creatity, critical thought	.035	.667	.505
Storage. Simple repetition	.066	1.485	.138
Storage. Mnemomics. Using mnemomic resources	.031	.651	.515
Handling resources to use acquired information	.041	.868	.386
Transfer. Using information	-.001	-.020	.984
Motivational strategies	-.013	-.268	.789
Affective components	-.075	-1.709	.088
Metacognitive strategies	-.004	-.071	.943
Strategies of context-based control, social interaction and handling resources	.146	2.731	**.007**
Gender	-.022	-.488	.626
Age	-.117	-2.685	**.007**
Area the degree covers	.025	.567	.571
Frequency of using a computer with Internet connection	.209	4.967	**.000**

Explaining the pedagogical competence about Communication (CP_COM) with learning strategies and the key personal and contextual variables

For the prediction of the Communication dimension, a significant model ($p<0.01$) was obtained, which explained 16.2% of the differences found (with the adjusted R^2).

The variables that significantly contributed to the prediction (see Table 10) were Storage by Simple Repetition, Age, Frequency of using a computer with Internet connection and Area the Degree Covers. In this case, Age did so, but inversely (the older students were, the lower their level of competence).

Table 10. The regression model components for learning strategies, and for personal and contextual variables, on the CP_COM dimension of the pedagogical competence

	Pedagogical competence dimension (Communication)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.084	1.666	.096
Selecting information	.064	1.328	.185
Information acquisition	-.057	-1.213	.226
Preparation	.126	2.308	.021
Organisation	.078	1.620	.106
Personalisation and creatity, critical thought	-.015	-.279	.780
Storage. Simple repetition	.103	2.325	**.020**
Storage. Mnemomics. Using mnemomic resources	.060	1.266	.206
Handling resources to use acquired information	-.021	-.443	.658
Transfer. Using information	-.038	-.736	.462
Motivational strategies	.063	1.334	.183
Affective components	-.005	-.111	.912
Metacognitive strategies	-.039	-.714	.475
Strategies of context-based control, social interaction and handling resources	.026	.481	.631
Gender	-.037	-.833	.405
Age	-.233	-5.354	**.000**
Area the degree covers	.091	2.106	**.036**
Frequency of using a computer with Internet connection	.218	5.193	**.000**

Explaining the pedagogical competence about Information Management (CP_GI) with learning strategies and the key personal and contextual variables

For the prediction of the Information Management competence dimension, a significant model ($p<0.01$) was obtained that explained 26.4% of the differences observed (with the adjusted R^2). The learning strategies that contributed to this prediction (see Table 11) were Knowledge of Sources and Seeking Information, Selecting Information and Organisation, as well as Gender and Frequency of using a computer with Internet connection. Frequency of using a computer with Internet connection and Selecting Information contributed more to this prediction, followed by Knowledge of Soruces and Seeking Information, Gender and Organisation.

Table 11. The regression model components for learning strategies, and for personal and contextual variables, on the CP_GI dimension of the pedagogical competence

	Pedagogical competence dimension (Information Management)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.176	3.725	**.000**
Selecting information	.202	4.473	**.000**
Information acquisition	-.041	-.933	.351
Preparation	-.051	-.996	.320
Organisation	.097	2.137	**.033**
Personalisation and creatity, critical thought	-.064	-1.296	.195
Storage. Simple repetition	-.038	-.910	.363
Storage. Mnemomics. Using mnemomic resources	.018	.415	.678
Handling resources to use acquired information	.063	1.417	.157
Transfer. Using information	-.011	-.236	.813
Motivational strategies	.058	1.325	.186
Affective components	-.045	-1.097	.273
Metacognitive strategies	.019	.378	.706
Strategies of context-based control, social interaction and handling resources	.066	1.333	.183
Gender	.123	2.911	**.004**
Age	.009	.213	.831
Area the degree covers	.027	.654	.513
Frequency of using a computer with Internet connection	.302	7.683	**.000**

Explaining the pedagogical competence about Collaboration (CP_COL) with learning strategies and the key personal and contextual variables

For the prediction of the Collaboration competence dimension, a significant model ($p<0.01$) was obtained that explained 24.5% of the differences found (with the adjusted R^2). The learning strategies that contributed to this prediction (see Table 12) were Knowledge of Sources and Seeking Information, Organisation and Handling Resources to Use Acquired Information, while Frequency of using a computer with Internet connection was much more relevant for the Collaboration competence.

Table 12. The regression model components for learning strategies, and for personal and contextual variables, on the CP_COL dimension of the pedagogical competence

	Pedagogical competence dimension (Collaboration)		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.148	3.093	**.002**
Selecting information	.078	1.708	.088
Information acquisition	.014	.308	.758
Preparation	-.015	-.299	.765
Organisation	.090	1.970	**.049**
Personalisation and creatity, critical thought	-.019	-.391	.696
Storage. Simple repetition	.007	.177	.859
Storage. Mnemomics. Using mnemomic resources	.079	1.748	.081
Handling resources to use acquired information	.101	2.263	**.024**
Transfer. Using information	.059	1.209	.227
Motivational strategies	.044	.987	.324
Affective components	-.063	-1.510	.132
Metacognitive strategies	.060	1.162	.246
Strategies of context-based control, social interaction and handling resources	.049	.968	.334
Gender	-.008	-.196	.845
Age	-.021	-.519	.604
Area the degree covers	.028	.685	.494
Frequency of using a computer with Internet connection	.262	6.585	**.000**

Explaining the overall ethical competence with learning strategies and the key personal and contextual variables

For the prediction of the overall ethical competence dimension, a significant model ($p<0.01$) was obtained that explained 17.8% of the differences found (with the coefficient of determination). The learning strategies that contributed to this prediction (see Table 12) were Selecting Information, Personality and Creativity, Storage by Simple Repetition. Gender and Frequency of using a computer with Internet connection also contributed. Personality and Creativity, Gender and Storage by Simple Repetition contributed the most to this prediction. Selecting Information and Frequency of using a computer with Internet connection did so, but inversely. It was noteworthy that Frequency of using a computer with Internet connection showed an inverse relation with the ethical competence, which was the opposite to that observed for the previously analysed competence dimensions.

Table 13. The regression model components for learning strategies, and for personal and contextual variables, on the overall ethical competence

	Overall ethical competence		
	Beta-typified quotients	t	Sig.
Knowledge of sources and seeking information	.086	1.667	.096
Selecting information	-.148	-3.004	**.003**
Information acquisition	.106	1.938	.053
Preparation	-.028	-.585	.559
Organisation	-.050	-1.039	.299
Personalisation and creatity, critical thought	.147	2.788	**.006**
Storage. Simple repetition	.105	2.333	**.020**
Storage. Mnemomics. Using mnemomic resources	.042	.889	.375
Handling resources to use acquired information	-.020	-.425	.671
Transfer. Using information	-.109	-2.118	.035
Motivational strategies	.061	1.287	.199
Affective components	-.004	-.100	.920
Metacognitive strategies	.032	.583	.903
Strategies of context-based control, social interaction and handling resources	-.006	-.122	.096
Gender	.125	2.610	**.009**
Age	.020	.422	.673
Area the degree covers	-.026	-.589	.556
Frequency of using a computer with Internet connection	-.184	-4.014	**.000**

Dimensional structure from mastering the six subscales of the learning strategies, and from the university students' technological, pedagogical and overall ethical competences, and their relation with the personal and contextual factors

In this section, a CATPCA was carried out in which the structure of the dimensions was obtained with the university students' mastery of learning strategies, and with the dimensions of the technological, pedagogical and overall ethical competences, and Age. This structure also included the centroids that corresponded to the personal and contextual factors (Gender, Area that the academic degree covers and Frequency of using a computer with Internet connection). Two dimensions were obtained (see Table 13), which explained 38.9% of total variance, supported by the scree-test criterion (see Figure 1).

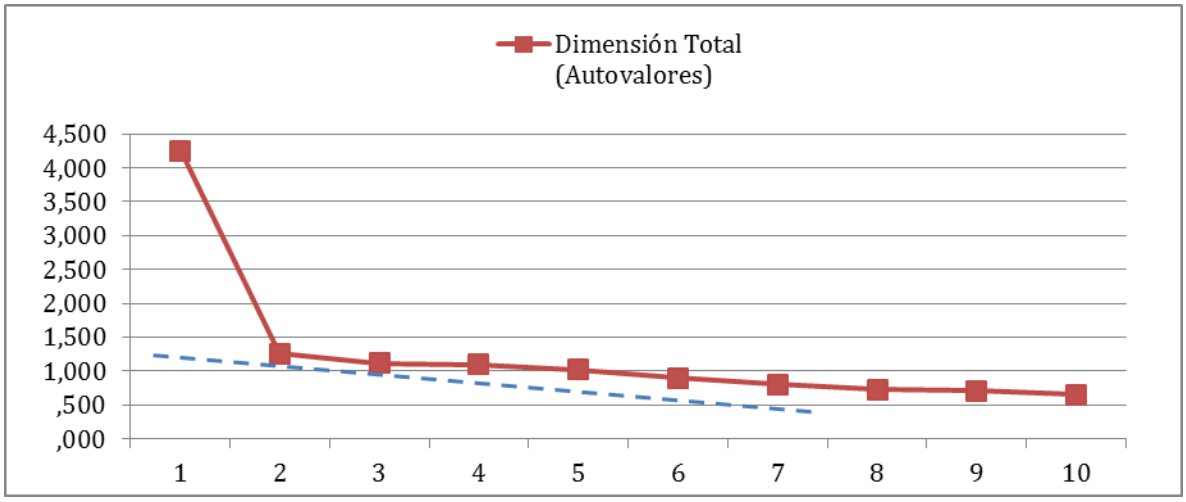

Figure 1. Scree-test with the self values of the components

The first dimension was the more relevant of the two (see Table 14) (self value of 6.632, 57.27% of explained variance, and Cronbach's α of 0.886). In this function, most dimensions were in the positive part, except for the Storage by Simple Repetition strategy, which was a *negative* strategy compared to the rest of the set (see Figure 2).

Table 14. Summarised Model

Dimension	Cronbach's α	Explained variance Total (Self values)	Percentage
1	.886	6.632	55.27%
2	.708	3.109	25.91%
Total	.936[a]	9.741	81.18%

Conversely, the second dimension established the clearly differentiated competence and strategy areas. The most positive part was where the Technological Competence dimensions were found, along with the Pedagogical Competences with a lower level, but in the same upper right-hand quadrant. The overall ethical competence dimension was found in the negative part, along with the rest of the learning strategy dimensions. Differention was found by a set of Knowledge of Sources and Seeking Information and Selecting Information in the same area as the overall ethical competence, which were all in the upper part of the quadrant.

For the considered personal and contextual variables, students' Age was slightly positioned in the lower lefthand quadrant, and contrasted considerably to the other technological competence dimensions and, to a lesser extent, to the pedagogical dimensions. In short, it came closer to the generality of the learning strategies and also to the overall ethical competence.

Male students were more inclined to the technological competence, and at a lower competence level than females, and were also inclined to pedagogy, but to a lesser extent. Male students went against the set of learning strategy dimensions, which implied a less positive strategic profile for male students than that of female students.

The degrees that were closest to the Education field showed a better level of competence for all the dimensions in general, and a better mastery of the technological and

pedagogical competences. The degrees that belonged to the Education field displayed a somewhat lower level of strategies and competences than the previous ones, and were mostly linked by learning strategies in general. The degrees that were furthest from the Education field obtained lower levels for all the considered dimensions, regardless of them being of the competence or strategy kind.

Frequency of using a computer with Internet connection consistently scored with all the competence- or strategy-type dimensions, and was seen as a clearly linked key to them all. All in all, higher levels of use were inclined more to the technological and pedagogical competence dimensions than to the other strategic dimensions.

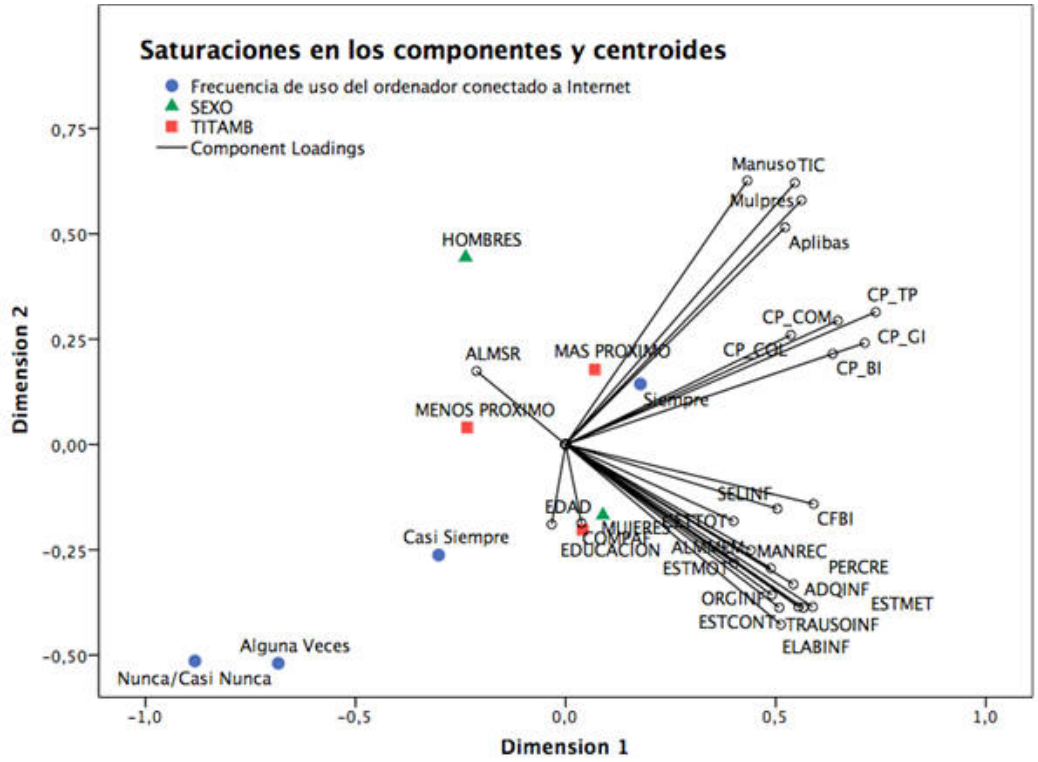

Figure 2. Representation of Dimensions 1 and 2 and the centroids of the considered personal and contextual dimensions

Conclusions

The obtained results indicate that learning strategies influence technological, pedagogical and ethical competences. It is noteworthy that this influence is independent of that due to the key personal and contextual variables.

The learnings strategies that most conditioned the technological and pedagogical dimensions are related with Information Processing, apart from the very relevant influence of the key personal and contextual variables (Gender, Age and Frequency of use).

The overall ethical competence is best explained by the information-related learning strategies, and also by the other four strategic subscales (Motivational, Affective Components, Metacognitive, and the Strategies of Context-based Control, Social Interaction and Handling Resources).

This consideration is reasserted by the CATPCA as Age appears to contrast to the technological competence, and male students display a greater mastery of the technological domain. Something similar can be stated for Frequency of using technologies, where the *Always* category is the most closely linked to the technological competences, but not so much to the pedagogical ones.

The students' degrees that strictly belong to the education field show greater strategic mastery and a higher level of ethical competence. The degrees that were closest to the Education field tend to be more inclined to the technological and pedagogical competences. Those furthest away from the Education field present a lower level for all three considered competence fields.

Female students present a better strategic level than their male counterparts for the Affective-Emotive Strategies of Support and Control (Motivational, Affective, Metacognitive, and Context-based Control and Interaction and Handling Resources) and in Information Processing and Use (Seeking and Selecting Information, and Processing Information and Use). Male students show a weaker strategic level and tend to be inclined to *superficial* strategies. These indications agree with findings reported in other research works (Cano, 2000; Grimes, 1985; González-Pumariega & García, 1995; Martín del Buey & Camarero, 2001; Núñez, González-Pienda, García-Rodríguez), which were obtained with other measuring instruments.

Age is related with technological competence and learning strategies. This fact extends the results obtained by Díaz (2015). An inverse trend is seen in most technological competence dimensions, where the group with the lowest level of competence is found as Age increases. Surprisingly in relation to other findings indicated in the literature (Almerich, Suárez, Orellana, Belloch, Bo & Gastaldo, 2005; EADETWA, 2007; IEAE, 2007; Russell et al. 2000; Sigalés et al., 2008; Suárez-Rodríguez, Almerich, Gargallo & Aliaga, 2013), the ethical competence shows that Age has no significant influence. This fact should lead to us explore the perspective in more detail because, once again, we find a clear indication from *cohort-guided* considerations to explain most technology-related questions (Bullen et al., 2009; Jones & Healing, 2010; Kennedy et al, 2008; van der Breemt, Akkerman & Simons, 2011).

The tendency observed for Frequency of using a computer with Internet connection reveals that the more it is used, the higher the technological and pedagogical competence level. This fact coincides with previous studies (Almerich et al., 2010a; Almerich, Suárez, Jornet & Orellana, 2011b; IEAE, 2007; Muir-Herzig, 2004; Sigalés et al. 2008; Suárez et al., 2010; Suárez et al, 2012a y 2012b; Tondeur, Van Braak & Valcke, 2007; Van Braak, Tondeur & Valcke, 2004). Nonetheless, the obtained results stress the relation by indicating that this use affects the ethical competence to a lesser extent compared to the technological competence, and affects more significantly, students' development of the series of learning strategies. This clear divergence leads us to review and wonder about the origin of this separation between technological elements and learning strategies, and agrees with the study of Verhoeven, Heerwegh and De Wit (2012). These authors found a weak link between learning styles and ICT competences for first-year university students, and that the non-integration of the two areas (technological and learning) made the education process weaker, and also made the enrichment that their overlapping provides difficult. And all this to a greater extent because the students who were analysed in that experiment studied in the Education field and had, therefore, many possibilities of playing an active role in different parts of the future Education system. It therefore indicates the need to establish a change in the guidelines of educational policies, and in the way work is done and arranged through the whole education system (Almerich et al., 2011; Suárez el al., 2012).

Certain evidence exists for the connection of teaching guidelines and student learning, and for the learning strategies that students put into practice and are reinforced during the learning process. Gargallo et al. (2012) indicated the need to work with the teaching method in classrooms to bring about positive changes since several proposals have backed the importance of this consideration (Biggs & Tang, 2007; Entwistle, 2009; Gargallo, 2008;

Gargallo, Garfella, Pérez & Fernández, 2010; Hounsell & Hounsell, 2007; McCune & Entwistle, 2011). Finally, it is worth stressing that suitable ICT use should enable the possibility of not only *doing things better*, but of *doing better things* in order to enrich teaching-learning processes (Reilly, 2005).

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