revista de EDUCACIÓN

Evaluación, formación e innovación en competencias informacionales para profesores y estudiantes de Educación Secundaria

Assessment and innovation in information literacy in secondary schools

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Information Literacy Assessment, Training and Innovation for Secondary School Teachers and Pupils[1]

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Abstract

The emergence of the information society is mediated by the impact of information and communication technologies and demands to schools teaching key competences. This need is clear in the field of information literacies, related to information processing and digital competences. And in this area, it is of vital importance both teacher training and student learning. This study aims to assess the effectiveness of an innovative project for training in information literacy in secondary schools. A pre-experimental design with pre-test and post-test on a sample of 260 students of Castile and Leon and Andalusia spread over 22 teaching groups. The empirical study is based on data collected using a validated instrument for assessing the four dimensions of information literacy skills. After the verification of the previous assumptions of normality and homogeneity of variances, an ANOVA with repeated measures and a T-test for two groups is applied in the data analysis. The results support the effectiveness of implemented projects, taking into account the factors autonomous community and tutor in the interpretation of data. In the conclusions, it is considered the importance of evaluation and training in key competences addressing the fundamental issues that arise around and discussing the results, which support the effectiveness of

the implemented projects. Finally, after an analysis of the contributions of this work, the weaknesses of the study are highlighted. Weaknesses are focused on the design and development of standardized assessment instruments and the level of experimentally of applied design. These issues point to some future lines of research which are described.

Keywords: secondary education, teacher education, evaluation, information literacy, digital competence, educational innovation.

Resumen

La emergencia de la sociedad de la información, mediada por el impacto de las Tecnologías de la Información y la Comunicación, demanda a los centros educativos la enseñanza de competencias clave, y en especial de competencias informacionales, relacionadas con el tratamiento de la información y la competencia digital. En este aspecto, adquiere una importancia vital tanto la formación del profesorado como la propia formación de los estudiantes. Este estudio pretende evaluar la eficacia de un proyecto de innovación para la formación en competencias informacionales en centros de Educación Secundaria. Se aplica un diseño pre-experimental con pretest y postest a una muestra de 260 estudiantes de Castilla y León y Andalucía repartidos en 22 grupos docentes. Se parte de datos recogidos mediante un instrumento validado de evaluación del rendimiento en las cuatro dimensiones de las competencias informacionales. Tras la comprobación de los supuestos previos de normalidad y homocedasticidad, en el análisis de datos se aplica un ANOVA con medidas repetidas junto con pruebas de t para dos grupos. Los resultados avalan la efectividad de los proyectos implementados, resaltando la importancia en la interpretación de los datos de los factores comunidad autónoma y profesor tutor. Se considera en las conclusiones la importancia de la evaluación y formación en competencias clave, abordando las cuestiones fundamentales que surgen alrededor y discutiendo los resultados obtenidos, que avalan la eficacia de los proyectos implementados. Finalmente, tras un análisis de los aportes del trabajo, se ponen de relieve los puntos débiles del mismo, centrados en el diseño y desarrollo de instrumentos de evaluación estandarizados y el nivel de experimentalidad del diseño aplicado. Estas debilidades apuntan hacia algunas líneas de investigación futuras, que son descritas.

Palabras clave: enseñanza secundaria, formación de profesores, Evaluación, competencias informacionales, competencia digital, innovación educativa.

Introduction

Current education policies have led to the entrenchment of a competence-based educational model (Delors, 1997; Martínez Clares & Echeverría Samanes, 2009) to the detriment of an objective-based model. This model, whose objective is to provide a better balance between theory and practice, has been consolidated and adapted to current educational needs within the context of the information or knowledge society (Ayuste, Gros, & Valdivieso, 2012; Hargreaves, 2003; Mansell & Wehn, 1998; Mateo, 2006; UNPAN, 2005; Webster, 2006).

The establishment of a key-competence framework (Official Journal of the European Union, 2006), which enables pupils' abilities, competences, skills, aptitudes, etc., to be assessed at different educational stages, has resulted in the emergence of new methodologies and curricular innovations related, in many cases, to the incorporation of ICT. Examples of this are the flipped classroom (Clark, 2015; Filiz, Kurt, & Orhan, 2015; Tourón Figueroa & Santiago Campión, 2015); project-based learning (PBL) (Badía & García, 2006; García-Almiñana & García Amante, 2006); and the emergence of the bimodal curriculum (Marquès Graells, 2013; Marquès Graells & Álvarez Cánovas, 2004), resulting in new learning environments and a rearrangement of educational roles.

It seems clear, however, that the integration of ICT is not possible without understanding and acquiring key competences related to the handling and processing of information, also known as information literacy (Area Moreira & Guarro, 2012; González Fernández-Villavicencio, 2012; Gros & Contreras, 2006).

According to the numerous definitions provided by both authors and international organisations and institutions (ALA, 1989; ALA/ACRL, 2000; Area Moreira & Guarro, 2012; Bundy y ANZIIL, 2004; CAUL, 2001; CRUE-TIC & REBIUN, 2009, 2012; SCONUL, 2004), the key dimensions of information literacy are information need, search, assessment, processing and communication.

At national level, the latest educational laws published include information literacy as one of the key competences, known as Information Processing and Digital Competence, which consists of: "the skills to search for, obtain, process and communicate information in order to transform it into knowledge. It includes different skills ranging from accessing information to transmitting it through different media once

processed, and involves the use of information and communication technology as an essential element for enquiry, learning and communication" (Ministry of Education, Culture and Sport, 2013, p. 21).

The acquisition of information literacy in the educational field is therefore considered a key element due to the close relationship it has with the teaching-learning process (Area Moreira & Guarro, 2012; Ferrari, 2013; Kellner, 2004; Monereo, 2009; Monereo & Badia, 2012), requiring the skills and abilities to distinguish between valid and invalid information, understand where to find it, assess sources and communicate it effectively to a specific audience.

Against this backdrop, the study of information literacy has achieved greater prominence in scientific research, with a proliferation of specific experiments (Kim & Shumaker, 2015; Kulachai Kultawanich & Na-Songkhla, 2015; Santharooban & Premadasa, 2015) and an evolution that ranges from simple assessment of self-perception of the competence itself (Rodríguez Conde, Olmos Migueláñez, & Martínez Abad, 2013) to the application of instruments to assess actual levels of performance in the competence (Martínez Abad, Olmos Migueláñez, & Rodríguez Conde, 2015). Specific experiments for assessing actual performance levels among secondary school pupils are still however at an embryonic stage (Bielba Calvo, Martínez Abad, Herrera García, & Rodríguez Conde, 2015).

Regarding the design of information literacy assessment instruments, for the most part, they appear to consist of typical scales for particular study and lack validation (Appleton, 2005; González, Marciales, Castañeda-Peña, & Barbosa-Chacón, 2013; Grant & Brettle, 2006; Kim & Shumaker, 2015; Kuiper, Volman, & Terwel, 2009; Rangachari & Rangachari, 2007; Resnis, Gibson, Hartsell-Gundy, & Misco, 2010; Saito & Miwa, 2007; Santharooban & Premadasa, 2015). While other studies with validated scales do exist, they generally only assess self-perception of the competence (Guo, Goh, Luyt, Sin, & Ang, 2015; Kulachai Kultawanich & Na-Songkhla, 2015; Pinto Molina, 2010; Young, 2015).

There are also numerous examples of information literacy training programmes that have been implemented and assessed. Experiments can be consulted in the fields of health sciences (Appleton, 2005; Grant & Brettle, 2006; Rangachari & Rangachari, 2007; Santharooban & Premadasa, 2015), library science (Kim & Shumaker, 2015; Resnis et al., 2010), psychology (Acuña Castillo, Garcia Rodicio, & Sanchez Miguel, 2011; Head & Eisenberg, 2009), social sciences and education (González

et al., 2013; Kulachai Kultawanich & Na-Songkhla, 2015; Pinto Molina, 2010; Young, 2015), and there are others without a specific context (Saito & Miwa, 2007).

With respect to the population at which these studies are directed, most of them focus on the development of information literacy skills and abilities at university stage (Acuña Castillo et al., 2011; Appleton, 2005; Beishuizen & Stoutjesdijk, 1999; González et al., 2013; Grant & Brettle, 2006; Head & Eisenberg, 2009; Kim & Shumaker, 2015; Kulachai Kultawanich & Na-Songkhla, 2015; Pinto Molina, 2010; Rangachari & Rangachari, 2007; Resnis et al., 2010; Saito & Miwa, 2007; Santharooban & Premadasa, 2015; Young, 2015), with some attempts carried out at basic education level (Kuiper et al., 2009; Rosales, Sánchez Miguel, & Pérez, 2004), both primary and secondary (Aguaded, Martín-Gutiérrez, & Díaz-Pajero, 2015; Blasco Olivares & Durban Roca, 2012; Fuentes Agustí & Monereo, 2008; Landry & Basque, 2015; Pifarré, Sanuy, Vendrell, & Gòdia, 2009).

Those focused on basic education, however, lack a holistic view of the competence, opting for an atomised approach aimed at developing one or more dimensions of information literacy. There is also a tendency to only address information search (Fuentes Agustí & Monereo, 2008; Head & Eisenberg, 2009) and processing (Acuña Castillo et al., 2011; Oliver & Perzylo, 1994; Rosales et al., 2004) as inherent dimensions of information literacy, disregarding the rest. Regarding information communication, certain studies have been carried out to address this competence, but not as a dimension inherent to information literacy, rather as a competence in itself, known as media competence (Aguaded et al., 2015; Landry & Basque, 2015).

Moreover, a significant number of studies focused on the field of basic education present programmes that are carried out in the context of a specific curricular aspect (Aguaded et al., 2015; Blasco Olivares & Durban Roca, 2012; Fuentes Agustí & Monereo, 2008; Grant & Brettle, 2006; Kuiper et al., 2009; Landry & Basque, 2015; Pifarré et al., 2009; Rosales et al., 2004). However, as indicated above, given the multidimensional structure of information literacy, these training programmes tend to focus on a dimension inherent to information literacy, rather than a global and holistic view of it.

In summary, it would appear that the instruments used for the assessment of information literacy, as well as being almost exclusively

self-perception scales, have a great deal of room for improvement, both in terms of their validity and the reliability of their measurements. In addition, there are scarcely any examples of specific experiments on global information literacy training in basic education, and even fewer based on designs with some level of experimentality.

Against this backdrop, the objective of this research is to assess the effectiveness of an information literacy training programme in secondary schools in Andalusia and Castile and León based on a valid and reliable information literacy performance assessment instrument.

Method

In order to achieve the proposed objective, a minimum-control pre-experimental design (Campbell & Stanley, 1973) was used and applied to several classes with pre-test and post-test measure. That way, the following research hypothesis could be proposed:

Information literacy training for secondary school teachers and the use of a specific programme with their pupils, under the conditions set by the research, will have a positive impact on pupils' level of information literacy performance.

The aim was to implement an effective information literacy training programme for teachers (Cabero Almenara, 2013; Ion & Cano, 2012) and test the effectiveness of several innovation projects designed for and applied to schools in Andalusia and Castile and León for the teaching of information literacy to pupils.

It should be noted that the design applied made it difficult to control certain external variables, which could represent a source of bias in the internal validity of the results obtained (Campbell & Stanley, 1973). However, by obtaining samples from different groups of teachers in a number of schools in the two autonomous regions, it was thought that the training events that were to occur during the application of the treatment would not equally affect all of the pupils, the expectation being that they would be distributed randomly. Consequently, it cannot be affirmed whether the academic issues that occurred in parallel to the application of the treatment were the cause of the global differences obtained.

Sample

The study sample was obtained from a population of Spanish secondary school pupils. From this reference population, divided into 17 clusters (one for each autonomous region of Spain), two clusters of heterogeneous performances were selected based on PISA test results for the years 2009 and 2012 (Ministry of Education, 2010; OECD, 2011, 2013). In order to assess the functioning of the treatment in different contexts, an autonomous region with high performance (from among Spain's autonomous regions as a whole) in all of the key competences assessed by PISA, Castile and León, and one with poor overall performance, Andalusia, were selected. A non-probability incidental sampling technique was applied to each cluster, resulting in a sample of 260 pupils, 200 resident in Castile and León and 60 in Andalusia. The difference in sample size was a result of a low teacher training programme completion rate in Andalusia: While 17 of the 27 teachers from Castile and León completed the training phase and continued with the experimental phase, only 5 of the 18 teachers in Andalusia continued with the process. It should be noted therefore that the study was characterised by problems of experimental mortality and a considerable difference between Castile and León (63%) and Andalusia (28%) in terms of the proportion of teachers who completed the programme, a point which will be specifically addressed in the study discussion. Although the statistical techniques used enable these sample size differences to be controlled, this factor is noteworthy and should be taken into account when drawing conclusions and generalisations.

Variables

The dependent variable was defined as the level of information literacy measured before and after implementation of the specific programme. As an independent variable or treatment, both the 30-hour online training programme imparted to teachers (Cabero Almenara, 2013), adapted from the programme proposed by Martínez Abad et al. (2015), and the didactic unit that the teachers themselves would design and teach to pupils in the classroom, based on criteria and advice provided by the project's research team, were defined.

The teacher training programme used[2] is therefore an adaptation of a future programme for Spanish secondary education teachers (Martínez Abad et al., 2015), tested and validated in that area. The programme specifically incorporates content and activities within the following specific areas or dimensions: Definition and structure of information processing and digital competence (IPDC)[3], teacher training in searching for, assessing, processing and communicating information and the incorporation of IPDC in educational processes. The Moodle 2 virtual platform training space, designed according to specific criteria to optimise information exchange, access and assessment (Carvalho Levy, 2005; Weis, 2001).

Regarding the didactic units to be taught by the teachers, no specific pre-determined structure was defined as it was important for each teacher to adapt what they had learned to their specific context. Each teacher, prior to designing the didactic unit, received an individualised report on the information literacy level of their class of pupils (based on the pupils' pre-test scores), which highlighted their strengths and weaknesses. On the basis of this information to identify needs, each of the teachers designed a didactic unit either with information literacy considerations incorporated in a cross-cutting manner or with an explicit focus on information literacy itself, adapting what they had learned during the training programme to the specific needs of their teaching environment. Prior to its implementation in the classroom, all of the teachers incorporated the didactic units into a Wiki within the Moodle platform in order for a team of advisers to review them and make any suggestions considered necessary (mainly in relation to the content incorporated and adjustment of the level of difficulty of the activities to the curricular level and to the findings of the prior assessment of the class of pupils).

After the review of the didactic units by the advisory team, the teachers had about a month to use them in the classroom. During this time, the communication channels between the advisory team and the teaching staff remained open in order to provide the teachers with support in certain technical areas related to the development of the didactic units (aspects related to content, access to specific resources on information literacy, etc.).

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[2] Consult the complete course programme at https://goo.gl/T2ci8L.
[3] The general term IPDC was used as it was more familiar to teachers than the more scientific term 'information literacy.'

Instrument

A pre- and post-test instrument was used to assess the level of information literacy reached by the pupils. It is a validated instrument (Bielba Calvo et al., 2015; Bielba Calvo, Martínez Abad, & Rodríguez Conde, 2017) to assess the pupils' level of performance, consisting of 61 dichotomous items (from 35 single and multiple selection questions). The instrument includes 6 questions related to the dimension of information search (featuring 21 dichotomous items), 11 questions on the dimension of assessment (14 items), 9 questions concerning information processing (13 items) and 9 other questions in connection with communication and dissemination of information (13 items).

Procedure

All of the activities carried out during the research process were divided into the following phases:

- Design, selection and adaptation of instruments (January-June 2014): Most of the work carried out in this phase involved the adaptation of the instruments to the reality and specific needs of the research.
- Contact with the regional education authorities of Castile and León and Andalusia in order to access the sample and implement the programmes (September-December 2014): These authorities took over the coordination of the training and innovation activities in collaboration with the research team.
- Implementation of the training programme for Spanish secondary school teachers (February-April 2015): Based on prior studies (Martínez Abad et al., 2015), the 30-hour extensive training course lasted for 3 months.
- Pre-test measure given to the pupils (April 2015).
- Implementation of innovation projects (May-June 2015): After designing the didactic unit and it being reviewed by the research team, the teachers taught it in the classroom as per the established criteria.
- Post-test measure given to the pupils (June 2015).
- Computerisation and data analysis (July-October 2015).

Data analysis

Finally, in terms of the **data analysis**, after the initial exploratory analysis of variable distribution and equality of variance-covariance structures, the repeated measures ANOVA technique was used. Within-subjects effects (pre-post test) and between-subjects effects (autonomous region and whether the teacher was the class's form tutor) were included. That way, a joint analysis was carried out on both the effects of the subjects' evolution over time and certain grouping variables in the level of performance shown in the dependent variable. After the repeated measures study, other techniques were used to complement the results, such as the *t*-test.

Results

The Kolmogorov-Smirnov test was used to check the fit of the distributions to the normal curve. As Table I shows, while the pre-test data perfectly fits the normal distribution, the post-test has a slightly negative symmetry mismatch. This results in Kolmogorov-Smirnov test values indicating a possible lack of fit.

TABLE I. Normal distribution data fit

	Kolmogorov -Smirnov		Asymmetry		Kurtosis	
	Z	**p.**	**Valor**	**Err. Típ.**	**Valor**	**Err. Típ**
Pre-test	1.19	.12	0.060	0.15	-0.58	0.30
Pos-test	1.40	.039	-0.34	0.15	-0.46	0.30

Despite this lack of fit, however, the distributions of the density curves of the variables have a bell-shaped distribution similar to normal distribution, indicating good levels of symmetry and a tendency towards platykurtic kurtosis. It can be observed that, while the pre-test distribution is symmetrical with a medium degree of pointedness, the post-test shows a slightly asymmetric negative distribution with a predominance of high scores. This tendency is moderate and no extreme values are observed, resulting in an assumption of normality of the variables.

The assumption of equality of the variance-covariance matrices is verified by means of Box's test of equality of covariance matrix and Levene's test of equality of variances. As shown in Table II, both assumptions are fulfilled.

TABLE II. Equality of variance-covariance structures

Box's test		Levene's test			
		Pre-test		Post-test	
F	**p.**	**F**	**p.**	**F**	**p.**
1.67	.90	1.706	.17	1.66	.18

Given the fulfilment of both the assumptions of normality of the dependent variables and equality of variance and covariance structures of the data, it is possible to proceed with the proposed multivariate analyses.

In terms of initial contrast, Table III shows that the within-subjects component, i.e. the difference between pre- and post-test, is significant. Furthermore, the between-subjects components have a clear interaction effect on the difference in performance of the subjects between the pre- and post-test. Both the pupils' autonomous region (AR) of origin and whether or not their teacher for the innovation project was their form tutor are variables that have a significant effect on the evolution of the subjects. A strong interaction effect is even observed at a second level among all of the variables at play in the analysis.

TABLE III. Analysis of repeated measures. Within-subjects effects.

|	SC	GL	MC	F	p.	h2
Pretest-Postest	165.27	1	165.27	4.22	**.04**	.02
Pretest-Postest*CCAA	636.65	1	636.65	16.25	**<.01**	.06
Pretest-Postest*Tutor	272.75	1	272.75	6.96	**.01**	.03
Pretest-Postest*CCAA*Tutor	1321.51	1	1321.51	33.74	**<.01**	.12
Error	10027.06	256	39.17			

In terms of the main effects, it can be observed that the treatment was effective, but, given the interaction effects, it is necessary to carry out a more detailed analysis of the estimated means, taking into account the autonomous region of origin and whether the teacher was the class's form tutor. Chart I shows that, while the pupils from Andalusia started from a level of performance in the pre-test that was inferior to that of the pupils from Castile and León, in the post-test, they reached a similar level to the latter's pre-test, even surpassing it in some cases.

CHART I. Pre-post test estimated marginal means by autonomous region
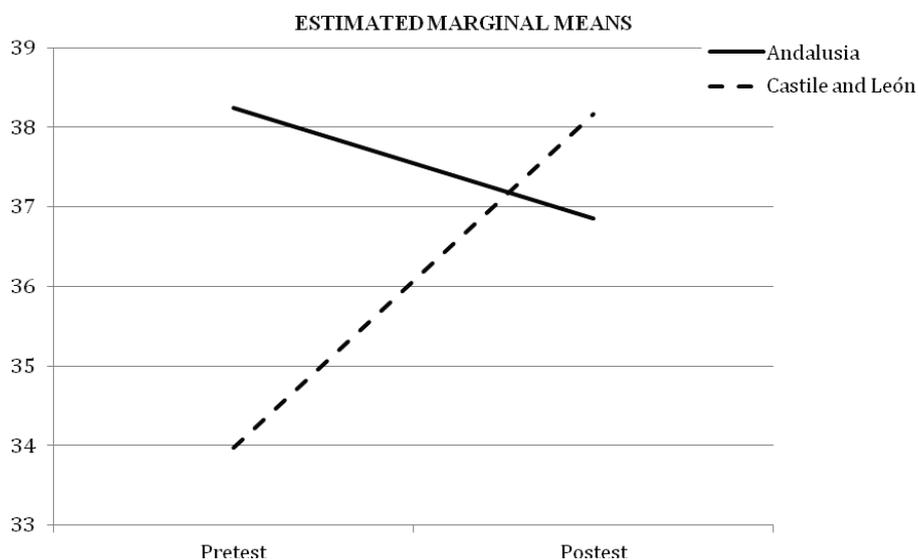
In terms of the interaction effect of the form tutor variable, Chart II clearly shows that, while teachers who were not form tutors of the class did not achieve an improvement in the performance of their pupils after their training, teachers who were form tutors did indeed achieve a significant improvement in pupil performance.

CHART II. Pre-post test marginal means by form tutor
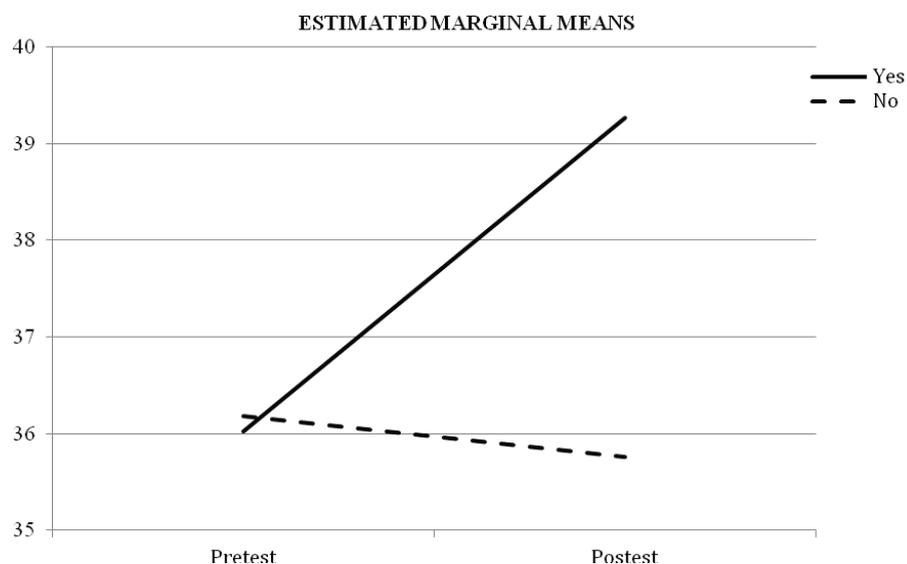
These results highlight the importance of these two variables when it comes to carrying out a detailed analysis of the programme's effectiveness factors. Firstly, prior to the application of the treatment, the trends revealed by the PISA tests were confirmed (Ministry of Education, 2010; OECD, 2011, 2013) with respect to differences between the key competence level of Spanish secondary school pupils in the regions of Castile and León and Andalusia. Secondly, the impact and importance of form tutors on the learning achieved by their pupils was confirmed, in contrast to that of teachers who were not form tutors of the class to which the treatment was applied.

Given that the sample size for the study was limited (n=260), it was decided not to analyse in detail the interaction effects obtained at the second level. Division of the sample into the 4 subgroups required at this level of interaction would result in small sample sizes in certain categories (in some cases, less than 30 subjects), thereby calling into question the conclusions and generalisations obtained from the hypothesis testing applied.

Testing was, however, carried out according to autonomous region of origin and the form tutor variable. First of all, in terms of autonomous region, Table IV confirms the initial findings: while the pupils from Castile and León showed greater information literacy than the Andalusian pupils, in the post-test, there was no significant difference between the two groups. These results reveal that the programme was more effective among pupils with lower initial performance levels than among those with higher starting levels. The programme therefore managed to equalise the level of performance of the subjects.

TABLE IV. Difference in means for independent samples by autonomous region

	Levene's test		Independent samples *t*-test		
	F	**p.**	$\bar{X}_{CyL} - \bar{X}_{Andal}$	**t**	**p.**
Pre-test	0.65	0.42	2.46	2.29	**.02**
Post-test	0.02	0.9	-0.54	-0.55	.58

Secondly, by incorporating as a grouping variable whether or not the teacher was the form tutor of the class, there are highly significant differences in the post-test (Table V), as can be seen in Figure 1.

TABLE V. Difference in means for independent samples by form tutor. Post-test

Levene's test		Independent samples *t*-test		
F	**p.**	$\bar{X}_{CyL} - \bar{X}_{Andal}$	**t**	**p.**
2.97	.09	-2.38	-2.80	**<.01**

Considering all of the above, it would appear that the project implemented was only effective under certain conditions; specifically, when pupils had low initial performance levels and it was their form tutors who carried it out in the classroom.

Conclusions and discussion

In spite of the impact that information literacy has had on scientific literature, examples of empirical studies and specific experiments implemented under the formalities of scientific research are scarce and often form part of exploratory and descriptive research phases (Appleton, 2005; Beishuizen & Stoutjesdijk, 1999; González et al., 2013; Kim & Shumaker, 2015; Rangachari & Rangachari, 2007; Saito & Miwa, 2007; Santharooban & Premadasa, 2015; Young, 2015). Thus, having established the theoretical underpinnings of what is understood to be information literacy (ALA, 1989; ALA/ACRL, 2000; Area Moreira & Guarro, 2012; Bundy & ANZIIL, 2004; CAUL, 2001; CRUE-TIC & REBIUN, 2009, 2012; SCONUL, 2004), and although its study in the field of formal education is flourishing, current development of this area of knowledge limits the degree of experimentality and depth in the research carried out. It should be noted, however, that the peculiarities of educational environments, which make it difficult to control multiple influential factors in experimental processes, heighten this limitation. This study attempts to take a step forward by evaluating the effectiveness of information literacy training through the implementation of innovation projects in schools based on a pre-experimental research design.

Furthermore, in the assessment of the information literacy of subjects, despite efforts made in recent years (Kulachai Kultawanich & Na-Songkhla, 2015; Young, 2015), there has been very little development of valid and reliable instruments for assessing the degree of performance of secondary school pupils, much less properly scaled instruments. In this respect, the type of scales that have been developed, refined and ultimately implemented in a widespread manner have been self-perception questionnaires using Likert-type response scales (Pinto Molina, 2010), mostly for university students. This type of measurement represents a soft measure for the assessment of competence, carrying with it significant biases. Aware of this, this research proposes the assessment of information literacy in secondary school pupils through a hard measure instrument, currently in its statistical validation and scaling phase, which has been designed and validated at content level under formal scientific criteria (Bielba Calvo et al., 2015).

Regarding considerations about the structure of information literacy, the majority of research studies and authors consulted do not consider it

as a construct that is developed on several related dimensions, but rather consider search, assessment, processing and communication as separate constructs with their own entity (Acuña Castillo et al., 2011; Aguaded et al., 2015; Fuentes Agustí & Monereo, 2008; Head & Eisenberg, 2009; Landry & Basque, 2015; Oliver & Perzylo, 1994; Rosales et al., 2004). As a result, the aforementioned studies often address the dimensions that make up information literacy separately, without viewing it in a global sense and placing it within the general competence. It would appear, however, both from a theoretical perspective and from the empirical evidence that some studies show (Martínez Abad et al., 2015), that information literacy can form a construct in which there are strong relationships of dependence between its dimensions. The results presented here provide evidence that complements this integrative view, showing the existence of aspects that are common to the different dimensions of information literacy, which can be isolated and assessed.

The results obtained here show that an effective procedure is feasible for information literacy training in secondary schools. In this regard, it seems that the educational innovation approach implemented has had a positive impact, functioning correctly in most schools. Moreover, the instrument used has shown examples of validity by obtaining results in the pre-test that have been consistent with those that PISA tests have obtained in recent years (Ministry of Education, 2010; OECD, 2011, 2013). Finally, the results also point to the fact that the implementation of innovation projects in schools promotes the development of key competences in pupils with low starting levels, as in the case of the Andalusian pupils. In fact, the procedure managed to level out the performance of both groups, democratising the competences achieved by all of the pupils. For its part, the form tutor factor also seems to have had a significant impact. The evidence shows that classes in which the project was implemented with their own form tutor evolved more favourably in terms of information literacy performance than classes in which this was not the case.

Limitations of the study and the future

To the strengths that the research has shown up to this point, it is necessary to add its main weaknesses, which relate to the design

implemented, the study's information collection instrumentation, the existence of unbalanced groups of teachers (in terms of size) between the regions of Castile and León and Andalusia and its adaptation to pupils' prior knowledge. Firstly, in terms of the design used, it should be noted that there was a lack of control over the intervening variables that pre-experimental designs bring with them (Campbell & Stanley, 1973). The biases inherent to the application of a design with these characteristics should be considered when it comes to making generalisations about the results obtained. Furthermore, in terms of the pre-post test measures incorporated into the study, although the pupils' prior and final performance level was taken into account, the performance of the teachers in the training phase was not considered at the beginning or end of the programme. This aspect diminishes the design's control, adding a bias that can be easily overcome in future studies by controlling, in the model, the performance of the teachers in the training programme and obtaining more accurate scores regarding the effectiveness of the innovation projects. Incorporating this information into the models can therefore enrich and make a significant contribution to the conclusions drawn with respect to the evolution of the projects and their effectiveness. In relation to the problems with the sampling, as previously indicated, the success rates for completion of the training programme by the teachers in Castile and León and Andalusia were very different. The question therefore arises about the different characteristics and conditions of the sample of teachers who eventually participated in the practical phase in both autonomous regions. It could be considered that this question may have distorted the pre-post test differences obtained in the study, thereby making it difficult to interpret and generalise the results. Finally, it seems that implementing the projects identically in all of the schools had different effects depending on the pupils' average level of prior knowledge. The results in this regard suggest that the adaptation of the projects to the reality and the specific needs of each school could be an essential factor in improving their effectiveness.

The results obtained from the study, together with identification of improvable aspects, lead directly to open lines of research. On the one hand, it seems clear that there is a need for in-depth studies on the design and validation of instruments for assessing information literacy specifically directed at secondary education in order to contribute to the reliable assessment of these core competences established in the

secondary education curriculum. It also seems, on the other hand, that the maturity that the field of training and assessment of key competences is reaching, in particular information literacy, requires, in the near future, studies that incorporate designs with a higher degree of experimentality. Given the complex educational reality, the implementation of quasi-experimental studies with a control group may constitute an acceptable level. Finally, the effectiveness of implementing this type of innovation project in a manner tailored to the specific needs of the schools and the pupils' prior knowledge should be considered. Despite hindering the definition and implementation of research designs, this individualised attention to each context seems of great importance, given the complex and multi-faceted reality in which formal educational processes take place.

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