Self-learning of Information Literacy Competencies in Higher Education: The Perspective of Social Sciences Students

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Preference for autonomous versus directed learning for the acquisition of information competencies (ICs) was analyzed among undergraduate social science students according to gender, degree program, belief in importance, and self-efficacy. Data were gathered using the IL-HUMASS (Information Literacy Humanities Social Sciences) online survey from students at five public Spanish universities enrolled in audiovisual communication, education, information science, pedagogy, journalism, psychology, social work, and tourism undergraduate programs during the 2013–2014 academic year. Mann-Whitney U, Kruskal-Wallis, and chi-square tests, as well as discriminant analysis, were performed. The results revealed a higher preference for the directed learning style in the four IL competency categories: searching, evaluation, processing, and communication-dissemination. Audiovisual communication, education, and journalism students showed a predilection for autonomous learning, whereas information science and psychology students preferred directed learning. Higher scores in belief in importance correlated with a greater preference for autonomous learning. In contrast, higher levels of self-efficacy were associated with a greater preference for directed learning.

Introduction

Though a difficult quest,[1] science is ultimately about finding general laws and theories that fully describe, explain, and predict the evidence in a field of interest. Individual studies confirm, question, or falsify laws and theories, which are therefore corroborated, corrected, or abandoned. In the same way, scientific approaches to information literacy (IL) should ideally try to find laws and develop theoretical models that can be applied to every case in the field of study, and, thereafter, try to confirm or put them into question. So, initial efforts in the field were devoted to proposing models for teaching information competency that could be applied

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to any learner who should become information literate. A general model of this type is needed both to establish a basic paradigm of intervention and to organize the information about the basic process of information literacy with the aim of providing a conceptual structure on which a synthesis of the discipline can be developed and from which practical interventions can be programmed, scheduled, and assessed.

One of the best and well-known IL models, provided by Carol Kuhlthau, is now almost thirty years old.[2] It shows the role of the different psychological layers (affective, cognitive, and behavioral) in the search information process and serves as a general and complete model for IL intervention. These theoretical models were followed by normative documents in the field of information competency development, particularly those by the Association of College and Research Libraries.[3] This normative effort was grounded in several decades of theoretical and empirical work in developing models of information competency acquisition. Besides this practical, normative effort, the last two decades of research have been devoted to incorporate the impact of the information technologies revolution; to amass evidence in different fields of practice and different environments; to further validate and develop the general IL models; and to enrich these models with the consideration of new relevant explicative variables.

Due to the scarcity of research on Social Sciences (SS) students' views regarding information literacy, it is of interest to explore their concept of the topic to gain a better understanding of the process of learning IL competencies. Restricted to library and information science (LIS) students, Head and Eisenberg[4] concluded that the kind of information resource used is an essential factor for understanding the subjective characteristics of students in relation to their information competencies. Results of the present research reveal that learning styles have much to say in the processes of improving SS students' IL competencies. This indeed agrees with the markedly phenomenographic suggestion raised by Bruce, Edwards, and Lupton:[5] "teachers need to assist students in developing new and more complex ways of experiencing Information Literacy."

The research presented in this article tries to build on these lines of research, by incorporating the information revolution, gathering further evidence, and enriching IL models with new variables. Particularly, its general aim is to identify what learning styles are used by SS students for the acquisition of information competencies (ICs) in relation to their specific programs of study and several social and psychological characteristics of the students. *Learning styles* refers mainly to the dichotomy "autonomous versus directed learning," as a result of both the students' attitudes and abilities (learning readiness) and of its framing by the educative environment, such as if the information competency categories are considered in the curriculum or they are left to students' self-learning.

The main research goals are the following:

R1: Provide an overview of the SS students' learning styles by the four information competency *categories* (searching, assessing, processing, and communicating information) to gain a better understanding of their general behavior and the influence of gender and degree program on such competencies.

R2: Determine which IL *categories* exhibit behavioral differences.

R3: Analyze the learning styles by the second-level IL *competencies*, providing a more precise and in-depth exploration of the first goal, particularly in relation to the different disciplines that were surveyed. Do significant differences arise among SS students of the various degree programs? If so, in which IL competencies do the SS students show different preferences?

R4: Determine if there is some kind of relationship between the SS students' learning styles and their reported levels of belief in importance (BI) and self-efficacy (SE) with regard to IL *competencies*.

R5: Explore in depth the SS students' tendencies toward preferred learning styles related to IL *competencies* according to their degree programs and perceptions of BI and SE by means of a discriminant model.

All in all, the potential benefits of this study to scholarship and practice are, among others, that students can be involved in the processes of attaining their own IL competencies; that each IL competence can be better achieved if it adapts to the learning style expressed by the student; or that knowing their preferences in terms of learning styles can motivate a greater involvement of students in their own learning.

Literature Review

The two scholarly pillars of this study are the constructivist and the phenomenographic approaches to IL. Both are focused not only on the common, general aspects of the IL experience, but also on the features that make it special, such as the social and personal variations in background, processing, and experience. Regarding the role of differential traits in IL development, teachers and students may have different social backgrounds, genetic traits, and personal experiences; they may therefore differ in their IL motivations and competencies. While teachers place different emphasis on topics and methodologies, students take different approaches toward mastering information competency. This is a common experience in teaching that, as expected, has also been consistently referred to in the IL literature.[6] In consonance with the focus on social and individual differences, a precise definition of IL is not pursued here; rather, IL is approached as a socially and scientifically evolving topic, in permanent construction, attending to the social and psychological characteristics that are emphasized.

Regarding the social dimension of IL, the first thing that draws the researcher's attention is its cross-disciplinary nature and its ubiquity in all the fields of human activity, well glossed by IL scholars. According to Lloyd[7] "the enactment of information literacy emerges through the meaningful activities people engage with in relation to the creation, dissemination, access and use of information within any particular setting." Another characteristic to emphasize on IL is its marked social condition. As stated by Walton and Cleland[8] "robust theoretical works and empirical studies supported by extensive information behavior research on the cognitive, metacognitive, affective and social processes which underpin IL indicate that IL is less of an individualized activity and more social in nature." IL's growing contextual dependence should also be emphasized, which further opens the field to the study of social differential traits. For Limberg et al.,[9] "studies tend to abandon the idea of information literacy seen as generic skills applicable across disciplines and contexts in favor of a view of information literacy as a social practice shaped by the culture and context in which it is embedded." Particularly, sociological sources of individual variability that have become the target of growing research interest have been contextual needs,[10] gender,[11] educational background,[12] occupational status,[13] and even culture and nationality.[14]

Besides IL social dimension, its psychological dimension has received careful attention in the scholarly literature, with phenomenography offering multiple contributions[15] on the basis of variations in experience as the main focus of approach and analysis.[16] Psychological variables in which students differ have been the subject of a substantial amount of research in the field of

IL. In this regard, students' self-concept of their IL competency, and self-efficacy in particular, is one of the variables that has attracted considerable attention. This is due to its significant and positive correlation with IL competency, its effects on motivation, and its importance for studying the congruence between objective and subjective measures of IL competency.[17] More comprehensibly, Malliari, Korobili, and Zapounidou[18] conducted a very interesting research on the information-seeking behavior of Macedonia University undergraduates, taking into account a complete set of personality characteristics, not only the usual sociological ones.

In recent decades, differential psychologists have shown an increased interest in the interaction between subjects and their contexts in an attempt to balance the need to recognize diversity while pursuing explanatory principles. The concepts of learning strategies and styles have become central in these efforts. The presence of various individual approaches to learning and thinking has been of interest to educational psychologists for many years.[19] In this effort, a number of interesting constructs have arisen, mainly around the concept of cognitive styles that imply the existence of stable and consistent long-term personality traits, dispositions, or preferences toward the acquisition of knowledge. Over the years, the earlier, simpler models of cognitive styles have evolved to become more complex. For example, the difference between deep and superficial processing[20] or a more recent and complex model considering four categories: converger, diverger, assimilator, and accommodator.[21] Both models have been extensively used in IL theory and practice.[22] At the other extreme lies what is likely the most elaborated effort: that of Sternberg,[23] who developed a very complex model to explain individual differences in cognition based on the metaphor of types of government. Later, the Sternberg's taxonomy and the previous research of other authors into two distinct types of thinking styles were synthesized: holistic and analytic thinking.[24] More recently, Zhang, Sternberg, and Fan[25] have proposed the "intellectual style" construct, "an encompassing term for such constructs as learning style, teaching style, teaching approach, and thinking style, which refers to one's preferred way of processing information."

The impact of personality dimensions on information seeking has been studied for years in the field of information behavior.[26] As stated by Markless and Streatfield,[27] "schools that take information literacy seriously usually link this to other pedagogic developments such as active learning and problem-solving. In this context, emphasis is placed on people's preferred learning styles being taken into account when planning and delivering sessions or learning programmes." Diehm and Lupton maintain that[28] "research on learning styles and approaches can be used by faculty and librarians to inform information literacy education." Palmer[29] provided a thorough, critical review on the application of learning styles in IL. In her review, she acknowledges the practical and theoretical importance of learning styles, but she advises against taking a highly controversial corpus of knowledge as a quick receipt for teaching IL and calls for research and reflection: "the problems with learning styles need to be acknowledged and considered much more extensively in the information literacy literature."

The autonomous, self-directed, or independent learning style has been mainly studied by Webber, Boon, and Johnston, who concluded that[30] "becoming confident autonomous learners and critical thinkers was clearly a goal for both students and staff." For McGuiness,[31] "the idea of individual responsibility for self-development and learning is a powerful one, and is viewed by faculty as a strong indicator of whether a student will benefit from their educational experience as a whole, not just in the IL arena." Coonan observed that[32] "the need for students to become informed and autonomous, capable of adapting to new information

contexts, is greater than ever before." In the same way, Candy[33] stresses the importance, and future, of self-directed learning within the context of lifelong learning: "since we are currently experiencing an unprecedented level and pace of change on a global scale, it is plausible to expect the demands of a changing world to lead to greater amounts of self-directed learning."

The IL-HUMASS test on information literacy, which served as the main source of data for this study, is precisely aimed at self-assessing IL among undergraduates and designed to provide insight into their perceptions and expectations about IL-related aspects.[34] Of the countless sources of variability that can be found within IL from the phenomenographic perspective, this research has focused its attention on only three of them, which are precisely those present in the IL-HUMASS questionnaire. There are two (BI: belief in importance of IL competencies and SE: self-efficacy) that relate to students´ affections; the third (LS) relates to their learning style. Based on the same test, yet applied to teaching staff, Pinto[35] concluded that "a deeper understanding of faculty members' relationship with IL is required, especially from the point of view of their subjective values, perceptions and opinions." In this same line, Pinto and Fernandez-Pascual[36] have carried out, among Social Sciences students, a more in-depth research on the affective sources of variability within IL-HUMASS:

> The belief in importance (BIM) concept, which some educators identify with the idea of motivation, refers to the rating of the importance of certain competencies on the part of students. Self-Efficacy (SE) seems to be a more sophisticated idea, often defined as people's beliefs about their capabilities to produce the designated levels of performance. SE determines how people feel, think, motivate themselves, and behave (p.1).

Methodology

Following the constructivist-phenomenographic approach,[37] this paper focuses on one of the sources of variation with regard to the acquisition of IL competency: autonomous learning and the contexts in which it develops. In the last part of the previous literature review, the capability to develop a learning style was considered a competency based on a long-term characteristic of the person, namely a personality trait: that is, a basic tendency toward self-directed learning that may be a predictor of academic success. The present paper intends to analyze this key competence and its main dimensions (search, evaluation, processing, and communication-dissemination of information) by relating it to four variables that have traditionally been studied in IL, closely linked to students' personal features. Two are objective (gender and academic discipline) and two students' subjective, or psychological, constructs (BI: belief in importance and SE: self/efficacy). With the results, a successful IL strategy that effectively addresses individual variations in SS students' experiences could be designed.

Data were gathered using the IL-HUMASS online survey, web-based format, and an attitudinal test considering three dimensions: motivation, self-efficacy, and favorite source of learning.[38] *Motivation* is defined as the importance given by students to the competencies for academic progress. *Self-efficacy* refers to their estimated levels of skill in the competencies. Students are asked to indicate their assessment of the competencies by marking their answers on a scale from 1 (low competency) to 9 (excellent competency) for each dimension. *Favorite source of learning* allows students to select among a set of possible sources of learning: class,

library, courses, self-learning, and others.

The 26 items in the survey are clustered in four categories:

- Searching:
  1. using printed sources of information;
  2. entering and using automated catalogues;
  3. consulting and using electronic sources of printed information;
  4. using electronic sources of secondary information;
  5. knowing the terminology of your subject;
  6. searching for and retrieving internet information;
  7. using informal electronic sources of information;
  8. knowing information search strategies.
- Evaluation:
  1. assessing the quality of information resources;
  2. recognizing the author's ideas within the text;
  3. knowing the typology of scientific information sources;
  4. determining whether an information resource is updated;
  5. knowing the most relevant authors and institutions within your subject area.
- Processing:
  1. systematizing information and abstracting;
  2. recognizing text structure;
  3. using database managers;
  4. using bibliographic reference managers;
  5. handling statistical programs and spreadsheets;
  6. installing computer programs.
- Communication-Dissemination:
  1. communicating in public;
  2. communicating in other languages;
  3. writing a document;
  4. knowing the code of ethics in your academic/professional field;
  5. knowing the laws on the use of information and intellectual property;
  6. creating academic presentations;
  7. disseminating information on the internet.

The questionnaire has been widely validated in previous studies, which makes this scale highly consistent and reliable.[39] Taking into account that there are other recent studies related to IL-HUMASS,[40] this research pays attention to the preferred sources of learning from a set of possible learning scenarios with regard to IL competencies and skills, including classroom, library, courses, and autonomous learning. Throughout the analysis, a distinction is made between directed (class, library, courses) and self-directed (autonomous) learning styles.

The population under study was drawn from SS students at five public Spanish universities: University Complutense of Madrid, University of Granada, University Jaume I of Castellón, University of Malaga, and University of Murcia. The students were enrolled in undergraduate degree programs in the social sciences related to audiovisual communication, education, information science, pedagogy, journalism, psychology, social work, and tourism. The sample was selected from third- and fourth-year students enrolled in compulsory subjects during the 2013–2014 academic years. A stratified sample design with proportional alloca-

tion was used considering three strata: university, degree program, and course. The sample size allowed calculating the minimum number of participants to estimate with an accuracy of 0.5 points the average values of BI and SE. Finally, the sample sizes in each stratum were increased by 20 percent to overcome the possible lack of response.

The method employed ensured that the gathered information was representative, providing a considerable level of consistency for drawing inferences. Samples included 1.575 valid surveys, which were distributed among the eight degree programs (see table 1).

TABLE 1
Sample Distribution by Degree Program and University

	Students per University						
Degree Program	Complutense Madrid	Granada	Jaume I Castellón	Malaga	Murcia	**Total**	%
1. Audiovisual Communication	33	26	29	82	28	198	13%
2. Education	24	166	55	42	83	370	23%
3. Information Science	59	39	0	0	24	122	8%
4. Pedagogy	15	45	1	22	30	113	7%
5. Journalism	43	0	53	85	55	236	15%
6. Psychology	35	131	27	11	19	223	14%
7. Social Work	27	73	0	18	19	137	9%
8. Tourism	30	67	23	36	20	176	11%
Total	266	547	188	296	278	1,575	
%	17%	35%	12%	19%	18%		

The distribution by gender and year of study is shown (see table 2). As can be observed, there is a clear predominance of women compared to men.

To address the study's goals, descriptive, inferential, and multivariate statistical techniques adapted to the nature of the survey´s ordinal variables were employed using *SPSS* software. As normality was not fulfilled, the use of nonparametric techniques was required. This was especially important in trying to respond to the first, second, and third goals, such as in which categories and IL competencies the students were showing different preferences in relation to their gender and the degree programs they were studying. Three nonparametric techniques were employed: a) the Mann-Whitney U test was selected and performed to compare the differences between two independent groups (male/female or third/fourth year); b) the Kruskal-Wallis test (an alternative to ANOVA) was performed to determine if there were any statistically significant differences between the different degree programs;[41] and c) the chi-square test was applied to determine if there was some kind of relationship between learning styles and the BI or SE values with regard to IL competencies (R4).

TABLE 2
Sample Distribution by Gender and Year of Study

Gender			Students	%
Male	Year	3rd	333	66.6%
		4th	167	33.4%
		Total	**500**	100%
Female	Year	3rd	768	71.4%
		4th	307	28.6%
		Total	**1,075**	100%

Finally, a discriminant analysis was carried out to give response to R5. This multivariate technique for classification is useful to construct a predictive model based on certain observed characteristics, as well as to forecast the group to which an observation belongs.[42] In this study, the focus is on successfully predicting the preferred learning style of the IL competencies based on the degree program and the reported BI and SE values.

Results and Discussion

The first issue to be explored is the preferred learning style of SS students. Outcomes reveal a preference for directed learning over autonomous learning not only concerning IL categories but also competencies. Subsequently, the relationship of these styles with the two affective dimensions—B: belief in importance and SE: self-efficacy—on the same set of competencies is explored. Finally, the discriminant model that allows predicting the style of learning is depicted. This section ends with a summary of the results obtained.

In regard to the preferred learning styles for achieving IL competency *categories* (R1), the results reveal a slight preference for directed learning over autonomous learning. Restricted to directed learning, the preference is higher in the categories of searching and evaluation. Conversely, within self-directed or autonomous learning, the greater preference is for the categories of processing and communication-diffusion of information (see table 3).

TABLE 3
Preferred Learning Styles Regarding the Four Competency Categories

	Autonomous Learning	Directed Learning	*P*-value
Searching	43.4%	56.6%	0.0000
Evaluation	40.2%	59.8%	0.0000
Processing	46.9%	53.1%	0.0138
Communication-Dissemination	44.4%	55.6%	0.0000
Global	**43.9%**	**56.1%**	

Concerning autonomous learning preferences by both genders, significant differences were found only in the processing category (Mann-Whitney U test, $P < 0.05$). In all categories, men are slightly more prone to self-learning (see table 4).

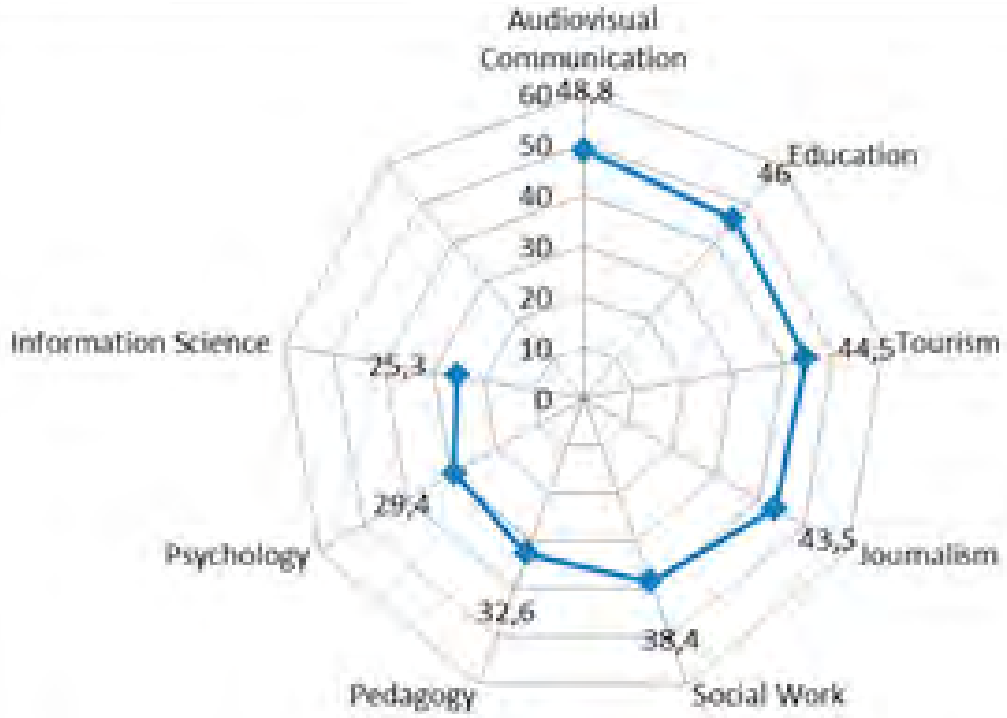
Regarding the degree programs, audiovisual communication, education, and journalism students show a predilection for autonomous learning, whereas information science and psychology students prefer the directed learning style *for IL categories* (see figure 1).

TABLE 4
Preferences within Autonomous Learning by Category and Gender

Category	Male	Female	*P*-value
Searching	44.40%	42.97%	0.6061
Evaluation	40.44%	40.00%	0.8816
Processing	49.00%	46.06%	0.0276*
Communication-Dissemination	45.57%	43.54%	0.4517
* Significant differences, Mann-Whitney U test, p<0.05			

However, these results do not indicate the obligation to adapt the learning of IL competencies to the preferred learning style. But it seems likely that students show a greater preference for directed learning when they have had a successful experience in the context of their instruction, as it happens in the case of information science and psychology students within the processing category. Outcomes reveal that the way of experiencing IL is related both to the academic degree and to IL competency categories.

FIGURE 1
Preferences (%) for Autonomous Learning Style by Degree Program



On the style of learning by IL *competency* (R3), the results show that most students prefer autonomous learning for seven competencies, while directed learning is preferred for the remaining 19. In competencies c3: *electronic sources of primary information* and c20: *communication in public*, these percentages do not present statistically significant differences (binomial test, $P > 0.05$), since the proportions of students who go for an autonomous or directed learning styles are similar (see table 5).

In regard to gender, the greater preference for the autonomous style is shaded in gray (see table 6). Significant differences regarding gender were found in these *competencies*: c4: *using electronic sources of secondary information*, c5: *knowing the terminology of your subject*, c16: *using database managers*, c18: *handling statistical programs and spreadsheets*, and c19: *installing computer programs* (Mann-Whitney U test, $P < 0.05$). This result is in line with the slight preference for analytical-mathematical thinking in males related to a greater use of visuospatial strategies in their socializing experiences. [43]

To better understand the influence of degree program on IL learning styles, nonparametric methods were used. The analysis was performed on the 26 IL *competencies* included in the IL-HUMASS test and the eight degree programs. Findings revealed different behaviors related to

TABLE 5
Autonomous Versus Directed Learning Style; Preferences by Competency; *P*-values of Binomial Test

Learning Style	Categories	Competencies	%	*P*-value
Autonomous	Searching	c6 searching for and retrieving information on the Internet (advanced searches)	67.3	0.000
		c7 using informal electronic sources of information (blogs, etc.)	73.8	0.000
	Evaluation	c12 determining whether an information resource is updated	58.4	0.000
	Processing	c14 schematizing and abstracting information	64.4	0.000
		c19 installing computer programs	78.9	0.000
	Communication-Dissemination	c25 creating academic presentations (PowerPoint, etc.)	66.3	0.000
		c26 disseminating information on the Internet (webs, blogs, etc.)	77.5	0.000
Directed	Searching	c1 using printed sources of information (books, papers, etc.)	62.5	0.000
		c2 entering and using automated catalogs	67.5	0.000
		c3 consulting and using electronic sources of primary information	51.3	0.844
		c4 using electronic sources of secondary information (databases, etc.)	70.9	0.000
		c5 knowing the terminology of your subject	85.1	0.000
		c8 knowing information search strategies	55.2	0.020
	Evaluation	c9 assessing the quality of information resources	55.4	0.034
		c10 recognizing the author's ideas within the text	58.3	0.000
		c11 knowing the typology of scientific information sources (theses, proceedings, etc.)	68.3	0.000
		c13 knowing the most relevant authors and institutions within your subject area	75.9	0.000
	Processing	c15 recognizing the structure of a text	63.6	0.000
		c16 using database managers (Access, MySQL, etc.)	62.8	0.000
		c17 using bibliographic reference managers (Endnote, Reference Manager, etc.)	59.2	0.002
		c18 handling statistical programs and spreadsheets (SPSS, Excel, etc.)	65.2	0.000
	Communication-Dissemination	c20 communicating in public	50.7	0.920
		c21 communicating in other languages	67.7	0.000
		c22 writing a document (report, academic work, etc.)	66.0	0.000
		c23 knowing the code of ethics in your academic/professional field	77.1	0.000
		c24 knowing the laws on the use of information and intellectual property	70.9	0.000

TABLE 6
Preference for the Autonomous Learning Style by Gender

Categories	Competencies	Male	Female	*P*-value
Searching	c1 using printed sources of information (books, papers, etc.)	36.40	38.00	0.5462
	c2 entering and using automated catalogues	33.40	32.10	0.6124
	c3 consulting and using electronic sources of primary information	51.40	47.10	0.1162
	c4 using electronic sources of secondary information (databases, etc.)	33.80	27.00	0.0063*
	c5 knowing the terminology of your subject	19.00	13.00	0.0021*
	c6 searching for and retrieving information on the Internet (advanced searches, etc.)	66.80	67.50	0.7853
	c7 using informal electronic sources of information (blogs, etc.)	71.40	73.40	0.4122
	c8 knowing information search strategies	43.00	45.70	0.3216
Evaluation	c9 assessing the quality of information resources	42.60	45.80	0.2400
	c10 recognizing the author's ideas within the text	43.60	40.70	0.2828
	c11 knowing the typology of scientific information (theses, proceedings, etc.)	28.80	33.20	0.0843
	c12 determining whether an information resource is updated	60.2	57.6	0.3354
	c13 knowing the most relevant authors and institutions within your subject area	27	22.7	0.0665
Processing	c14 schematizing and abstracting information	52.00	55.5	0.1995
	c15 recognizing text structure	36	36.7	0.7906
	c16 using database managers (Access, MySQL, etc.)	41.2	35.3	0.0258*
	c17 using bibliographic reference managers (Endnote, Reference Manager, etc.)	41.4	40.6	0.7664
	c18 handling statistical programs and spreadsheets (SPSS, Excel, etc.)	41.4	30.9	0.0000*
	c19 installing computer programs	82	77.4	0.0394*
Communication-Dissemination	c20 communicating in public	50.4	48.8	0.6612
	c21 communicating in other languages	34.6	31.2	0.1845
	c22 writing a document (report, academic work, etc.)	36.2	32.9	0.2034
	c23 knowing the code of ethics in your academic/ professional field	25.6	21.6	0.0823
	c24 knowing the laws on the use of information and intellectual property	29.4	28.9	0.8407
	c25 creating academic presentations (PowerPoint, etc.)	64.8	67.1	0.3742
	c26 disseminating information on the Internet (webs, blogs, etc.)	78	77.2	0.7266

*Significant differences ($p<0.05$)

the learning styles of the IL competencies depending on academic degree, except for cl: *using printed information sources* (Kruskal-Wallis test, $P = 0.656 > 0.05$),[44] c20: *communicating in public* ($P = 0.073 > 0.05$), and c22: *writing a document* ($P = 0.372 > 0.05$). These results provide further evidence that SS students are conditioned by the learning sources at their reach. There is a general tendency toward the directed learning style in all the degree programs, which has been quantified showing the degrees with a higher/lower trend (see tables 7–10 of the appendix).

As a general trend, students prefer directed learning for the 23 IL *competencies* in which significant differences were found by academic degree. The detailed statistical results are shown in tables 1A-4A of the appendix.

To address R4, the possible relationships between students' BI and SE levels and learning styles were analyzed. First, descriptive measures associated with the students' BI and SE values were calculated, distinguishing between autonomous and directed learning styles (see table 7). In this regard, students who prefer an autonomous learning style show higher BI levels, while students who prefer the directed style declare themselves to be more self-efficacious. It seems reasonable to think that students with higher BI and SE levels in some IL competencies, from the knowledge of their intrinsic characteristics, are more able to identify their preferred learning style. The authors agree with Dunn, Dunn, and Price[45] and with Allinson and Hayes[46] when asserting that the learning style may be the most important determinant of educational success.

TABLE 7
Descriptive Measures of BI and SE for IL Competencies with Regard to Competency Categories and Preferred Learning Styles

Learning Style	Searching		Evaluation		Processing		Communication-Dissemination	
Autonomous	**BI**	**SE**	**BI**	**SE**	**BI**	**SE**	**BI**	**SE**
Mean	7.55	6.54	7.81	6.61	7.41	6.22	8.14	6.78
SD	0.92	1.14	0.96	1.11	1.01	1.20	0.76	1.03
Directed	**BI**	**SE**	**BI**	**SE**	**BI**	**SE**	**BI**	**SE**
Mean	7.49	6.70	7.78	6.73	7.39	6.39	8.12	6.82
SD	1.00	1.13	1.07	1.08	1.36	1.13	0.99	1.02

Outcomes are consistent with other research on tendencies for self-learning. A recent study showed that participants with Type I styles (that is to say, more creativity-generating, less structured, and cognitively more complex) had higher levels of university self-efficacy, while students with Type II styles (in other words, more norm-favoring, more structured, and cognitively more simplistic) displayed lower levels.[47]

In addition, the chi-square test of independence was performed to determine the existence of relationships between the levels of BI or SE and learning styles. To satisfy the validity conditions of the chi-square test for contingency tables (the expected value of each cell should be greater than 5), the BI and SE values were recoded into the following three levels: low (from 0 to 4.99), medium (from 5 to 6.99) and high (from 7 to 9). The results reveal some relationship between the levels of both BI and SE and the preferred learning style for most

IL competencies (chi square, $P < 0.05$). The only exceptions are c4: *using electronic sources of secondary information* and c10: *recognizing the author's ideas in the text*, as the expected values of the chi-square test were not reached for these competencies.

Regarding the fifth goal, the most important contribution of this research is the possibility of discriminating between the styles (autonomous or directed) based on the reported BI and SE levels and the degree program (as some correlations between the levels of both BI and SE and the preferred learning style were found). To offer a better answer on this research question, a discriminant analysis was performed for each IL competency. This statistical technique permits predicting the students' preferred learning style.[48] The discriminant analysis provides a classification scheme that allows the following: a) explaining the choice regarding the learning style of the students in the sample; and b) predicting the group to which a new student is most likely to belong, assuming that the BI and SE profiles and the degree program are known.

SPSS directly provides the predicted group membership for the whole sample (see table 8 for selected cases). These model files can be used to apply the model information to other data files for scoring/classification purposes: "export model information to the specified file in XML format." This knowledge allows teachers to modify or reinforce students' previous learning tendencies.

TABLE 8
How the Discriminant Model Works. Predicted Group Membership

		C3			C11			C14			C24		
Id Student	Degree	BI	SE	Predicted Group	BI	SE	Predicted Group	BI	SE	Predicted Group	BI	SE	Predicted Group
1	Aud Comm	9	4	Autonomous	7	5	Autonomous	9	6	Directed	8	7	Directed
2	Inf Science	8	8	Directed	8	7	Directed	8	9	Directed	9	2	Autonomous
3	Journalism	7	7	Autonomous	7	6	Directed	7	6	Autonomous	7	7	Directed
4	Psychology	8	3	Directed	7	3	Directed	9	8	Autonomous	8	8	Directed

More details on the discriminant analysis are included in the appendix. Specifically: a) the discriminant scores obtained by one information science student, with reported levels in BI and SE, are displayed in tables 5A through 8A in the appendix to show how to manually apply the model; and b) the results for the discriminant analyses of the remaining competencies are given in tables 9A through 12A in the appendix.[49] Finally, the capacity of the discriminant models adjusted for each IL competency was obtained, although the discriminating power of the models is visibly lower for competencies c1: *using printed sources of information*, c20: *communicating in public*, and c22: *writing a document*, as no significant differences were found between the degree programs with regard to the learning style in these competencies[50] (see table 13A in appendix).

Summary of Results

- Directed learning is preferred for the four IL competency categories: searching, evaluation, processing, and communication-dissemination. The preference is higher in the categories of searching and evaluation.
- Autonomous learning students show higher belief-in-importance levels; self-efficacious ones prefer the directed style.

- Audiovisual communication, education, and journalism students prefer autonomous learning.
- Information science and psychology students prefer the directed learning style.
- Statistically different profiles by degree program were not found in the competencies c1: *using printed sources of information*, c20: *communicating in public*, and c22: *writing a document*. (Here, students prefer directed style.)
- Within the searching category: Students show a greater preference for the autonomous style in c6: *searching for and retrieving Internet information* (advanced searches) and c7: *using informal electronic sources of information* (blogs, etc.). A higher percentage of women than men report this preference. For the remaining competencies, men generally display a preference for the directed learning style, especially in c4: *using electronic sources of secondary informatio*n (databases, etc.) and c5: *knowing the terminology of your subject*.
- In the evaluation category, the autonomous style is lightly preferred only for c12: *determining whether an information resource is updated*.
- In the processing category, the higher preferences for the autonomous style are found for c14: *schematizing and abstracting information* and c19: *installing computer programs.*
- Within the communication-dissemination category, students clearly declare a preference for an autonomous learning style in c25: *creating academic presentations* (PowerPoint, etc.) and c26: *disseminating information on the Internet* (webs, blogs, etc.).
- Statistically significant differences regarding gender were found only in five competencies: c4: *using electronic sources of secondary information*, c5: *knowing the terminology of your subject*, c16: *using database managers*, c18: *handling statistical programs and spreadsheets*, and c19: *installing computer programs*.
- The source of preferred learning can be predicted from belief-in-importance and self-efficacy levels from a discriminant analysis.

Conclusions and Recommendations

Results shed light on students' process of learning, which in turn may lead to different pedagogical approaches. When competencies are grouped, a higher preference for the directed learning style in the four IL categories (searching, evaluation, processing, and communication-dissemination of information) has been uncovered. Nevertheless, the analysis by degree program shows significant differences concerning preferred learning styles in most competencies.

A significant finding refers to the relationship uncovered between BI levels and learning styles: specifically, the greater belief-in-importance of a competency on the part of students, the larger the preference for autonomous learning. The same way, relationships between levels of SE and their learning styles were also observed, indicating that higher levels of self-efficacy are related to a greater preference for directed learning. This is the main advantage of the discriminant model used here on the base of BI and SE values, as it has the ability to predict learning styles. A better understanding of students' learning styles can reinforce and contribute to improving their academic performance, as faculty and instructors could redirect or strengthen such learning styles according to their better relationships with the students' beliefs and self-efficacy.

In addition, the model provides insight into students' information-seeking preferences, which can be useful for faculty and instructors aiming at promoting effective self-learning, as

results can aid them in preparing online curricular materials and open educational resources associated with the autonomous learning style of the competencies prone to it. Likewise, the model can be of use for faculty and instructors in designing specific tools for face-to-face teaching of those IL competencies that are related to the directed learning style.

Knowing the opinion of faculty members about the importance of the most relevant learning scenarios (classroom, library, courses, and self-learning) in achieving the mastery of each IL competency is a matter of primary concern. In doing so, it would be possible to contrast these results with the information provided by the sample of SS students, thus knowing which learning resources are recommended and if they differ from the resources preferred by students. This would allow linking three important elements—experts' opinions, students' beliefs, and learning styles—of any learning process, which consequently could be applied to each discipline.

This pioneering evidence-based research has revealed key results on how an interuniversity group of students belonging to eight undergraduate degree programs within the field of Social Sciences perceives, behaves, and relates with regard to a series of IL competencies. The rigorous and comprehensive nature of the statistical model used makes it transferable and applicable to the analysis and evaluation of other key transversal competencies for students' global learning.

APPENDIX

TABLE 1A
Attitudes toward Directed Learning by Degree Program; Searching Category

Searching	Higher trend toward directed learning	Lower trend toward directed learning
c2	Information Science	Education
c3	Information Science/ Psychology	Audiovisual Communication/5-Journalism
c4	Information Science/Psychology/ Tourism	Education
c5	Information Science/Pedagogy/Psychology	Education/Journalism
c6	Information Science	Audiovisual Comm./Education/Pedagogy / Journalism/Psychology/Social Work /Tourism
c7	Information Science	Audiovisual Communication/Social Work
c8	Information Science	Primary Education

TABLE 2A
Attitudes toward Directed Learning by Degree Program; Evaluation Category

Evaluation	Higher trend towards directed learning	Lower trend towards directed learning
c9	Information Science	Audiovisual Comm../Education/Pedagogy / Journalism/Psychology/Social Work /Tourism
c10	Education/Information Science/Tourism	Journalism/Psychology
c11	Information Science	Audiovisual Comm../Education/Pedagogy / Journalism/Psychology/Social Work /Tourism
c12	Information Science	Audiovisual Communication/Journalism
c13	Information Science/Psychology/Social Work	Journalism
c14	Information Science/ Education	Psychology

TABLE 3A
Attitudes toward Directed Learning by Degree Program; Processing Category

Processing	Higher trend towards directed learning	Lower trend towards directed learning
c15	Information Science/Education	Psychology
c16	Information Science/Tourism	Audiovisual Communication
c17	Information Science	Audiovisual Communication/Education
c18	Pedagogy/Psychology/Tourism	Audiovisual Communication
c19	Information Science	Audiovisual Communication/ Journalism

TABLE 4A
Attitudes toward Directed Learning by Degree Program; Communication-Dissemination Category

Communication-Dissemination	Higher trend towards directed learning	Lower trend towards directed learning
c21	Education/Information Science/Pedagogy	Psychology
c23	Psychology/ Information Science/ Social Work	Education
c24	Information Science/ Audiovisual Communication	Psychology/ Social Work
c25	Tourism/Pedagogy/Information Science	Audiovisual Communication/ Journalism
c26	Information Science/Education	Psychology/Audiovisual Comm./ Social Work

DISCRIMINANT ANALYSIS and Fisher's functions

Mathematically, the discriminant analysis consists of a linear transformation of the explanatory variables to obtain functions with the capacity to classify other individuals.

The discriminant models[39] for the selected competencies (one per category), c3 *consulting and using electronic sources of primary information*, c11 *knowing the typology of scientific information sources*, c14 *schematizing and abstracting information*, and c24 *knowing the laws on the use of information and intellectual property,* are listed in tables 5A–8A for student labeled "2" in table 8. Discriminant scores (one variable for each discriminant function in the solution) are also included to show how the model works.

TABLE 5A
How the Discriminant Model Works for Competency c3; Discriminant Scores

	Fisher's Standardized Function Coefficients										***Score***	***Assigned group***
c3	**BI**	**SE**	**Audiovisual Comm.**	**Information Science**	**Journalism**	**Pedagogy**	**Education**	**Psychology**	**Social Work**	**Constant**		
Directed	4.22	1.54	8.56	7.25	7.82	7.60	6.57	7.68	8.74	–25.69	27.64	X
Autonomous	4.23	1.69	8.92	7.50	6.33	6.83	6.86	6.50	8.15	–24.63	27.23	
Reported	8	8	0	1	0	0	0	0	0			

TABLE 6A
How the Discriminant Model Works for Competency c11; Discriminant Scores

	Fisher's Standardized Function Coefficients										***Score***	***Assigned group***
c11	**BI**	**SE**	**Audiovisual Comm.**	**Information Science**	**Journalism**	**Pedagogy**	**Education**	**Psychology**	**Social Work**	**Constant**		
Directed	2.45	0.93	8.25	8.66	7.22	7.83	7.76	8.22	8.67	–15.99	18.78	X
Autonomous	2.56	0.79	8.28	8.99	6.21	7.63	7.53	8.54	9.02	–14.03	16.97	
Reported	8	7	0	1	0	0	0	0	0			

TABLE 7A
How the Discriminant Model Works for Competency c14; Discriminant Scores

	Fisher's Standardized Function Coefficients										***Score***	***Assigned group***
c14	**BI**	**SE**	**Audiovisual Comm.**	**Information Science**	**Journalism**	**Pedagogy**	**Education**	**Psychology**	**Social Work**	**Constant**		
Directed	8.15	2.68	9.19	6.14	9.39	7.33	7.04	6.36	8.92	–46.78	47.68	X
Autonomous	8.21	2.94	9.22	5.69	8.77	7.35	7.29	6.95	9.02	–50.36	47.47	
Reported	8	9	0	1	0	0	0	0	0			

TABLE 8A
How the Discriminant Model Works for Competency c24; Discriminant Scores

	Fisher's Standardized Function Coefficients										***Score***	***Assigned group***
c24	**BI**	**SE**	**Audiovisual Comm.**	**Information Science**	**Journalism**	**Pedagogy**	**Education**	**Psychology**	**Social Work**	**Constant**		
Directed	2.85	0.90	6.49	8.28	7.63	7.18	6.49	7.49	8.72	–17.76	17.97	
Autonomous	2.92	0.62	5.55	8.32	6.41	7.23	5.63	7.65	8.83	–16.43	19.41	X
Reported	9	2	0	1	0	0	0	0	0			

From tables 5A–8A, this student would choose a directed learning style for competencies c11 and c24, while he would prefer an autonomous style for competencies c3 and c14 (as he is assigned to the group in which the highest score is obtained, highlighted in yellow).

To evaluate the efficiency of the discriminant models adjusted for each IL competency, classification tables were obtained using the Jackknife method or leave-one-out procedure.[39] These tables provides the percentage of correctly classified cases and hence the discrimination capacity of the model. Results are included in table 13A.

Wilks' Lambda was used to assess the discriminating power of the functions.[39] The scale ranges from 0 to 1, where values closer to 0 indicate the greater discriminant power of the variables considered (see table 13A). The Wilks' Lambda values are quite high, thus demonstrating the presence of overlapping between groups. The transformed Wilks' Lambda values (chi square) are significant, indicating that the variances of each group are different and the discriminant analysis can be applied.[40] In this study, we have considered the intra-group correlations and the previous probability of belonging to a specific group according to the size of the group. The nominal variable "degree program" was recoded into eight dichotomous dummy variables (one for each program). The dummy variables take the value of 1 if the student is in that program and zero otherwise. The discriminant functions obtained minimize the likelihood of classification error.

1. SEARCHING

TABLE 9A
Coefficients of the Discriminant Functions for the Competencies of the Searching Category

		BI Cat	SE Cat	Audiovisual Comm.	Information Science	Journalism	Pedagogy	Education	Psychology	Social Work	Constant
c1	Directed	18.62	4.28	8.55	7.01	6.90	7.39	7.57	6.90	8.61	–36.13
	Autonomous	18.76	4.49	8.62	6.64	7.14	7.23	7.70	7.11	8.49	–37.64
c2	Directed	6.83	2.23	8.48	6.41	7.81	7.77	8.80	8.06	8.77	–15.64
	Autonomous	7.01	2.22	8.39	4.95	7.32	7.51	9.19	7.48	8.17	–16.61
c4	Directed	9.76	2.14	8.20	6.90	7.98	8.44	8.43	7.79	9.15	–19.80
	Autonomous	9.91	2.23	9.17	6.04	8.14	8.55	10.14	7.57	9.52	–21.94
c5	Directed	21.99	2.73	8.08	8.59	8.46	9.13	8.20	6.67	8.33	–39.17
	Autonomous	22.16	2.54	8.81	8.47	9.36	9.13	9.07	6.58	8.48	–41.39
c6	Directed	21.15	3.03	7.55	7.87	8.20	8.56	7.50	9.18	10.20	–38.81
	Autonomous	21.48	3.57	7.21	5.41	7.74	8.14	7.45	8.74	10.18	–39.97
c7	Directed	7.58	4.51	8.82	8.73	7.85	8.30	8.76	10.50	9.35	–20.98
	Autonomous	7.37	5.13	9.56	7.36	8.26	8.21	8.71	10.81	10.07	–21.09
c8	Directed	4.96	1.57	8.62	7.13	9.06	8.09	7.81	8.28	9.12	–12.30
	Autonomous	5.04	1.45	8.53	5.07	7.83	7.78	8.37	8.42	8.93	–12.25

2. PROCESSING

TABLE 10A
Coefficients of the Discriminant Functions for the Competencies of the Processing Category

		BI cat	SE cat	Audiovisual Comm.	Information Science	Journalism	Pedagogy	Primary Education	Psychology	Social Work	Constant
C9	Directed	18.71	2.75	7.76	9.41	8.20	9.61	7.81	8.26	10.13	–34.53
	Autonomous	18.99	2.93	8.06	8.32	8.29	9.52	8.28	8.41	10.14	–36.12
C10	Directed	28.78	3.27	7.30	7.92	7.94	7.16	7.10	5.94	8.67	–50.07
	Autonomous	28.71	3.67	7.43	7.80	8.76	7.03	7.02	6.62	8.80	–51.52
C12	Directed	15.82	3.20	7.92	8.32	7.23	9.76	8.58	9.04	10.22	–30.92
	Autonomous	16.35	3.24	8.44	7.10	7.92	9.38	8.79	8.76	10.25	–32.24
C13	Directed	12.94	1.71	6.62	7.46	6.35	6.17	7.68	6.88	7.47	–23.70
	Autonomous	13.22	1.40	6.85	6.66	7.11	6.03	7.89	6.64	7.16	–25.00

3. EVALUATION

TABLE 11A
Coefficients of the Discriminant Functions for the Competencies of the Evaluation Category

		BI cat	SE cat	Audiovisual Comm.	Information Science	Journalism	Pedagogy	Primary Education	Psychology	Social Work	Constant
C15	Directed	16.32	6.36	8.33	7.73	7.88	6.86	6.62	8.18	9.71	–35.79
	Autonomous	16.44	6.62	8.30	7.24	8.06	6.99	6.37	8.71	9.98	–37.48
C16	Directed	5.70	2.22	10.49	8.06	10.79	9.12	9.77	9.60	10.79	–14.48
	Autonomous	5.75	1.77	11.88	7.43	11.24	9.43	10.97	10.22	11.47	–14.93
C17	Directed	4.71	1.82	8.90	7.90	9.46	8.51	8.42	8.47	9.27	–12.05
	Autonomous	4.87	1.29	9.51	6.89	9.05	8.21	9.07	8.45	9.13	–11.95
C18	Directed	7.88	2.02	11.95	9.57	11.46	10.55	10.26	9.50	10.67	–17.78
	Autonomous	8.07	1.98	14.41	10.07	13.30	10.64	11.69	9.47	11.82	–20.02
C19	Directed	6.16	2.56	7.97	9.10	9.79	9.51	9.17	10.37	10.45	–16.08
	Autonomous	6.50	3.32	9.17	7.83	10.56	9.30	9.49	11.04	10.98	–17.71

4. COMMUNICATION

TABLE12A
Coefficients of the Discriminant Functions for the Competencies of the Communication Category

		BI cat	SE cat	Audiovisual Comm.	Information Science	Journalism	Pedagogy	Primary Education	Psychology	Social Work	Constant
C20	Autonomous	49.44	2.73	9.23	12.32	7.47	9.34	7.70	9.12	11.78	–80.70
	Directed	49.86	2.94	9.68	12.81	7.45	9.49	7.74	9.73	11.84	–82.73
C21	Autonomous	18.61	2.54	9.88	11.95	9.52	12.68	10.64	10.30	13.15	–34.61
	Directed	18.57	2.63	10.32	11.79	9.67	12.63	10.44	11.08	13.54	–35.58
C22	Autonomous	68.22	2.96	7.29	9.79	8.08	10.64	7.30	6.14	11.58	–109.18
	Directed	68.17	2.98	7.74	9.93	8.43	10.53	7.53	6.41	11.82	–109.97
C23	Autonomous	17.85	1.72	8.39	9.62	7.37	7.57	7.12	6.53	7.70	–31.45
	Directed	17.82	1.72	8.02	8.65	6.89	7.35	7.62	5.37	6.83	–32.34
C25	Autonomous	18.57	14.31	11.32	11.79	10.54	7.81	8.50	11.05	10.42	–52.32
	Directed	18.66	14.69	12.30	11.94	11.43	7.88	8.77	11.83	10.74	–53.44
C26	Autonomous	17.98	5.92	8.60	8.81	6.91	8.46	10.04	12.62	10.00	–39.20
	Directed	17.99	6.36	9.18	7.84	7.28	8.42	9.67	13.22	10.76	–39.23

5. RESULTS OF THE CLASSIFICATION

TABLE 13A
Wilks' Lambda Values and Predictive Capacity of the Models

Category	Competency	Wilks' Lambda chi^2 (sig.)	% Correctly Classified Cases (Jackknife)
Searching	C1	0.688/ (0.028)*	68.5
	C2	0.651/ (0.000)	77.5
	C3	0.501/ (0.000)	73.7
	C4	0.693/ (0.000)	81.4
	C5	0.576/ (0.000)	85.1
	C6	0.509/ (0.000)	81.2
	C7	0.529/ (0.000)	83.7
	C8	0.483/ (0.000)	71.5
Processing	C9	0.557/ (0.000)	67.5
	C10	0.562/ (0.000)	71.1
	C11	0.561/ (0.000)	78.2
	C12	0.535/ (0.000)	73.1
	C13	0.466/ (0.000)	85.9
Evaluation	C14	0.559/ (0.000)	73.2
	C15	0.477/ (0.000)	73.2
	C16	0.402/ (0.000)	75.3
	C17	0.512/ (0.000)	74.0
	C18	0.473/ (0.000)	78.8
	C19	0.492/ (0.000)	90.0
Communication-Dissemination	C20	0.580/ (0.000)	66.3
	C21	0.476/ (0.000)	77.6
	C22	0.445/ (0.524)*	66.0
	C23	0.547/(0.000)	87.1
	C24	0.514/ (0.000)	82.2
	C25	0.569/ (0.000)	78.4
	C26	0.552/ (0.000)	87.6

* Not significant 5%

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