

Full length article

## Undergraduate students' perspectives on digital competence and academic literacy in a Spanish University

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### Abstract

Recent studies show that students' digital competence is part of a process of academic literacy that requires the development of information and ICT literacies. This article attempts to analyse digital competence and the development of information and ICT literacies in relation to academic literacy practices which take place in the learning process in undergraduate studies. Data were collected through completion of self-report questionnaires asking about the writing and reading practices and the process of literacy development in university students. The survey was completed by a sample of 786 students in the School of Education. The data obtained were analysed using the techniques of principal components analysis and discriminant analysis. The results describe the ICT and information literacies in literacy practices of the participants, and their relation to the academic literacy process that takes place at university. The results have allowed us to assess the processes for the development of ICT and information literacies and their relationship to academic literacy. Our study indicates a wide gap between digital competence developed in informal learning contexts and its scarcity in university literacy practices (formal learning settings). In general, Spanish University academic practices do not incorporate ICT and information literacies processes as a part of students' academic literacy. Deficient ICT and informational literacies may lead to difficulties in the professional development of teachers.

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**Keywords:** Higher education; Digital competence; Academic literacy; Information literacy; Computer/ICT literacy

## 1 Introduction

In recent decades, the daily use of ICT has changed literacy practices in our society ([Ala-Mutka et al., 2009](#); [Gillen, 2014](#); [Snyder, 2001](#)), in general, and in undergraduate students, in particular ([Barton, 2001](#); [Crook, 2005](#)). Digital media also display changes in reading and writing practices at university with new forms of communication ([Satchwell & Ivanič, 2007](#)). The use of digital media requires a new pedagogy ([Cope & Kalantzis, 2009](#)) in order to develop digital competence within academic literacy ([Johnston & Webber, 2003](#); [Lea & Jones, 2011](#)).

Academic literacy ([Lea & Street, 1998, 2006](#); [Thesen & Cooper, 2014](#); [Wingate, 2015](#)) in a university setting (i.e. the concepts and strategies required to participate in an academic community) has been facing a new challenge in the last two decades ([Gee, 2000](#); [Lea & Jones, 2011](#); [Merchant, Gillen, Marsh, & Davies, 2013](#); [New London Group, 1996](#)). The social and cultural changes that have taken place in the 1990's up to the present have led to a more diverse student population and therefore more diverse learning needs in the context of higher education ([Goodfellow & Lea, 2013](#)). The use of the internet in various private and professional fields has aroused great interest in the field of digital competence in educational programmes and the teaching and learning processes at university ([Goodfellow, 2011](#); [Lea, 2013](#); [Säljö, 2010](#)).

## 2 Theoretical framework

Communication in the current social context is dynamic and involves situated literacy events ([Barton & Lee, 2013](#)) in different domains such as at school, at home or between peers ([Lillis, 2001](#)). The various elements of the

discourse such as the mode (linguistic, visual, gestural, spatial or auditory) or the genre (an email, a report etc.) play an important role in redefining a new communicative framework in a social context and, therefore, at university (Kress, 2003).

In our inquiry, we investigated the use of digital competence in a university setting and its relationship to the development of academic literacy. "Digital" refers to activities related to new information and communications media (Goodfellow, 2011). We define "competence" as the set of knowledge, skills and attitudes that are necessary for personal and professional development in different contexts. In this article, "digital competence" is understood as:

(...) the set of knowledge, skills, attitudes, abilities, strategies, and awareness that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socializing, consuming and empowerment (Ferrari, 2012, p. 30).

This concept of digital competence considers learning both in the academic domain, as part of institutional literacy practices in a university, and in the social domain where informal learning and hybrid vernacular literacies play an important role (Meyers, Erickson, & Small, 2013). Hybrid vernacular literacies are a result of the interaction between literacy practices that occur in different domains, which arise in daily life and beyond the cultural practices of institutions (Barton & Hamilton, 1998). Domains are settings, spaces and cultural beliefs where literacy events are practised (Pahl & Rowsell, 2012). In conclusion, digital competence develops in various domains (at home, among peers, in academic or professional settings) that interact with each other (Scribner & Cole, 1981) as Fig. 1 shows.

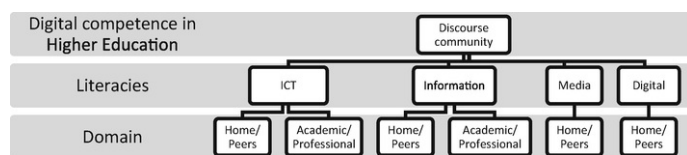


Fig. 1 Domains and literacies of discourse communities in Higher Education.

Source: Adaptation of Pourbaix (The reference is: Pourbaix, R. (2000). *Emergent literacy practices in an electronic community*. In Barton, D., Hamilton, M., & Ivanic, R., *Situated Literacies. Reading and Writing in Context* (pp. 125-148). London and New York: Routledge.) (2000) and Ala-Mutka (2011).

alt-text: Fig. 1

The social domains (home, peers and so on) develop several literacies, especially media and digital literacies. Media literacy is defined as the ability to understand, interpret, recreate and assess different media (Buckingham, 2007) and digital literacy is the technical ability to use the computer and internet (Ala-Mutka, 2011).

Taking this into account, our research has focused on digital competence in higher education. Figure one shows the different literacies that make up digital competence, and the domains in which it is developed. Beetham, McGill, and Littlejohn (2009), Goodfellow (2011), and Newman (2008) have suggested that information and ICT literacies are the most representative of digital competence in the academic domain. Information literacy includes the ability to search for, select, analyse, organize and communicate information effectively, as defined by the American Library Association (1989) and by the Chartered Institute of Library and Information Professionals (CILIP, 2012), while ICT literacy includes the set of skills and knowledge related to the ICT industry (Beetham et al., 2009).

Digital competence can be reconceptualised regarding academic literacy in a university setting. The development of digital competence should not only focus on individual skills (Buckingham, 2008; Lankshear & Knobel, 2011), but also on the ability of the academic institution to integrate the individual into a cultural and social practice like the academic discourse community (Lea, 2013; Maybin, 2000). This discourse community is composed of a group of people who recognize, interpret and produce common discourse and literacy practices (Barton, 1994; Hyland, 2009; Swales, 1990).

This academic discourse community is dissociated from informal and professional digital practices (Goodfellow, 2011; Meyers et al., 2013). It draws on the learning process of undergraduate students where academic practices interact with hybrid vernacular ones (Fairclough, 1992; Gregory & Williams, 2000; Ivanič et al., 2009; Maybin, 2007; Satchwell & Ivanič, 2007), and where multimodal reading and writing - with their different literacies (visual, verbal, etc.) - have the same relevance and interest (Kress & Van Leeuwen, 2001; Kress, 2010).

In the light of the characteristics of current academic literacy described above, we pose the following research questions related to the digital competence developed by undergraduate students, focusing on two bachelor degree programmes in one Spanish university:

- a. What are the characteristics of digital competence of undergraduate students in one Spanish University?
- b. What are the literacy practices of students and which practices do they use to develop digital competence at university?

c. Is digital competence integrated into academic writing and reading tasks?

d. Do the academic practices of undergraduate students incorporate ICT and information literacies developed in informal learning contexts?

## 3 Methodological framework

### 3.1 Sample

The convenience sample in our study was composed of students from the academic courses 2012/13 and 2013/14 of two undergraduate degree programmes. This form of sampling involves selecting the most readily available respondents, regardless of characteristics, until the sample size has been achieved (Dwyer et al., 2009; Özdemir, St. Louis, & Topbaş, 2011). All the students on both programmes were invited to participate in this study. In the case of the Degree in Early Childhood Education the sample consisted of 354 students out of a population of 480 students (sampling error of 2.67 for a confidence level of 95%) and in the case of the Degree in Primary Education, the sample was 432 students out of a population of 1200 (sampling error of 3.8 for a confidence level of 95%). 73.9% of the students were aged between 18 and 21. Most participants (68.5%) had attended high school, followed by 25.2% that had come from an upper-level certificate in Vocational Training and 2.9% from other university degrees or diplomas. 80.2% were not working and, of those who were, 10.2% were employed in education-related activities. Over 90% of the participants were female, reflective of Spanish Schools of Education where women represent the majority of students. According to the figures of the [Instituto Nacional de Estadística \(2016\)](#), in Spain 97.7% of teachers in preschool and 81.0% in primary education are women.

All the participants in the current research were adults and all of them were informed about the nature of the study and the conditions of their participation. Participation was voluntary and followed the informed-consent rules, which restricts the use of information to research purposes only, and assures both anonymity and confidentiality. This paper has followed the internal regulation in Social Sciences by the Ethical Committee of Experimentation of the University of Seville.

### 3.2 Research instruments

Data were collected using a reduced version of a self-report questionnaire and it was completed online (available at <https://es.surveymonkey.com/r/K6H3NJR>). The items were assessed with a Likert scale from 1 (never) to 6 (always). The whole instrument was created from the New Literacy Studies approach (Barton & Hamilton, 1998; Baynham, 1995; Gee, 1990; Street, 1995); it consisted of 39 questions (146 items) clustered in five dimensions: personal literacy (reading), personal literacy (writing), cultural consumption, library culture and undergraduate academic literacy. A brief description of these dimensions can be found in [Table 1](#). A non-metric multidimensional scaling (PROXSCAL) was performed to determine the construct validity of the self-report. The four values that measure the misalignment of the stress data or statistics collected are close to zero and the two measurements that measure the adjustment are close to one (Dispersion Accounted For or DAF and Tucker Consistency Coefficient or TCC). The results reported in [Table 1](#) are very good indicators of adjustment (Biencinto, Carpintero, & García-García, 2013) and confirm the existence of the five proposed dimensions in the structure of the questionnaire and its foundation in the New Literacy Studies approach (see [Table 1](#)).

**Table 1** Questionnaire dimensions.

alt-text: Table 1

Source: From [Authors \(2017\)](#).

Dimension	Cronbach's Alpha	Stress measurements				Adjustment measurements	
		Ngs <sup>a</sup>	Stress I	Stress II	S-Stress	D.A.F.	TCC
<b>Personal Literacy (Reading)</b> Individual reading in different domains of non-formal and informal learning.	0.81	0.05	0.22	0.47	0.15	0.95	0.98
<b>Personal Literacy (Writing)</b> Individual writing in different domains of non-formal and informal learning.	0.80	0.03	0.17	0.38	0.06	0.97	0.99
<b>Cultural Consumption</b> Social practices in which reading and writing are present in different places related to the purchase/sale of literate products.	0.74	0.03	0.16	0.35	0.07	0.97	0.99
<b>Library Culture</b> Social practices in which reading and writing are present in different locations, such as the use of public or private libraries.	0.77	0.05	0.23	0.49	0.10	0.95	0.97

<b>Undergraduate Academic Literacy</b> Social practices in which reading and writing are present in different places of formal learning.	0.93	0.06	0.25	0.51	0.15	0.94	0.97
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<sup>a</sup> ~~Note~~. Ngs: Normalized gross stress.

In order to research the digital competence of undergraduate students, 10 main questions, with several sub-questions, each one related to information literacy and ICT literacy were chosen (see [Table 2](#)). The internal consistency or reliability of the items of information literacy and ICT literacy was calculated. Cronbach's Alpha for information literacy was 0.75 and 0.72 for ICT literacy. [Nunnally and Bernstein \(1994\)](#) reported about the acceptable values of alpha from 0.70. However if Cronbach's Alpha is too high it may suggest that some items are redundant. A maximum Cronbach's Alpha value of 0.90 has been recommended by [Streiner \(2003\)](#).

**Table 2** Percentage distribution, standard means and deviations of university students' scores in Digital Competence (information literacy).

alt-text: Table 2

	Never 1	2	3	4	5	Always 6	Mean	SD
<b>When reading on the net, the students tend to interpret the text better when there is...</b>								
Only a written text	5.2	16.3	24.9	31.7	15.5	5.0	3.52	1.23
The written text is accompanied by an image or an audio-visual element	0.9	3.1	7.8	23.4	38.8	25.1	4.73	1.07
A link to other pages	6.7	15.1	28.2	26.2	16.0	3.3	3.41	1.24
<b>When beginning to read a text, do you read the document...?</b>								
Completely	2.4	6.4	13.6	23.4	32.2	20.6	4.40	1.27
A fragment or part of the text	8.8	17.2	20.5	29.3	17.4	3.1	3.40	1.30
With a quick or superficial overview	15.5	22.0	23.0	18.6	10.9	3.7	2.98	1.39
I look for information that interests me in a heading or a section	8.5	15.3	21.8	26.2	18.8	4.5	3.47	1.34
<b>When reading a book, magazine, etc., if the student has difficulties with understanding or wants to broaden their knowledge, they would use...</b>								
A dictionary	16.0	17.2	17.3	18.7	16.2	8.8	3.30	1.58
Internet	1.3	1.1	3.8	14.0	42.4	36.9	5.07	0.99
An encyclopedia	37.9	20.4	14.4	9.9	4.1	0.6	2.13	1.26
Maps, plans, etc.	39.2	20.0	16.8	6.9	2.4	0.9	2.03	1.18
Drawings or explanatory diagrams	21.9	18.2	14.5	20.1	12.0	3.1	2.90	1.50
<b>Digital format or electronic resource regularly used in the library</b>								
Collections of electronic books: E-books	47.3	8.3	7.0	8.8	4.3	2.0	1.98	1.44
Devices (Kindle, iPad, Reader, etc.)	51.3	6.1	6.0	4.6	2.5	0.9	1.65	1.21
Digital magazines	40.7	11.2	12.2	8.7	4.6	1.7	2.12	1.40
Google books	43.5	10.8	9.8	6.9	4.1	1.0	1.95	1.33
Databases: Dialnet, ERIC, Francis, etc.	31.8	9.7	10.3	12.0	10.7	4.5	2.66	1.68
University library catalogue	11.1	7.1	9.0	16.0	22.4	23.4	4.14	1.68
<b>Has the student consulted any magazines and/or articles in the library?</b>								

Printed on paper	33.5	8.7	10.9	13.1	12.8	8.8	2.88	1.80
In digital format	34.4	11.7	11.1	13.0	10.7	5.5	2.66	1.68

### 3.3 Data analysis

The complexity of the mean scores of the self-report items was reduced by principal component analysis (PCA), and component extraction was based on eigenvalues greater than 1. The components obtained from the PCA were rotated using the Varimax criterion. A second order PCA, from factor scores for each student estimated by the Bartlett method, was carried out to simplify the first rotated solution in the items related to ICT and information literacies (Murakami, 1998; Ogasawara, 2002).

A linear regression was computed for modelling the relationship between academic literacy (dependent variable) and two independent variables (ICT literacy and information literacy). Finally, a linear discriminant analysis was used to determine the extent to which ICT literacy and information literacy discriminate between two or more naturally occurring groups of students in relation to their scores in academic literacy.

## 4 Findings

### 4.1 Development of digital competence (information and ICT literacies)

The data obtained refer to information literacy (Table 2) and indicate that the students, when reading online, usually find it easier to interpret a text when there is a multimodal element such as images or audio accompanying the text ( $M = 4.73$ ;  $SD = 1.07$ ), 38.8% pointing out that this almost always happens. Other than multimodal texts, students understood best when they read printed text ( $M = 3.52$ ;  $SD = 1.23$ ). However, it was also observed that they did not differentiate their reading in relation to purpose ( $M = 4.40$ ;  $SD = 1.27$ ). Reading online does not require traditional, directional scanning from left to right and bottom to top, so an information literacy would involve the use of different scanning strategies in the selection of information, which we did not observe in our sample. In addition, the participants mostly agreed that when reading a book, magazine or other text, and having difficulty understanding what they are reading or wanting to broaden the information, they rely primarily on internet sources ( $M = 5.07$ ;  $SD = 0.99$ ) and they almost never consult maps, plans, encyclopaedias or drawings and explanatory diagrams. As for the electronic or digital resources commonly used in the library, we found that the catalogue of the university was most used ( $M = 4.14$ ;  $SD = 1.68$ ), with other available resources used infrequently, such as electronic books in Kindle format, Google books or digital magazines.

Data referring to ICT literacy (Table 3) show students mainly opt for handwriting, with paper (class notebooks, daily planners, etc.) being most used ( $M = 5.02$ ;  $SD = 0.99$ ), followed by electronic devices such as computers ( $M = 4.61$ ;  $SD = 1.03$ ) and mobile phones ( $M = 4.46$ ;  $SD = 1.43$ ). Social networks are the most used means for writing on the internet ( $M = 4.73$ ,  $SD = 1.34$ ), with infrequent use of blog writing and monographic theme websites. According to the data, the most used source to support writing in a digital environment, interestingly, is the use of photographs or images ( $M = 4.18$ ;  $SD = 1.28$ ), followed by videos and animations.

**Table 3** Percentage distribution, means and standard deviations of scores of university students in Digital Competence (ICT literacy).

	Never 1	2	3	4	5	Always 6	Mean	SD
<b>Device usually used for writing</b>								
Paper (classroom notebooks, daily planner, etc.)	0.1	1.8	5.7	17.9	36.4	37.5	5.02	0.99
Computer	0.9	2.4	9.3	28.0	39.4	18.8	4.61	1.03
Mobile phone	5.5	5.7	10.2	19.7	29.3	26.5	4.46	1.43
Tablet	39.7	9.7	9.2	7.6	7.8	3.8	2.30	1.62
<b>Medium most used by student</b>								
Social networks (Facebook, Tuenti, etc.).	3.7	5.0	7.6	15.8	32.2	33.8	4.73	1.34
Personal Blog (diaries, reviews, commentaries, etc.).	43.6	13.2	10.8	8.1	3.7	2.5	2.06	1.40

Monographic pages (fanfiction, role, forums, chats, etc.).	46.1	14.1	8.1	6.7	3.4	1.3	1.89	1.29
<b>When writing text, the student uses</b>								
Blogs	41.7	12.5	11.3	9.9	4.6	2.3	2.15	1.43
Faction	59.4	7.6	2.9	2.0	0.3	0.0	1.29	0.71
Flicker stories	60.2	7.1	2.8	1.9	0.0	0.0	1.26	0.65
Web pages of participative writing (p.e. National Novel Writing Month)	53.7	7.8	6.2	3.8	0.9	0.5	1.52	1.01
Youtube channels	48.1	11.3	7.9	7.4	3.3	0.8	1.84	1.26
<b>When writing in digital media, Texts written using digital media generally include...</b>								
Photographs or images	4.6	6.4	12.7	28.8	31.7	12.6	4.18	1.28
Videos	10.9	13.2	20.0	26.3	21.5	3.4	3.47	1.37
Animation	21.6	14.5	17.7	20.2	14.4	3.7	3.02	1.52
Computer simulation	35.1	20.6	14.5	8.3	5.0	0.9	2.17	1.29
<b>Normal place for book buying</b>								
Bookshops	4.1	6.1	9.3	19.5	31.3	27.9	4.54	1.37
The internet	38.0	8.1	11.8	10.6	9.5	4.6	2.51	1.67
In a stationery store	10.4	9.5	13.9	22.0	24.8	14.1	3.88	1.55
At a news stand	38.8	17.2	10.7	9.5	4.8	1.3	2.13	1.35

## 4.2 Verbal and hybrid practices for academic reading and writing

Students were found to use different practices to improve their level of academic literacy. For this they base their work on different media (notebook, tablets, mobile phones, etc.) and when they do not understand a text, they rely on different resources which can include pictures, diagrams, etc. Similarly, they can read a full text, a part thereof or seek only the information that interests them and, if they need to complete information, they can use dictionaries, databases and various electronic resources (see [Table 3](#)).

To reduce the variability observed in self-reports regarding the processes of academic literacy (through its information and ICT literacies) we conducted a principal component analysis. As shown in [Table 4](#), the results of this analysis allow us to identify two main components. The first, 'Verbal practices', showed higher correlations (saturation) on items related to a comprehensive reading of a monomodal text (so when reading information online, interpreting is best achieved when there is only a written verbal communication, that is, a monomodal practice of reading and writing). Saturation also occurs in this factor with those items indicating that the student, when having difficulties in understanding a text, turns to a dictionary or the internet. With regard to writing a text, this factor has high correlations with those items that indicate that students use handwriting and a personal computer (primarily as a word processor).

**Table 4** Saturations of the items in the main components relative to the digital competence practices.

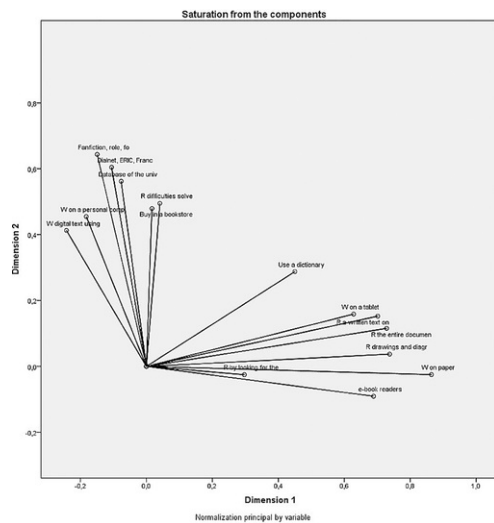
alt-text: Table 4

	Dimension	
	1	2
1. When reading on the internet you interpret best when there is only a written text	0.69	0.15
2. When reading a text you begin by reading the entire document	0.72	0.11

3. When reading a text you begin by looking for the information in which you are interested in a heading or section	0.30	-0.03
4. When you have difficulty understanding what you are reading, you use a dictionary	0.45	0.28
5. When you have difficulty understanding what you are reading, you rely on drawings and explanatory diagrams	0.02	<i>0.50</i>
6. When you have difficulty understanding you are reading, you use the internet	0.73	0.03
7. You usually write on paper (class notebooks, daily planners, etc.)	0.87	-0.03
8. You usually write on a Tablet	-0.18	<i>0.45</i>
9. You usually write with a personal computer	0.64	0.16
10. When you compose a text in digital format you do so using simulations	0.01	<i>0.48</i>
11. When you do buy a book you do so in a bookstore	0.69	-0.10
12. You use e-book readers (Kindle, etc.) in the library	-0.11	<i>0.60</i>
13. You use databases (Dialnet, ERIC, Francis, etc.) in the library	-0.05	<i>0.57</i>
14. You search the database of the university library	0.41	0.03
15. You consult the databases of magazines and digital library	-0.12	<i>0.65</i>
16. When contributing to online material, you usually write on a page with a monographic theme (fanfiction, role, forums, chats, etc.)	-0.25	<i>0.41</i>

The second main component, called 'Hybrid practices', includes those items related to multimodal reading (see Table 4, values in italics). There are high correlations with those items which show that when the student has difficulty understanding in this component, he or she then relies on drawings or explanatory diagrams. This factor also indicates saturation by those items related to writing on a tablet, which involves the use of multimodal elements when composing the text (simulations, videos, etc.) and thematic monographic pages on the internet. Lastly, high correlations in this factor are seen in items that indicate that the student, when consulting the book collection of the university library, does so using different bibliographic databases, electronic devices (e-book, etc.) and electronic journals.

A projection in the area of the factor weights shows the spatial distribution of the correlations of the items with each of the major identified components (See Fig. 2). In an orthogonal arrangement, the component items 'Verbal practices' are arranged in the vertical axis, while the component items of 'Hybrid practices' are located on the x axis.



**Fig. 2** Projection in two-dimensional space of the main components.

alt-text: Fig. 2

### 4.3 Relationship between verbal and hybrid practices

The main component ‘Academic literacy’ largely explains the observed variability in the items that describe the process of student academic literacy. At this point, one might consider to what extent factor scores can be predicted for students in that component based on their level of information and ICT literacies. In order to analyse the relationship between academic literacy and information and ICT literacies we conducted a linear regression analysis. In the proposed regression mode, academic literacy is the criterion variable (measured from the factor scores of students), and the information and ICT literacies are the predictor variables.

The new regression model would explain 44% of the variance (adjusted  $R^2 = 0.44$ ) in the scores obtained by students in the academic literacy test. As shown in Table 5, the two predictors are statistically significant in terms of predicting students' academic literacy scores.

**Table 5** Coefficients obtained in the regression of the verbal and hybrid practices.

alt-text: Table 5

Model	Unstandardized coefficients		Standardized coefficients	T	p	
	B	Std. error	Beta			
1	(Constant)	0.05	0.03		1.92	0.06
	Verbal practices	0.55	0.03	0.62	22.09	0.00
	Hybrid practices	0.25	0.03	0.26	9.44	0.00

We conducted a new regression analysis considering now each of the items which makes up the dimensions of Verbal and Hybrid practices. The regression analysis allowed us to explain 57% of the observed variability (adjusted  $R^2 = 0.57$ ) in the scores of students in academic literacy. This analysis reveals that each of the items of the questionnaire significantly contributes to statistical prediction of the scores of students in the component ‘Academic literacy’ (see Table 6).

**Table 6** Unstandardized and standardized coefficients of the items.

alt-text: Table 6

Coefficients <sup>a</sup> model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
(Constant)	-5,17	,22		-23,62	,00
1. When reading on the internet you interpret best when there is only a written text	,08	,03	,10	3,06	,00
2. When reading a text you begin by reading the entire document	,18	,03	,23	6,48	,00
3. When reading a text you begin by looking for the information in which you are interested in a heading or section	,10	,02	,13	4,25	,00
4. When you have difficulty understanding what you are reading, you use a dictionary	,04	,02	,07	2,07	,04
5. When you have difficulty understanding what you are reading, you rely on drawings and explanatory diagrams	,08	,02	,12	4,07	,00
6. When you have difficulty understanding you are reading, you use the internet	,08	,03	,08	2,30	,02
7. You usually write on paper (class notebooks, daily planners, etc.)	,18	,04	,18	5,05	,00
8. You usually write on a Tablet	,05	,02	,09	2,85	,00



9. You usually write with a personal computer	,13	,03	,14	4,13	,00
10. When you compose a text in digital format you do so using simulations	,08	,02	,11	3,53	,00
11. When you do buy a book you do so in a bookstore	,08	,02	,10	3,25	,00
12. You use e-book readers (Kindle, etc.) in the library	,10	,03	,13	4,01	,00
13. You use databases (Dialnet, ERIC, Francis, etc.) in the library	,06	,02	,10	3,11	,00
14. You search the database of the university library	,04	,02	,07	2,07	,04
15. You consult the databases of magazines and digital library	,06	,02	,10	3,08	,00
16. When contributing to online material, you usually write on a page with a monographic theme (fan fiction, role, forums, chats, etc.)	,06	,02	,08	2,74	,00

<sup>a</sup> Dependent variable: Academic literacy.

#### 4.4 Classification of subjects according to their literacy characteristics

In this section we performed a discriminant analysis, for which the characteristics that differentiate students according to the level of academic literacy have been identified. The discriminant function has taken into consideration the factor scores of students in two groups corresponding, respectively, to the main components: 'Verbal practices' (the number of valid cases was 336) and 'Hybrid practices' (387 valid cases).

The Wilks's lambda obtained ( $0.74$ ,  $p = 0.0001$ ) was statistically significant and would indicate that, although there is some overlap between the two groups of students, we can reject the null hypothesis that the 'Verbal practices' group and the 'Hybrid practices' group have equal averages in the two discriminant variables. The values of the centroids in the discriminant function indicate that student averages in the 'Verbal practices' group are located in the negative scores function. At the same time, student groups are located on the positive scores function in the 'Hybrid practices' (see [Table 7](#)).

**Table 7** Centroid values in the discriminant function.

Type of practices	Function
	1
1 Verbal	-0.63
2 Hybrid	0.55

*Notes.* Unstandardized canonical discriminant functions evaluated at group means.

Based on the discriminant function, assigning students to one or other literacy of the centroid group to which they are closest has enabled classification of the academic literacy scores in 70.8% of students. Of them, 66.7% of students have been classified according to their original group, initially assigned to the 'Verbal practices' group, and 74.4% of students to the 'Hybrid practices' group (see [Table 8](#)).

**Table 8** Classification results.

Types of strategies		Predicted group membership		Total	
		1	2		
Original	Count	1 Verbal	224	112	336
		2 Hybrid	99	288	387
	%	1 Verbal	66.70	33.30	100.00

	2 Hybrid	25.60	74.40	100.00
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a. 70.8% of original grouped cases correctly classified.

## 5 Discussion

The data obtained in this study exemplify the development of information and ICT literacies in an academic environment. These results are related to digital competence as a fundamental process of academic literacy that is developed by undergraduate students in Higher Education (Goodfellow & Lea, 2013; Jones & Lea, 2008). The information literacy of students has different characteristics according to the multimodal elements which make up a text read online. It is observed that when the text incorporates images or videos, the students acknowledge that reading is simpler and easier to understand (Unsworth & Cléirigh, 2014, pp. 176-188). However, the students also state that they usually read the entire text, which describes the use of reading strategies with a single vector (left to right) (Baldry & Thibault, 2010). Such reading, using digital technology, is similar to that which is done when reading printed text. Consequently, the development of information literacy requires the use of information selection strategies and non-linear reading (Kress & Van Leeuwen, 2001). However, frequent reading of the complete text by students exemplifies reading strategies different from the principle of relevance (Sperber & Wilson, 1994) so that ways of reading, taking into account purpose, are not differentiated. Therefore, university students do not incorporate hybrid strategies into their reading and writing practices.

Consequently, students turn to the internet for further information or to resolve their doubts when they have difficulties understanding academic texts in digital media. This search does not include the consultation of maps, plans, drawings and explanatory diagrams. Excluding a multimodal reading of information indicates one of the deficiencies in the information literacy of university students (Warschauer, 2007). Similarly, when students use electronic library resources, they do not usually make use of documentary and bibliographic resources in a digital environment (e-book, electronic magazines, among others), indicating that the preferred library materials are printed texts (Bennett & Maton, 2010).

The purpose of finding information in order to complete an assignment determines the type of document being consulted. In this sense, students prefer to use printed documents versus digital documents, which is not what happens when searching for other reasons such as finding the meaning of a word or for a restaurant review. From this we infer that the information and ICT literacies that a university student uses in the academic environment (formal learning) differ from those used in hybrid vernacular literacies (informal learning). In the case of Spanish students, an asymmetric development is seen depending on the domain in which they find themselves (Lillis, 2001).

The development of ICT literacy has had a difficult time finding its place in an academic context. The student nowadays often uses handwriting (on paper) to perform academic tasks, with the use of digital media appearing at the end of the process for the writing stage of the task. In this case, ICT literacy is being developed in a context where digital competence is not necessary, a fact that shows how today's writing practices have not been transformed in the Spanish academic environment (Cope & Kalantzis, 2000). Writing by using digital media and in different non-academic domains is gaining in popularity, particularly in social networks that incorporate multimodal elements, but not in the case of blogs and other websites that involve thematic writing. The cause of these data can be found in the interplay between the visual, spatial and verbal aspects of the Web that make social networks more attractive than other virtual spaces (Barton & Lee, 2013).

Students' academic literacy has been described thus far in terms of academic literacy practices. Literacy practices are developed by students in order to improve their academic literacy, as has already been noted, and can be reduced into two dimensions called verbal and hybrid practices. It is possible to predict factor scores of students in academic literacy from their factor scores in verbal and hybrid practices with an acceptable margin of error. The data described in this research show the presence of students' digital competence in an academic context. However, the processes of teaching in the university continue to give priority to verbal literacy practices versus hybrid ones. Thus, both reading and writing strategies (verbal and hybrid practices) overlap when the students' factor scores in academic literacy are classified according to the mode used in writing and reading within their university learning processes. In this sense, the cluster analysis correctly classified only 71% of such practices, identifying them as verbal and hybrid practices of reading and writing in a university setting.

It is important to note some limitations of our research, one of which is the sample. The sample was selected for convenience, consequently the participants were all education students and were mostly female. Therefore, our findings cannot be generalised to other courses or a wider population. Another limitation is that the responses were restricted by the questionnaire's construction. Participants were required to respond to predetermined items so could not identify other factors that might be relevant to the development of literary practices. A qualitative approach could provide further insight and would complement the findings from this study.

Our study has presented some relevant findings regarding ICT and information literacies in higher education context. However, there are some issues that future research should address. For instance, it would be useful to compare the literacies of those on a range of higher education courses, to find out if there are differences between courses and to see if there are any differences between males and females. Finally, a future direction for our research is to adopt an explanatory design using mixed methods (Creswell & Plano Clark, 2007) in order to look more deeply into the use of ICT and the development of information literacies.

## 6 Conclusion

Our research provides an overview of the digital competence of undergraduate students in and out of the University environment. The results have allowed us to assess the processes for the development of ICT and information literacies and their relationship to academic literacy. Our study evidences a wide gap between the digital competence developed in informal learning contexts and its scarcity in university literacy practices (formal learning settings). In general, Spanish University academic practices do not incorporate ICT and information literacies processes as a part of students' academic literacy.

Our analysis has portrayed a Spanish University in transition towards an education in dialogue with Web 2.0, where the web is not only a repository of contents, but a platform for interacting with other subjects, socializing and collaborating by exchanging numerous multimodal content and learning strategies, among other resources (O'Reilly, 2005). Several reports have highlighted the important role that Web 2.0 should play in Higher Education (Conole & Alevizou, 2010; Conole, de Laat, Dillon, & Darby, 2006; Franklin & Van Harmelen, 2007; Redecker, Ala-Mutka, Bacigalupo, Ferrari, & Punie, 2009; White, 2007). This will involve the integration of informal learning into Higher Education classrooms mediated by Web 2.0 applications (Zhao & Kemp, 2012). This inclusion also entails a change in the teaching methodology in formal education (Collis & Moonen, 2008; García-Martín & García-Sánchez, 2013). Therefore, the JISC LXP study noted in one of its recommendations "HEIs need to conceptually change their perspectives and rethink their positions as institutions of learning within the 21st century media landscape" (Conole et al., 2006, p. 99). In this process of transition, education institutions and individuals have asymmetric behaviours, with an irregular growth in literacy practices, consumption habits and in the use of library resources in local and global domains. This has highlighted a resistance to printed multiliteracy practices in the academic field in Spain and the need to incorporate a pedagogy of multiliteracy (Cope & Kalantzis, 2009). The incorporation of various digital technologies into the classroom has to also transform the educational work environments, teaching methodology, and social and cultural languages of ICT (Cervetti, Damico, & Pearson, 2006; Luke, 2000).

This situation raises a new problem in the incorporation of students to the labour market, where the development of digital competence is necessary. Deficient ICT and informational literacies may become the origin of difficulties in the professional development as teachers. Therefore, practices in the digital competency of Spanish university students require actions such as (1) the assessment of the level of multiliteracies of incoming students, (2) the assessment of the competence of teachers to introduce literacy elements in their teaching methodology and (3) the design and implementation of a plan to improve the ICT and information literacies of students through curriculum disciplines (Committee of Inquiry into the Changing Learner Experience, 2009). Reflection on the digital competence applied to formal learning raises questions, among others, about the digital competence of *digital natives* (Bennett, Maton, & Kervin, 2008) and its possible repercussions in an academic environment (Goodfellow, 2011). Our research in the context of Spanish higher education shows the need to implement training programmes to develop digital competence across the curriculum in undergraduate students.

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## Highlights

- Analysing digital competence in relation to academic literacy practices.
- Describing the ICT and information literacies in literacy practices at university.
- Digital competence developed in informal and formal learning contexts.

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## Queries and Answers

**Query:** Please check the affiliation 'b', and correct if necessary.

**Answer:** Dos Hermanas

**Query:** The citation 'Nunnally and Berstein (1994)' has been changed to match the author name/date in the reference list. Please check here and in subsequent occurrences, and correct if necessary.

**Answer:** It's ok.

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**Query:** Could you please provide the grant number for 'Government of Spain', if any?

**Answer:** The grant number is CAS15/00100

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**Answer:** In this case, the reference Ala-Mutka et al., 2009; Dwyer et al., 2008; have more than six authors.

**Query:** Please update the author group in Ref. 'Authors, 2017'.

**Answer:** Replace

**Query:** Please note that the significance of footnote 'a' is given in Table 8, but it is not cross-referred anywhere inside the table. Kindly check.

**Answer:** This fact is already in the text. This footnote can be deleted.

**Query:** Ref. 'Adaptation of Pourbaix (2000)' is cited in the text but not provided in the reference list. Please provide it in the reference list or delete this citation from the text.

**Answer:** Incorporate reference: Pourbaix, R. (2000). Emergent literacy practices in an electronic community. In Barton, D., Hamilton, M., & Ivanic, R., *Situated Literacies. Reading and Writing in Context* (pp. 125-148). London and New York: Routledge.

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