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Abstract

This study stems from the increasing importance of key competences, and especially of information literacy, in secondary education. This research aimed to evaluate the efficacy of a specific training program on information literacy for future secondary school teachers. A pre-experimental design with minimal control and pretest-posttest was devised through an ad hoc instrument, which evaluated the subjects' actual level of information literacy. The study was carried out with a representative sample of future secondary education teachers from Castile and Leon, who were undertaking the Master's degree in Secondary Education Teacher Training. In the hypothesis testing, the results of the calculation of the effect size show that the training program, which was delivered online, was very effective in teaching conceptual (or *knowledge*-related) contents (g>1.15), moderately effective in teaching *skill*-related contents (1.15>g>0.5) and ineffective in teaching *attitudes* (g<0.5). The graphic analysis also shows that the learning patterns are different for each component according to the initial level reached in the pretest. The study concludes by confirming the effectiveness of the program, noting the importance of explicit teacher training on key competences, specifically in information literacy competences, and by analyzing the relevance of this type of training for the integration of key competences in the teaching-learning processes

implemented in the different school subjects. Finally, the paper proposes a future study on the impact of information literacy teacher training on the students' achievement, taking into consideration the limitation of splitting the competence into its constituent parts to evaluate it, disregarding its holistic nature.

Keywords: Secondary teacher education; information literacy; teacher qualifications; summative evaluation; basic education; life skills.

Resumen

Ante la importancia creciente concedida a las "competencias básicas" en la educación secundaria obligatoria, en concreto a las competencias informacionales, se presenta este estudio, cuyo objetivo ha sido la evaluación de la eficacia de un programa de formación específica en competencias informacionales para futuros profesores de educación secundaria. Metodológicamente, se planteó un diseño pre-experimental de control mínimo con pretest y postest mediante la aplicación de un instrumento de evaluación del nivel real en competencias informacionales diseñado ad hoc a una muestra representativa de futuros profesores de educación secundaria de Castilla y León, estudiantes del Máster de profesorado. En el contraste de las hipótesis planteadas, los resultados, a partir del cálculo del tamaño del efecto, muestran cómo el programa, de carácter online, fue muy eficaz en el aprendizaje de contenidos relacionados con el saber ($g>1.15$), moderadamente eficaz en la enseñanza de contenidos relacionados con el saber hacer ($1.15>g>0.5$) y poco eficaz en la adquisición de actitudes o saber ser ($g<0.5$), con tendencias de aprendizaje diferenciadas en cada componente en función del nivel inicial mostrado en el pretest. Se concluye corroborando la eficacia del programa, señalando la importancia de la formación explícita del profesorado en competencias básicas, más específicamente en competencias informacionales, y analizando la relevancia de este tipo de formación para la integración de las competencias básicas en los procesos de enseñanza-aprendizaje desarrollados en las diversas materias. Finalmente, se propone el futuro estudio del impacto de la formación del profesorado en competencias informacionales sobre el aprendizaje alcanzado por los estudiantes, teniendo en cuenta la limitación propia de fragmentar la competencia en sus partes constituyentes para evaluarla, sin atender a su naturaleza holística.

Palabras clave: Formación de docentes de educación secundaria; alfabetización informacional; competencias del docente; evaluación sumativa; educación básica; competencias para la vida.

Problem statement

Thanks to the emergence of competency-based learning and the importance it has gained (Martínez Clares and Echeverría Samanes, 2009; Villa Sánchez and Poblete Ruiz, 2009) the development of a series of key competences considered indispensable to all citizens of the 21st century society is generalized in many education systems, both at national (Boletín Oficial del Estado, 2007) and international level (Diario Oficial de la Unión Europea, 2006).

The novel character of the competency-based model for basic education teacher training, together with the transversal nature attributed to the key competences, adds difficulties to the proper development and implementation of these competences in the teaching-learning process. In fact, even though the initial secondary education teacher training programs define teachers as competent people in the integration of the key competences into the educational process (Tribó Travería, 2008), said programs don't pay any specific attention to key competences within their training plans.

Therefore, some doubts arise on the ability of secondary education teachers to integrate into the educational process a series of contents on which they have not received explicit training, and this brings up the need to implement educational processes and programs that facilitate the specific training of teachers and future teachers regarding key competences.

Thus, the present study focuses on the training of future secondary education teachers on information literacy, which is a key competence integrated in the Spanish curriculum under the name *'information processing and digital competence'*. We designed and implemented a specific training program dealing with information literacy, and we evaluated its efficacy through the pretest and posttest application of an ad-hoc instrument that evaluates the level of real or objective competence and non-perceived or subjective competence (Rodríguez Conde, Olmos Miguéláñez, and Martínez Abad, 2013).

State of the art

Despite their official origin and development being placed in the last third of the 20th century (American Library Association, 1989; Zurkowski, 1974),

the main progress of the theoretical body of information literacy was actually made in the early 21st century, with the development of manuals and standards related to the contents of said competence (ALA/ACRL, 2000; Bundy and ANZIIL, 2004; CAUL, 2001; SCONUL, 2001). However, in the current literature one can still find theoretical studies that point out the main topics to be discussed in any training action dealing with information literacy (Forrest and Simpson, 2007; Johnston and Webber, 2003; Spring, 2010). This kind of studies, which usually consist of literature reviews, have proliferated in the first decade of the 21st century, and are still common nowadays (Diehm and Lupton, 2012; González Teruel, 2011; Leguízamo León and García Carrasco, 2011; Mackey and Jacobson, 2011).

In this regard, despite the current reluctance to implement decontextualized programs for information literacy training whose aim is merely the competence itself, the majority of studies are limited to directly implementing the program (Appleton, 2005; Grant and Brettle, 2006; Oliver and Perzylo, 1994; Rangachari and Rangachari, 2007; Saito and Miwa, 2007), although there are some exceptions in which the program is developed within proper curricular contents (Beishuizen and Stoutjesdijk, 1999; Kuiper, Volman, and Terwel, 2009).

On the other hand, even though information literacy has been defined as a construct (Van Helvoort, 2010), the literature is noticed to have a good number of studies that work only with one of the theoretical dimensions that make up this competence. This break up is mainly due to the evidence (Rodríguez Conde, Olmos Migueláñez, and Martínez Abad, 2012; Rodríguez Conde, Olmos Migueláñez, Pinto Molina, Martínez Abad, and García Riaza, 2011) suggesting that this competence is highly complex and it benefits from being analyzed in a fragmented way rather than in a holistic one:

■ *Information searching*: Within this dimension we can find studies from different fields, including Library and Information Sciences, Computer sciences or Education. Main evidences suggest that to ensure a sound learning of *information searching* it is necessary to plan training actions that include continuous help or feedback (Puustinen and Rouet, 2009) and which allow for a later reflection in and on the actions (Saito and Miwa, 2007). On the other hand, the role of previously formulated questions or main search topics

seems to be crucial (Kuiper et al., 2009), and they must be specific and focused on the objective. These studies usually incorporate some modules related to the *evaluation of information* within the training programs, because it constitutes a more limited field and it is closely linked with information searching.

- *Information processing*: This is another usual field in scientific studies, especially the elements that have to do with text comprehension and its related learning difficulties (Acuña Castillo, García Rodicio, and Sánchez Miguel, 2011; Beishuizen and Stoutjesdijk, 1999; Oliver and Perzylo, 1994; Rosales, Sánchez Miguel, and Pérez, 2004; Sánchez Miguel, Rosales, and Cañedo, 1998). Given the relevant tradition of the research on this topic, the studies are highly experimental.
- *Information communication and dissemination*: It is worth mentioning the progress made over the past few years by studies on media literacy (Appel, 2012; Austin, Pinkleton, Austin, and Van de Vord, 2012; Camps Cervera, 2009; González Fernández-Villavicencio, 2012; Grizzle, Wilson, and UNESCO, 2011; Jeong, Cho, and Hwang, 2012; Kesten, 2012; Pérez Tornero, 2008), which is becoming a prolific research field and, in many cases, separated from information literacy (although closely linked with it).

In addition to studies that specifically analyze one of the dimensions that make up the information literacy competence, there are also attempts to develop training programs to teach information literacy as a whole (Appleton, 2005; Grant and Brettle, 2006; Rangachari and Rangachari, 2007). In this regard, the studies we located suffer from a lack of a broad definition of competences that provides a proper basis for the devised training program, which in all cases is of the authors' making. As for the evaluation of these programs' efficacy, it is carried out through instruments, which sometimes are designed ad hoc, with no previous validation (Appleton, 2005; Grant and Brettle, 2006) and other times are extracted from other studies, and they may measure self-perception (Rangachari and Rangachari, 2007). This way, it could be said that, on a general level, the evaluation instruments are improvable, regarding both the reliability and validity of their measurements.

Finally, in all cases, the results and findings indicate that these programs favor the development of more appropriate and effective

behaviors related to information literacy, and in some cases there is even a tendency towards the improvement of academic performance in subjects who have acquired a good level of information literacy (Appleton, 2005).

Consequently, at this point of the research, the following questions are posed:

- Will the design of a program specifically focused on contents related to information literacy optimize the acquisition of this competence on the part of future secondary education teachers?
- How can we evaluate the level of information literacy achieved in an authentic and objective way?
- Will the importance assigned by future teachers to information literacy change after the course? In which direction?

Research methodology

Based on the context presented above, and bearing in mind that the **design** of choice is a pre-experimental design with minimal control (Campbell and Stanley, 1963), implemented in a group with pretest and posttest measurements, we can formulate the following research hypothesis: *the future secondary education teachers that have undertaken the designed training program, under the conditions established by the research, will achieve a higher level of information literacy than their previous one.* Therefore, we intend to provide a validated program for the improvement of this collective's level of information literacy. In this kind of design, one cannot control some external variables that can bias the results, and eliminate the internal validity of the study (Campbell and Stanley, 1973). However, since the members of the sample belong to different groups of students from the Master's degree in Secondary Education Teacher Training, the academic events that could transpire during the application of the treatment would not affect all subjects in the same way. Therefore, we can't claim that these events are the cause of the global differences that were registered.

From the evidences shown by Juanes and Ruiz-Canela (2008), who carried out a meta-analysis of the results from more than 200 training programs, this study will test three hypotheses, which indicate that the treatment will achieve:

- H_1: large effects in the component **knowledge**.
- H_2: medium effects in the component **skills**.
- H_3: small effects in the component **attitudes**.

Thus, the **dependent variable** (level achieved in the different dimensions of information literacy) will be measured before and after administering the program for the improvement of information literacy competence.

The treatment consists of the online implementation of a training program through the platform Moodle 1.9. This program was planned to be delivered in an extensive way over 40 hours, to be implemented between January and February 2012. It is made up by 12 individual and group activities (both in medium and large groups), divided in 4 content blocks which correspond to the dimensions of information literacy (information searching, evaluation, processing and communication). The selection of the contents included in the program was made on the basis of the criteria set by the standards of the different institutions we consulted (ALA/ACRL, 2000; Bundy and ANZIIL, 2004; CAUL, 2001; CRUE-TIC and REBIUN, 2009; SCONUL, 2001). As for the interface of the space allotted for the program within Moodle, a certain criteria were maintained so that the exchange of information, the access to it and the evaluation were optimal (Carvalho Levy, 2005; Nielsen, 1989). Consequently, the recommendations proposed by Weis (2001) were considered for the design of the interface.

For the evaluation of the program, and again on the basis of the abovementioned standards, we designed an instrument with four types of scales to assess the three studied components differentially:

- Objective test (*knowledge*): Composed by items with four response options.
- Ordinal scale (*skills*): Subjects must establish the correct order in which they would carry out a given operation according to the wording of the item. The items are made up by four phases the subjects have to arrange in the proper order.
- Performance pills (*skills*): Subjects are asked to carry out a brief activity in which they have to show evidence of a skill related to information literacy.
- Attitude scale (*attitudes*): The survey on the perception of the importance of information literacy IL-HUMASS developed by Pinto (2009) was applied.

Once the items were designed, we conducted a validation process carried out by nine expert judges (secondary education teachers and guidance counselors; university professors from the fields of computer sciences, communication and information and library sciences) under adequacy and relevance criteria. The results of this validation originated some small changes in the wording of twenty-five items, some deep changes in thirteen items due to moderate problems of relevance and adequacy and, finally, seven items were removed due to severe relevance problems. In the end, out of the eighty-seven items that made up the initial instrument, we obtained a scale composed of eighty items[1].

Lastly, we checked the reliability of the scales through the calculation of the difficulty and discrimination indexes of each item from the objective test, the item-total statistics of the attitude scale, and the reliability indexes of each dimension and the instrument as a whole based on the Kuder-Richardson coefficient (KR_{20}) and Cronbach's alpha. After these verifications, we removed four items of the objective test from the final analysis due to low discrimination issues. Regarding the difficulty of the objective test, we obtained indexes within acceptable levels and well distributed among the different levels of difficulty, and as for the reliability, it yielded an acceptable global value (KR_{20}=.765). Regarding the scales designed for the evaluation of the *skills* component, the number of items per dimension is small, so the employment of internal consistency techniques was deemed inadequate, and we relied on the validation process carried out by the expert judges.

The reliability of the attitude scales, measured with Cronbach's alpha, yielded satisfying results, both in each of the dimensions ($\alpha_{searching}$=.88; $\alpha_{evaluation}$=.85; $\alpha_{processing}$=.78; $\alpha_{communication}$=.81) and the scale as a whole (α=.94).

Given the experimental nature of this study, we don't have enough resources to take on a bigger sized **sample**. For this reason, to ensure representativeness, instead of applying the criterion of sample size calculation, we tested the hypothesis of the adjustment of subject distribution by teaching groups to the population distribution through the goodness of fit test (based on Chi-square). Since the table value of the test statistic $\chi^2_{9;.05}$**=16.919 >** χ^2**=2.17**, which is the value obtained in the test, we don't reject H_0, and we assume that the sample distribution

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[1] To see the full instrument, please follow this link http://bit.ly/1aEQhRf

is adjusted to the population distribution regarding the distribution of subjects in the different specialties of the Master's degree in Secondary Education Teacher Training. On the other hand, we checked the sample's randomness through the run test, obtaining satisfying results for each of the variables (α=.05; p-value=.05) and therefore confirming the independence between the observations of the sample.

Regarding the **data analysis**, an initial exploratory analysis was performed through the study of the distribution of the analyzed variables, which led to the decision to employ the following techniques: parametric (Tejedor Tejedor, 1999, 2006), parametric with trimmed mean (Borges del Rosal, Sánchez Bruno, and Cañadas Osinski, 2000) or non-parametric (Corder and Foreman, 2009; Siegel, 1970), where appropriate. Along with the hypothesis testing, we calculated the effect size based on Hedges' (1982) g statistic. Lastly, we performed a more detailed **graphic study** of the variables that had shown a difference of a T score (50, 15) in relation to the standardized variables.

Results

The exploration of the distributions through the scatter diagram (graph I) shows that the variables seem to adjust to the normal distribution despite having slight asymmetries. In the case of the variables belonging to the *attitudes* component, we located several outliers that can be extreme in the lower scores, thus making it appropriate to use the trimmed mean technique, trimming the bottom 5% of the scores.

GRAPH I. Pretest. Density functions.
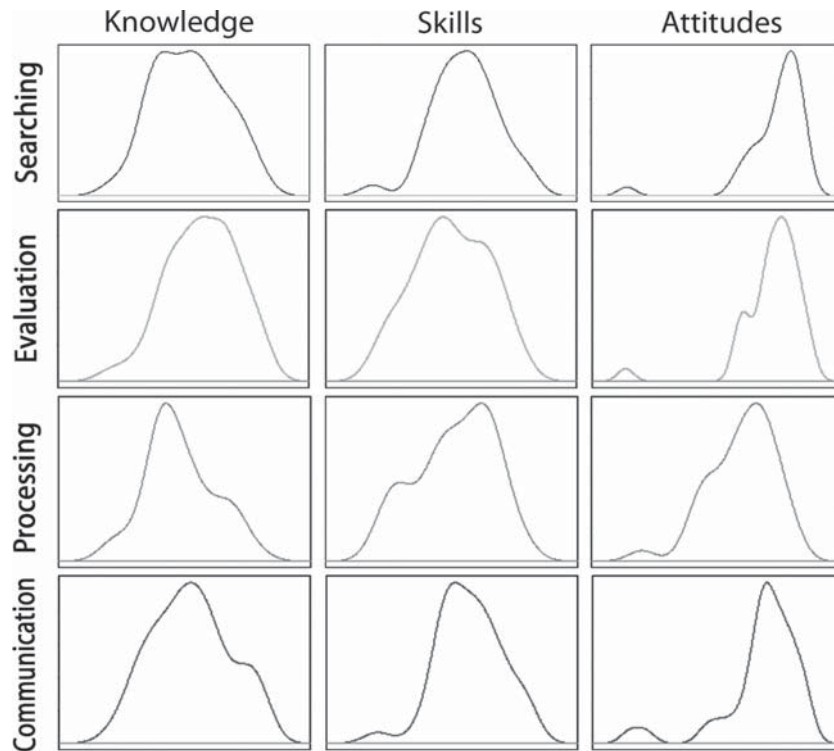
The results of table I support the observations derived from the analysis of the density functions. The asymmetry and kurtosis indexes, once the bottom 5% of the scores from the *attitudes* component were trimmed, were found to be close to the limits of the normal distribution. On the other hand, the Kolmogorov-Smirnov test shows that all variables adjust to a normal distribution.

TABLE I. Pretest. Exploration of the basic statistics for standardized T scores.

Pretest	Asymmetry		Kurtosis		K-S	
	Value	*Std. Error*	*Value*	*Std. Error*	*Z*	*p.*
Searching. Knowledge	0.09	0.39	-0.72	0.77	0.879	.422
Searching. Skills	-0.28	0.39	0.74	0.77	0.374	.999
*Searching. Attitudes**	0.10	0.40	-0.78	0.78	1.126	.158
Evaluation. Knowledge	-0.35	0.39	-0.19	0.77	1.030	.239
Evaluation. Skills	-0.10	0.39	-0.83	0.77	0.529	.943
*Evaluation. Attitudes**	-0.42	0.40	-0.10	0.78	1.075	.198
Processing. Knowledge	0.29	0.39	-0.18	0.77	1.123	.160
Processing. Skills	-0.37	0.39	-0.90	0.77	0.690	.728
*Processing. Attitudes**	0.25	0.40	-0.23	0.78	0.639	.808
Communication. Knowledge	0.12	0.39	-0.74	0.77	0.724	.672
Communication. Skills	-0.28	0.39	0.71	0.77	0.588	.879
*Communication. Attitudes**	0.10	0.40	-0.80	0.78	1.280	.076

* Mean trimmed at 5% for bottom scores

Therefore, we don't reject the hypothesis that the variables are adjusted to the normal distribution. In conclusion, to test the significance of the treatment, we will perform a parametric hypothesis testing through a t-test for dependent samples, and we will be able to calculate the parametric effect size based on Hedges' g in all cases.

If we study the basic descriptive statistics of the pretest-posttest variables, in table II we can observe how the differences between the means always favor the posttest, meaning that the subjects have improved their performance in all components of the four studied dimensions.

TABLE II. Descriptive statistics and pretest-posttest mean differences

	n	Pretest		Posttest		$\bar{X}_{posttest}$- $\bar{X}_{pretest}$
		$\bar{X}$	S_x	$\bar{X}$	S_x	
Searching. Knowledge	36	0.42	0.20	0.72	0.16	0.30
Searching. Skills	36	20.50	3.31	22.22	2.07	1.72
*Searching. Attitudes**	34	7.97*	0.65	8.15*	0.56	0.18
Evaluation. Knowledge	36	0.37	0.27	0.71	0.24	0.34
Evaluation. Skills	36	19.69	3.31	22.08	2.52	2.39
*Evaluation. Attitudes**	34	7.81*	0.71	8.14*	0.51	0.23
Processing. Knowledge	36	0.47	0.24	0.72	0.22	0.25
Processing. Skills	36	21.03	2.64	23.39	2.24	2.36
*Processing. Attitudes**	34	7.34*	0.96	7.66*	0.64	0.32
Communication. Knowledge	36	0.38	0.28	0.61	0.18	0.23
Communication. Skills	36	21.97	3.07	24.44	2.18	2.47
*Communication. Attitudes**	34	8.00*	0.65	8.13*	0.66	0.13

* Mean trimmed at 5%

Finally, if we perform a hypothesis contrast through a t-test for dependent samples (table III), we obtain significant differences between the pretest and the posttest, favoring the posttest in most of the variables.

TABLE III. Hypothesis testing. t-test for dependent groups (pretest-posttest)

		t	p.	Effect size	
				g	p.
Searching. Knowledge	36	8.92	.00	1.84	.97
Searching. Skills	36	3.84	.00	0.83	.80
*Searching. Attitudes**	34	**1.76***	**.09***	0.31*	.62*
Evaluation. Knowledge	36	5.82	.00	1.42	.92
Evaluation. Skills	36	4.58	.00	0.95	.83
*Evaluation. Attitudes**	34	2.92*	.01*	0.66*	.75*
Processing. Knowledge	36	4.76	.00	1.12	.87
Processing. Skills	36	5.59	.00	1.05	.85
*Processing. Attitudes**	34	2.30*	.03*	0.49*	.69*
Communication. Knowledge	36	4.45	.00	1.28	.90
Communication. Skills	36	5.92	.00	1.13	.87
*Communication. Attitudes**	34	**1.22***	**.23***	0.18*	.57*

* Mean trimmed at 5%

While all dimensions yield significant differences in the components *knowledge* and *skills*, the component *attitudes* presents significant differences in the evaluation and processing dimensions and non-significant differences in the searching and communication dimensions.

It seems that the initial hypothesis can be accepted, since the subjects seem to show a better performance in the posttest in the components of most of the evaluated dimensions. The subjects show a clear improvement in their level of information literacy.

Despite the misgivings of some statisticians and psychometrists about considering large, medium and small effect sizes (Glass, McGaw, and Smith, 1981), it seems clear that this classification helps interpret these indexes in a more simple way. Thus, by testing the three hypotheses on the basis of the extent of the significant differences (effect sizes) and according to the criterion proposed by Hopkins (2000), we find the following sizes:

- Large (g>1.15) in the variables belonging to the component *knowledge*. This entails that the treatment has improved the subjects' conceptual knowledge on information literacy in an important way (we accept H_1).
- Medium (1.15>g>0.5) in the variables belonging to the component *skills*. This component reaches medium to medium-large effect sizes in all dimensions. This means that the course has been effective in the development of the procedural component of information literacy (we accept H_2).
- Small (g<0.5) in the component *attitudes*. In this case, the variables related to the attitudes are the ones that have experienced the lowest improvement, since they have got small to medium-small effect sizes (we accept H_3).

Once we confirmed that there are significant differences in most of the variables between the pretest and posttest measurements, and that the effects of the differences are large in many cases, it is worth exploring the exact behavior of the variables along the progress of the study through a more in-depth graphic analysis.

GRAPH II. Scatter diagrams and bidimensional variables histogram. Knowledge
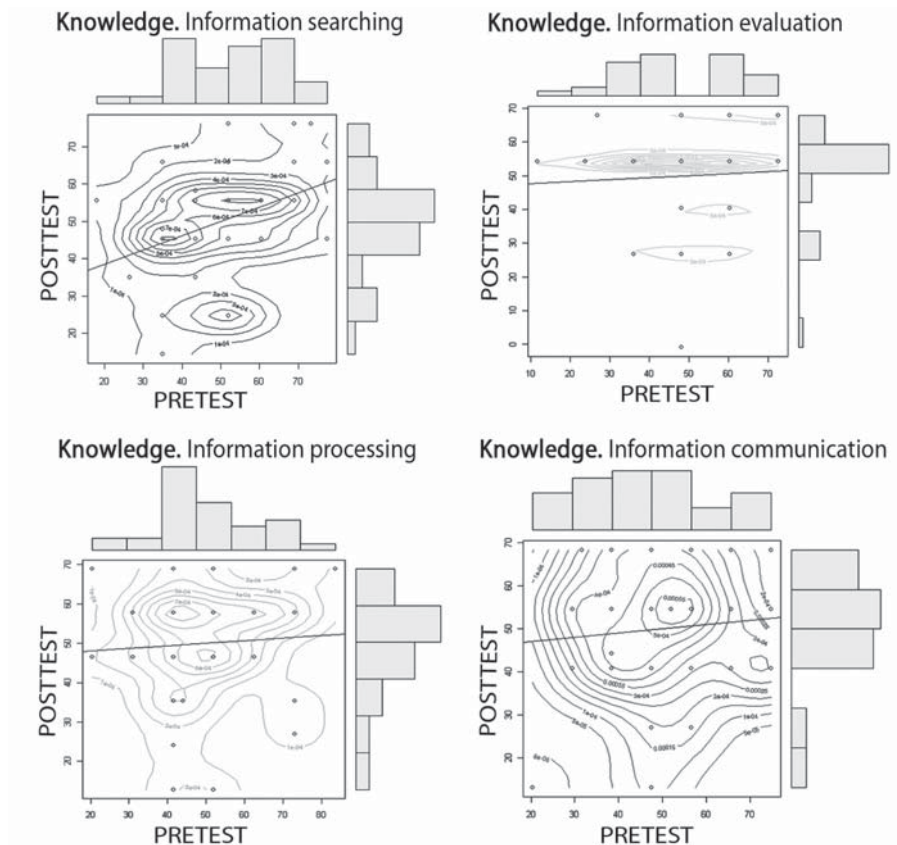
Graph II shows how the component *knowledge* tends to have a higher variability in the pretest, and regression lines with slopes of little significance. Posttest shows more homogeneous distributions. Thus, subjects with lower scores in the pretests have experimented more sizable improvements than subjects with medium or high scores.

Regarding the component *skills* (graph III), we can observe distributions with similar dispersions, and regression lines with clearly significant slopes. On the other hand, the pretest shows no apparent tendency concerning asymmetry, and it presents platykurtic distributions.

Therefore, subjects with both low and high scores will achieve substantial improvements thanks to the treatment.

GRAPH III. Scatter diagrams and bidimensional variables histogram. Skills
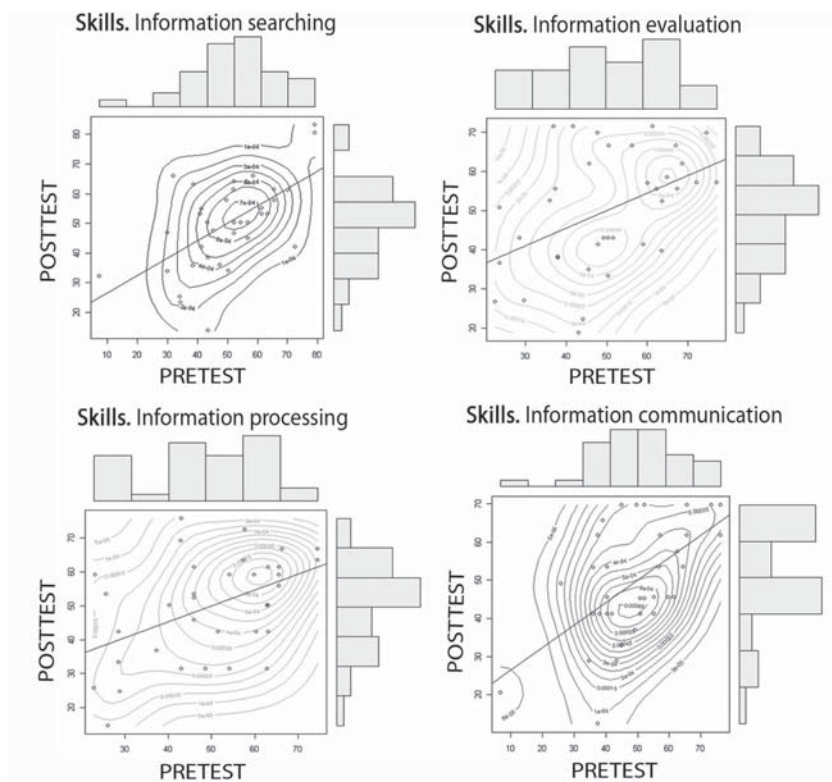
We can also observe how variability is slightly greater in the pretest than in the posttest, although it is so in a less perceptible way.

Finally, graph IV shows joint distributions for the variables of the component *attitudes*. This variables show distributions with a clearly higher variability in the pretest and posttest, and regression line slopes with a certain degree of significance. The evident negative asymmetry of the pretest indicates that the subjects already had high levels of positive attitudes before the treatment, and consequently the improvement in this aspect has been minor.

GRAPH IV. Scatter diagrams and bidimensional variables histogram. Attitudes
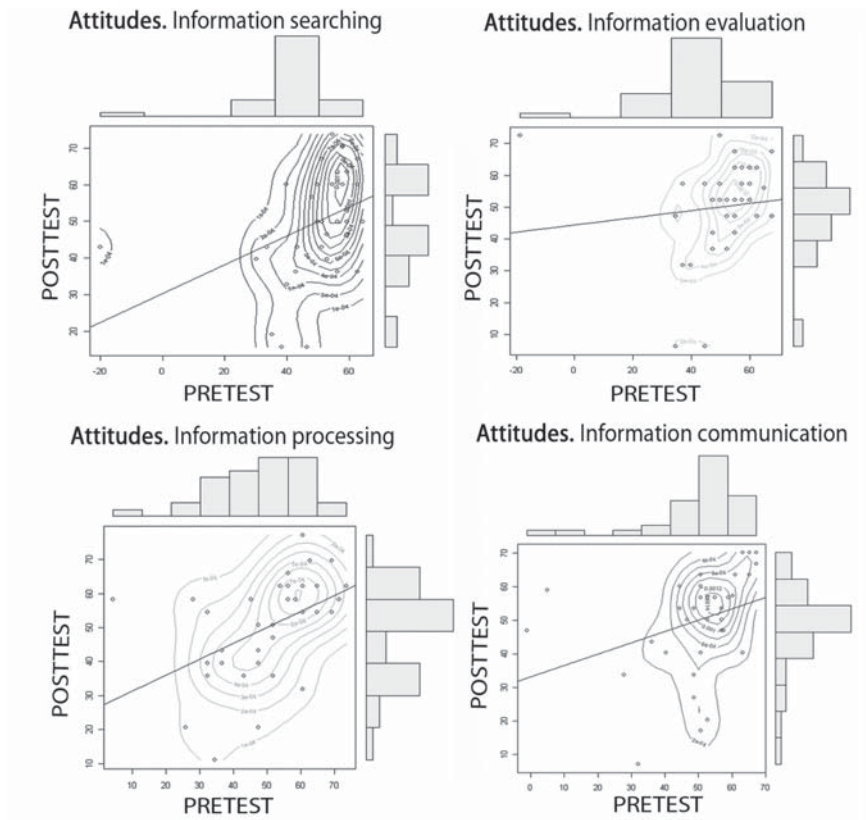
Discussion and conclusions

Education systems both at national and international level are promoting and spreading the implementation of learning processes related to the development of information literacy (Mackey and Jacobson, 2011; National Forum of Information Literacy, 2005; Pinto Molina, Sales, and Osorio, 2008; Rodríguez Conde et al., 2011; Weiner, 2010). This fact is evidenced by the efforts made to integrate this kind of competences in

national curricula and international steering documents (Boletín Oficial del Estado, 2007; Diario Oficial de la Unión Europea, 2006; OCDE, 2004, 2005).

The emergence of these learning processes does not effectively correspond to the importance assigned to them within teacher training actions, either initial (Dagiene, Zajanckauskiene, and Zilinskiene, 2008; Prendes Espinosa and Castañeda Quintero, 2010) or permanent (Almerich et al., 2005; Almerich, Suárez, Jornet, and Orellana, 2011; Hernández Martín and Quintero Gallego, 2009; Rivas, 2004; Suárez Rodríguez, Almerich, Gargallo López, and Aliaga, 2010).

Despite agreeing with the fact that information literacy should be taught transversally in formal educational processes, it seems logical to think about the importance of implementing training activities, both initial and permanent, for secondary education teachers. This explicit training would allow for a systematic and conscious instruction of the content itself. Later on, the teacher, as a professional expert in the implementation of teaching-learning processes, would be the one to contextualize this kind of learning in the right experiential and significant framework.

This reasoning is based on the results obtained in this study, which generally show that the program has been successful, given that the initial hypotheses were tested and accepted. Along the described process, we have designed a program with didactic and pedagogical criteria and, following a scientific perspective, it has been implemented with a sample of future compulsory secondary education teachers, having proven its efficacy through a rigorous evaluation process.

Despite this evidence, we must not forget that information literacy, like all competences, is made up by *knowledge*, *skills* and *attitudes* (Martínez Clares and Echeverría Samanes, 2009; Villa Sánchez and Poblete Ruiz, 2009; Zabala and Arnau, 2007). Dividing competences in their constituent parts can facilitate the evaluation of their current state. However, it is necessary to acknowledge that, ultimately, (information literacy) competences make up a whole that is integrated and related. Thus, all evaluation processes must maintain a global perspective on the competence itself.

Regarding the conceptual content, that is, the *knowledge* component of the competence, we can observe that the participating group experiences a high level of learning. This is the component that shows a greater change when comparing the pretest with the posttest. This results

are justified on account of the participating group being composed by academics who are critic with e-learning and who, despite acknowledging the potential of the tools used in virtual training to promote a more active training which is centered in the student, "tend to think that virtual learning is limited to imitating face-to-face learning" (Martínez Caro, 2008, p. 154), related to master classes more than anything else.

As for the contents related to the component *skills*, we can observe a medium to medium-large improvement in all dimensions included in information literacy. These significant effects are deemed as successful given the aforementioned difficulty to work with procedural contents through a remote or online methodology.

The component that showed the most moderate treatment effect was the so-called *attitudes*. There were some differences favoring the posttest, but this had a small to medium-small effect size. The very nature of the scale (Likert-type) could have biased these results, because the subjects who showed a high performance in the pretest were left with little improvement margin in the posttest.

Moreover, even when in many cases this component is considered as the less important one within the competence, we must not forget that "attitudes have a great impact on the improvement of information literacy" (Wen and Shih, 2008, p. 796), and that positive attitudes in teachers and students promote the effective integration of information literacy in the educational processes implemented in the classroom (Álvarez Álvarez et al., 2011; Tejedor Tejedor and García-Valcarcel, 2006).

Limitations of the study and future lines of research

Although the strengths of the program are apparent, evidenced by the systematic evaluation of the three components of the competence, it is worth mentioning some weaknesses, especially regarding the size and composition of the sample, which was non-probabilistic, due to the experimental nature of the study. This bias has to be taken into consideration, and it calls for caution when establishing generalizations beyond those described in this study.

The design of this research, in which the treatment is applied in the form of an e-learning training program over the course of 7 weeks, is also a considerable limitation. On the one hand, despite the communication

channels established for the course, the distance that results from the implementation of online courses greatly limits the training in the more attitudinal aspects, as it has been shown in the results of this study. On the other hand, the limited duration can constitute a hindering factor in the acquisition of the contents by the future teachers so that they can effectively integrate them in their teaching practice.

Besides the abovementioned **limitations**, we must also take into account that the present study evaluates the knowledge related to information literacy acquired by future teachers, not their ability to put this knowledge into practice in the classroom. In fact, this limitation opens up relevant **future lines of research**, such as to what extent a greater knowledge of the contents related to information literacy on the part of teachers promotes both the integration of these competences in the teaching-learning process itself and a greater quality in their implementation. In this regard, although it is difficult to find studies that work directly with the teaching-learning processes implemented in schools, some interesting research can be found (Colás Bravo and Jiménez Cortés, 2008; Gutiérrez Martín, Palacios Picos, and Torrego Egido, 2010; Medina Moya, Jarauta Borrasca, and Urquizu Sánchez, 2005), which can guide the performance in future research works derived from this study.

Therefore, even though the training of future teachers on information literacy is not without interest, it begs the question as to whether this training is enough to ensure an effective integration of this key competence in the curriculum or if it is necessary to provide a more applied training, related to the didactic aspects that must govern the teaching of information literacy in basic education.

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