BMJ Open

Students' satisfaction and perceived impact on knowledge, attitudes, and skills after a two-day course in scientific writing: a prospective longitudinal study.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-018657
Article Type:	Research
Date Submitted by the Author:	13-Jul-2017
Complete List of Authors:	Fernandez, Esteve; Institut català d'Oncologia, Tobacco Control Unit Garcia, Ana; Universitat de València Serés, Elisabet; Fundació Antoni Esteve Bosch, Fèlix; Fundació Antoni Esteve
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Medical publishing and peer review
Keywords:	Journalology, Publishing, EDUCATION & TRAINING (see Medical Education & Training), observationl study

Students' satisfaction and perceived impact on knowledge, attitudes, and skills after a two-day course in scientific writing: a prospective longitudinal study ‡

Short title: A scientific writing course: satisfaction and perceived impact

Esteve Fernández[1,2,3,]*, Ana M. García[4], Elisabet Serés[5], Fèlix Bosch[5,6]

[1] Tobacco Control Unit, Cancer Control and Prevention Programme, Institut Català d'Oncologia (ICO), Barcelona, Spain.

[2] Cancer Prevention and Control Group, Institut d'Investigació Biomèdica de Bellvitge (IDIBELL), L'Hospitalet de Llobregat, Barcelona, Spain.

[3]Department of Clinical Sciences, School of Medicine, Campus de Bellvitge, Universitat de Barcelona, L'Hospitalet del Llobregat, Barcelona, Spain.

[4] Department of Preventive Medicine and Public Health, University of Valencia, Valencia, Spain.

[5] Esteve Foundation, Barcelona, Spain.

[6] Department of Experimental and Health Sciences, School of Health and Life Sciences, Universitat Pompeu Fabra, Barcelona, Spain.

* **Corresponding Author:** efernandez@iconcologia.net (EF)

‡ Preliminary results of this study were presented at the 7th International Congress on Peer Review and Biomedical Publications, September 8-10, 2013, Chicago IL USA. Poster communication: Fernández E, García AM, Serés E, Bosch F. Ten years' experience teaching health professionals to write and to publish articles. Available at: http://www.peerreviewcongress.org/abstracts_2013.html#4

Abstract

Objectives: This study aimed to determine students' satisfaction with a two-day course on scientific writing in health sciences and to assess their perceptions of the long-term impact on their knowledge, attitudes, and skills.

Setting: 27 editions of a two-day course on writing and publishing scientific articles in health sciences

Participants: 741 students attending the 27 courses

Design: Prospective longitudinal study

Primary and secondary outcome measures: ThImmediately after each course, students completed a first questionnaire, rating their satisfaction with different aspects of the classroom sessions on a Likert scale (0–5). Approximately two years after the course, students completed a follow-up questionnaire, using a Likert scale (0–4) to rate their knowledge, skills, and attitudes in relation to scientific writing before and after attending the course.

Results: 741 students (70.0% women) participated in the 27 editions of the course; 568 (76.8%) completed the first questionnaire and 182 (24.6%) completed the follow-up questionnaire. The first questionnaire reflected high overall satisfaction (mean score, 4.6). In the second questionnaire, students reported that the course had improved their knowledge (mean improvement: 1.6; 95%CI 1.6–1.7), attitudes (mean improvement: 1.3; 95%CI 1.2–1.4), and skills (mean improvement: 1.4; 95%CI 1.3-1.4) related to writing and publishing scientific papers. Most respondents (n=145, 79.7%) had participated in drafting a scientific paper after the course; in this subgroup, all the specific writing skills assessed in the second questionnaire significantly improved.

Conclusions: Students were satisfied with the format and the contents of the course and considered that the course had improved their knowledge, attitudes, and skills in relation to scientific writing and publishing. courses are particularly necessary in countries without strong traditions in scientific publication.

Word count: 274 words

Strengths and limitations of this study

- The study analyzed 10 years' experience including 27 editions of a two-day course completed by more than 700 health science researchers
- This is the first systematic evaluation of students' satisfaction and improvements in knowledge, skills, and attitudes acquired of such a course in Spain.
- The study measures the perceived gains rather than objectively assessed gains.
- Selection bias could lead to overestimation of results in the satisfaction survey: more satisfied students might be more likely to participate.
- The response rate to the follow-up questionnaire was low.

Keywords: Journalology; Program Evaluation; Publishing; Questionnaires; Teaching; Writing

Introduction

Publications are the measurable results of scientific activity. However, most health science researchers, especially in non-English-speaking countries, receive little training in scientific writing [1]. Writing is challenging for researchers, especially for newcomers, who also need publications to advance their careers [2].

Most researchers are expected to acquire the skills to write scientific papers without formal training, through "learning by doing"[3]. Inadequate training in scientific writing can make postgraduate students and established researchers reluctant to write [4]. In recent decades, the number of courses and workshops on scientific writing has increased, but the effectiveness of these endeavors remains to be determined [5].

Given the lack of undergraduate courses on scientific writing in Spain, in 2003 we designed and launched a two-day course on writing and publishing scientific articles for researchers in the health sciences in the early stages of their careers [6]. This study aimed to determine students' satisfaction with this course and their perceptions regarding its long-term impact on their knowledge, attitudes, and skills.

Methods

The following sections describe the course, the questionnaire administered in the classroom to evaluate students' immediate satisfaction with the course, and the follow-up questionnaire sent to participants to evaluate their perceptions of the impact of the course.

Course characteristics

We designed an intensive two-day classroom course for Spanish-speaking undergraduate, graduate, or postgraduate degrees in health sciences to cover the basic skills involved in scientific writing based on classic books about scientific writing [3,7]. The main objectives of the course were to provide basic advice about scientific writing, to present the structure and contents of standard scientific articles, and to explain the editorial and peer review processes for health science journals. The course imparted this knowledge over 15 hours, combining lectures with individual and group

exercises based on real examples. The syllabus for the first day (8 hours) covered scientific writing style, scientific publishing formats, and the structure and contents of the original article; the syllabus for the second day (7 hours) covered ethical principles in scientific publishing, selecting a target journal, preparing manuscripts for submission, and the editorial and peer review processes. The full program of the course is available at http://www.esteve.org/en/rc-programa, and most of the contents are included in a book used for reference in the course [8]. The Esteve Foundation (www.esteve.org) offered the course to institutions throughout Spain. The course targets health science researchers in training or in the initial stages of their careers (e.g., graduate and postgraduate students, postdoctoral fellows, medical residents, etc.), since most undergraduate and postgraduate curricula in the health sciences in Spain did not include formal training in scientific writing. Two lecturers (AMG and EF) and the promoter (FB) developed all the contents. The lecturers are professors of epidemiology and public health and have recognized experience as authors, reviewers, and editors in national and international journals. During the course, both lecturers are present and actively participate in all the sessions. While one explains a topic, the other stimulates the audience with questions or suggestions, making the teaching more dynamic and participative. The number of students in each edition ranged between 17 and 40 [6]. After a pilot edition during the Minorca Public Health Summer School in 2003, the first edition took place in Valencia in January 2004, and the most recent (39th edition) took place in Barcelona in October 2016. The present study includes data from 741 students participating in the 27 editions held between 2004 and 2013. The course has been accredited [No. 09/013214-MD] by the Catalan Council for Continuing Education in the Health Professions with the approval of the National Health System's Committee on Continuing Education under Spain's Ministry of Health.

First satisfaction questionnaire

We administered a satisfaction questionnaire at the end of each edition of the course. Each student anonymously rated items on a Likert scale (0–5) presented on printed form. The items queried students about their satisfaction with the course overall, materials, contents of the lectures, contents of the practical exercises, lecturers, and

organizational aspects. The questionnaire is available at http://www.esteve.org/en/rc-encuesta. We used the same questionnaire without changes in the 27 editions of the course. We obtained 569 (76.8%) responses from the 741 trainees.

Follow-up questionnaire

We designed a follow-up questionnaire (available at http://www.esteve.org/en/rc-encuesta-diferido) to collect sociodemographic data and to assess students' perception of the effect of attending the course on their knowledge (5 items), attitudes (3 items), opinions (3 items), and skills (16 items: 3 general skills and 13 specific skills) with regard to scientific writing. The follow-up questionnaire also reassessed students' overall satisfaction with the course through a new question: "Would you recommend this course to a colleague?". Respondents rated all items on a Likert scale (0–4). To analyze the impact of the course on specific skills, we restricted the analysis to students who had collaborated in publishing a scientific article after doing the course. We emailed the follow-up questionnaire to the first 174 students (29.3% responded) in 2006 and to the subsequent 91 students (27.5% responded) in 2007. In 2013, we emailed the remaining 475 students, asking them to fill out the questionnaire online (22.3% responded). Hence, we obtained a total of 182 responses from 741 students (24.6% response rate).

Statistical analyses

We computed means, medians, ranges, standard deviations (SD), 95% confidence intervals (CI), and interquartile ranges for the responses to each item in the questionnaire. To compare the characteristics of the subgroup of students in whom the specific writing skills were analyzed with those of the entire group of respondents to the second questionnaire, we used chi-square and Student's t-tests. To compare the responses on the items in the follow-up questionnaire asking about students' perceptions of their knowledge, skills, and attitudes before and after the course, we used the Wilcoxon non-parametric test for paired samples (before-after comparisons). The distribution of the scores (including the pre-post difference in scores) is presented using traditional boxplots. We used SigmaPlot™ 11.0 (Systat Software Inc, Chicago, IL, USA) for data processing and statistical analysis.

Ethical requirements

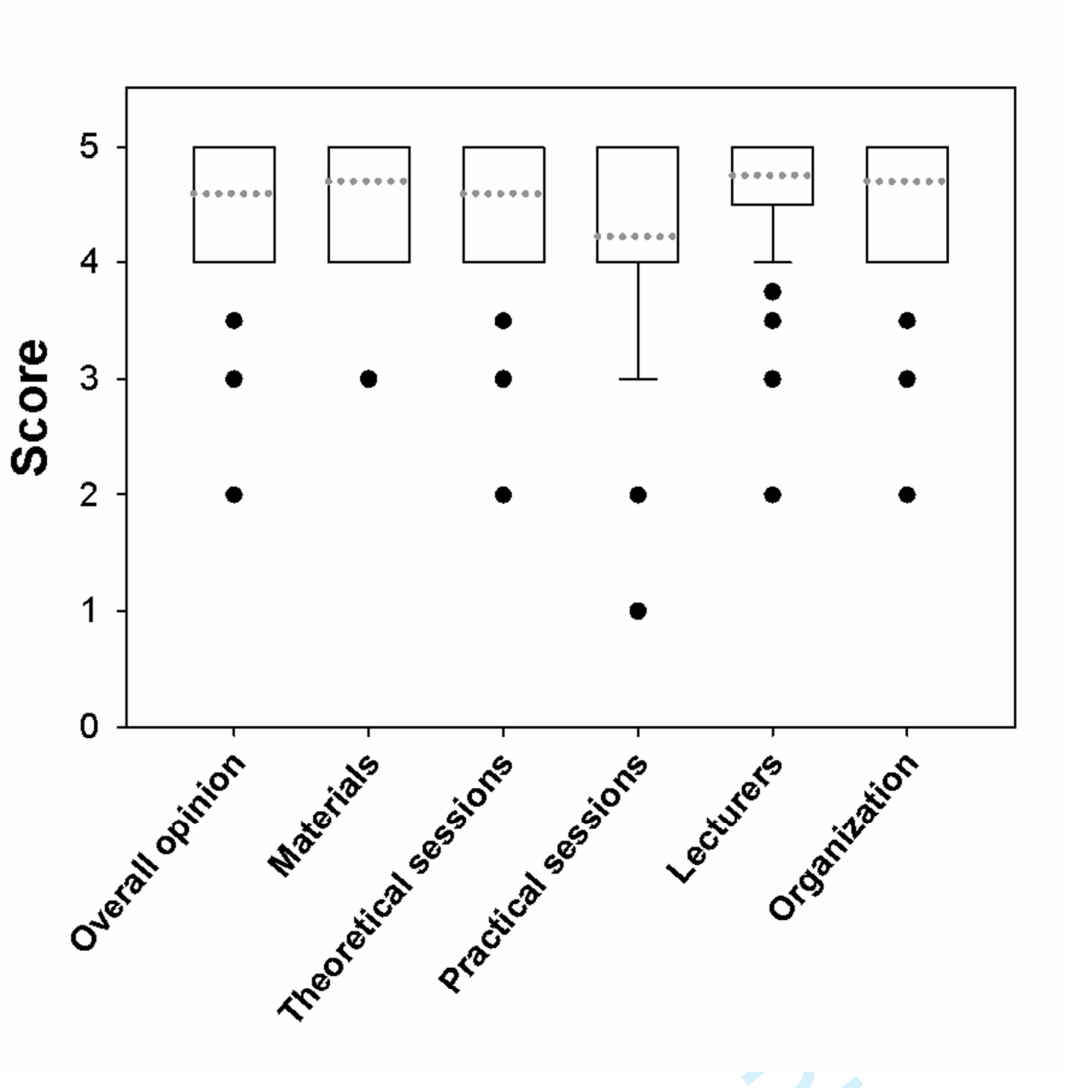
Participants provided informed consent to participate in the study (oral consent for the first satisfaction questionnaire and written consent for the follow-up questionnaire). As the surveys were conducted as part of the routine evaluation of the course, as approved by the Council for Continuing Education, no further ethics approval was required.

Results

A total of 741 students (70.0% women) attended one of the 27 editions of the course; 569 (76.8%) of these completed the first questionnaire. Overall, they rated the experience as very positive (mean 4.6, SD 0.6, of a maximum 5). Students' ratings of satisfaction with the course handouts, theoretical sessions, teachers, and overall organization were above 4.5 (Fig 1); only satisfaction with the practical sessions was rated below 4.5 (mean 4.2, SD 0.8).

Table 1 summarizes the general characteristics of the 182 (24.6%) students (age, 39.1; 131 (72%) women) who responded to the follow-up questionnaire and of the subgroup who went on to collaborate in the publication of a scientific paper (n=145, 79.7% of the students who responded to the follow-up questionnaire). In the overall group, students had degrees in medicine (36.3%), pharmacy (11.5%), biology (11.0%), or other related fields such as nursing, psychology, biochemistry, biotechnology, or statistics (41.2%); slightly more than half (52.2%) were involved in basic research. Students in the subgroup were similar to the entire group of respondents to the follow-up questionnaire in terms of age, gender, and undergraduate training, but not in the type of research in which they were mainly involved.

Fig 1. Results of the first questionnaire: students' (n=569) satisfaction with different aspects of classroom sessions in the 27 editions of the scientific writing course in Spain, 2004-2013.



Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For all 6 variables, the median coincides with the upper line of the box. The whiskers represent the 90th and 10th percentiles and the dots represent outliers (each dot represents at least one response).

Table 1. Characteristics of the students who answered the follow-up questionnaire about the course on scientific writing (27 editions). Spain, 2004-2013.

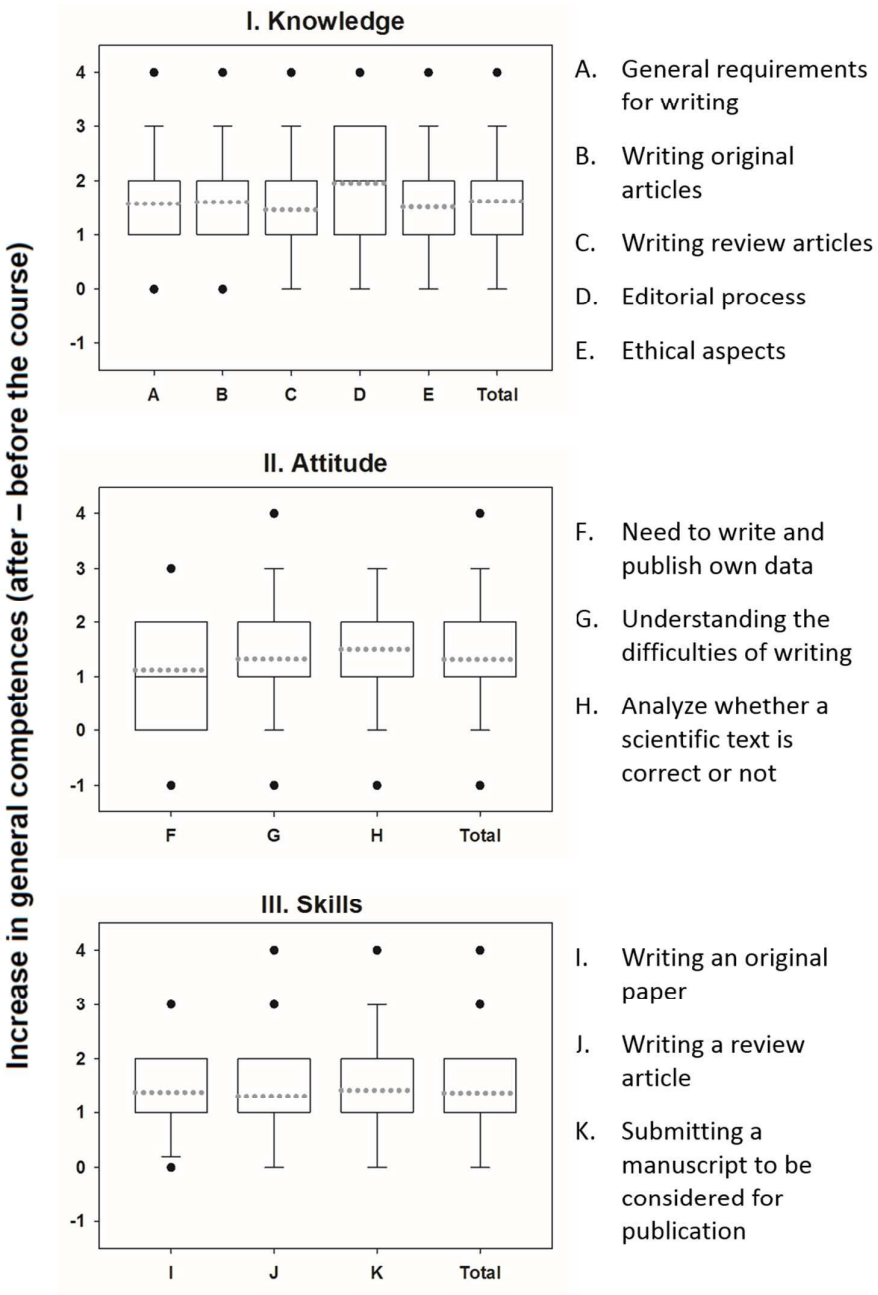
	Total	Students who went on to collaborate in preparing a paper for publication	p-value
Trainees, n	182	145	
Age, mean (SD) [years]	39.1 (9.4)	38.8 (9.6)	0.849[a]
Gender, n (%)			
Women	131 (72.0)	103 (71.0)	0.902[b]
Men	51 (28.0)	42 (29.0)	
Field of degree, n (%)			
Medicine	66 (36.3)	56 (38.4)	0.981[b]
Pharmacy	21 (11.5)	17 (11.6)	
Biology	20 (11.0)	15 (10.3)	
Others	75 (41.2)	58 (39.7)	
Main type of research, n (%)			
Clinical research	41 (22.5)	37 (25.3)	0.036[b]
Basic research	95 (52.2)	89 (61.0)	
Others	46 (25.3)	20 (13.7)	

[a]Student's t-test; [b] chi-square test

The mean scores for all the items that assessed students' perceptions of their knowledge, skills, and attitudes after the course were higher than those for their perceptions of these dimensions before the course (Fig 2). Overall increases in scores for knowledge (mean 1.6; 95% CI 1.6-1.7), attitudes (mean 1.3; 95% CI 1.2-1.4), and skills (mean 1.4; 95% CI 1.3-1.4) after the course were significant ($p<0.001$). Among the items about knowledge (Fig 2, Panel I), we observed the greatest improvement (2 points) in the understanding of the editorial process. All but 5 assessments (by 4 students) yielded higher post-course scores regarding attitudes toward publishing (Fig 2, Panel II). Students also indicated the need for training in scientific writing at both the undergraduate (mean score 3.1; 95% CI 2.9-3.3, of a maximum 4) and postgraduate level (mean score 3.9; 95% CI 3.8-4.0). The mean score on the question asking about students' overall degree of satisfaction with the course was 3.8 (SD 0.4).

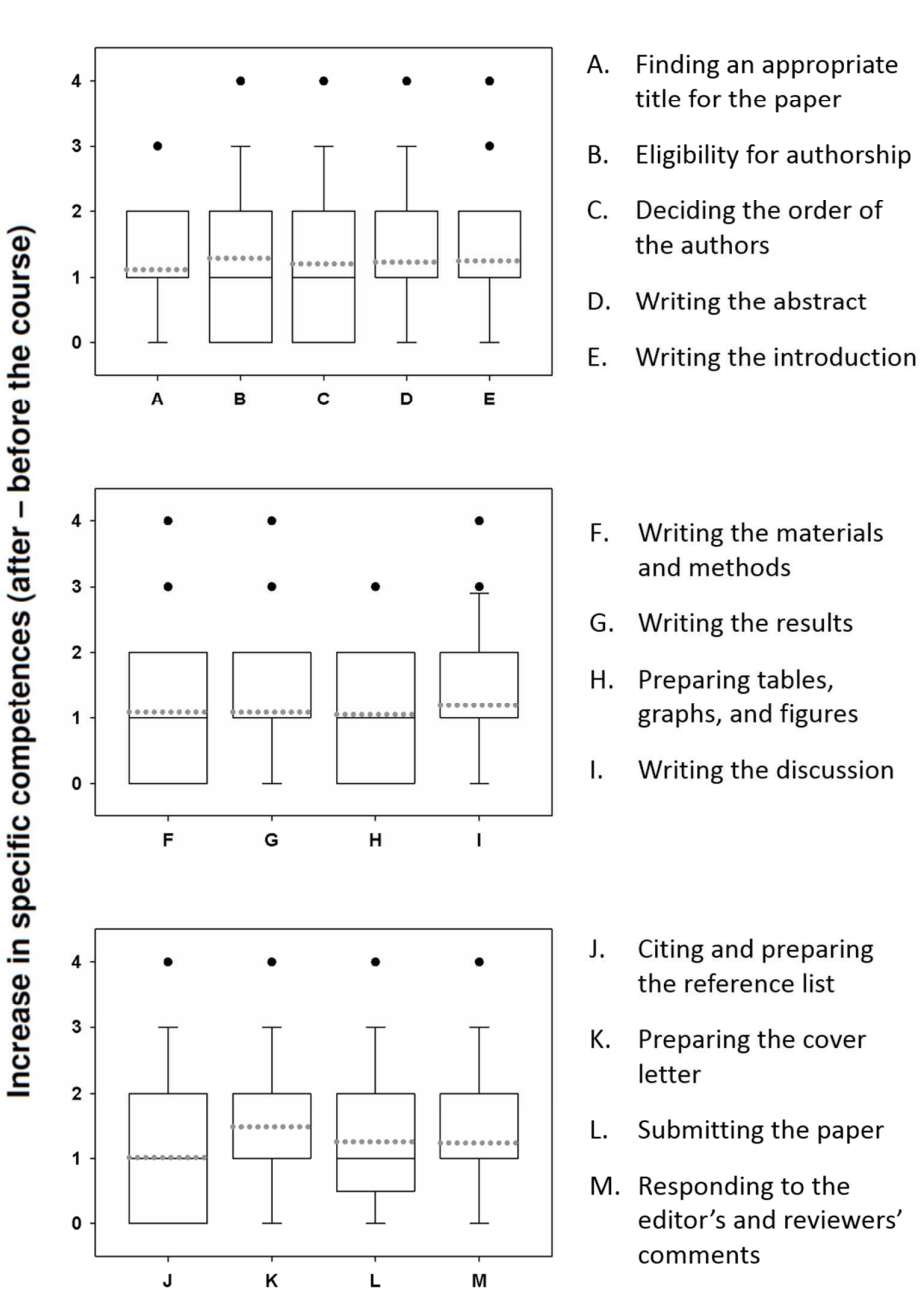
Fig 3 shows the change in perceptions of specific writing skills before and after the course in the subgroup of students who went on to collaborate in the publication of scientific paper. Statistically significant improvements were observed for all the skills ($p<0.001$; Wilcoxon signed-rank test). Average improvements ranged between 1.0 (95% CI 0.8-1.2) points for citing and writing references to 1.5 (95% CI 1.3-1.7) for preparing cover letters, with improvements in the remaining skills lying between these values: determining eligibility for authorship (1.3, 95% CI 1.1-1.5), writing introductions (1.3, 95% CI 1.1-1.5), writing abstracts (1.2, 95% CI 1.0-1.4), writing discussions (1.2, 95% CI 1.0-1.4), and responding to editors' and reviewers' comments (1.2, 95% CI 1.0-1.4).

Fig 2. Perceived change in overall competences among students (n=182) who completed the follow-up questionnaire about the scientific writing course (27 editions in Spain, 2004-2013).



The increase in general competences was calculated for each item from individual scores; individual scores were calculated by subtracting the rating on the item asking about competence after attending the seminar from the rating on the item asking about competence before attending the seminar. Significant gains were observed for all general competences ($p<0.001$; Wilcoxon signed-rank test). Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For variables A and B, the median coincides with the upper line of the box, and for variables C, E, G, H, I, J, and K the median coincides with the bottom line. The whiskers represent the 90th and 10th percentiles, and the dots represent extreme values.

Fig 3. Changes in specific writing skills in students who went on to publish after the scientific writing course (n=145) (27 editions in Spain, 2004-2013).



The increase in specific writing skills was calculated for each item from individual scores; individual scores were calculated by subtracting the rating on the item asking about competence after attending the seminar from the rating on the item asking about competence before attending the seminar. Significant gains were observed for all general competences ($p<0.001$; Wilcoxon signed-rank test). Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For variables A and B, the median coincides with the upper line of the box, and for variables C, E, G, H, I, J, and K the median coincides with the bottom line. The whiskers represent the 90th and 10th percentiles, and the dots represent extreme values.

Discussion

This study analyzed 10 years' experience including 27 editions of a two-day course on how to write scientific articles completed by more than 700 health science researchers. The two surveys showed high satisfaction with the two-day format and the contents of the course. Moreover, the second survey showed that students considered that the course had improved their overall knowledge, attitudes, and skills as well as some specific writing skills. Importantly, students expressed the need for this type of training at both the undergraduate and postgraduate levels.

Our results are similar to those of other published experiences, most of which were included in two systematic reviews [5,9] that evaluated different outcomes. Like other authors [10], we analyzed students' satisfaction with the course. Most published accounts report experiences in English-speaking countries (United States, Australia, New Zealand)[5]. Galipeau et al.'s systematic review [5] included 12 studies focused on writing for publication; most of these had shortcomings like small samples, low validity, or biases, so the authors concluded that there are important gaps in our knowledge of how to improve scientific writing.

Jawaid et al.[11] reported an experience from Pakistan (language of course not stated), with 120 attendees who participated in a three-month course based on four interactive workshops. Through a pre- and post-workshop questionnaire comprising 14 questions, the authors concluded their course improved attendees' knowledge and skills related to writing. One study from the United States [12] not included in Galipeau et al.'s systematic review [5] assessed improvements in writing after a 60- to 90-minute case report writing workshop. In a three-year period, 214 students (mainly clinicians and educators) attended the workshops, and pre-post evaluation found a significant improvement in self-rated writing competence and in the perceived probability of submitting a case report. In another study from the United States, Guydish et al.[13] assessed the impact of a scientific writing seminar aiming to encourage manuscript writing and dissemination of addiction research. Over a 14-year period, a total of 113 postdoctoral students in 14 cohorts completed the six-month

seminar. After the course, between 75% and 100% of the students from each cohort submitted papers and between 60% to 100% of these were published. The authors concluded that writing seminars may be useful among early-stage investigators.

Regardless of whether scientific writing courses yield positive or negative results, evaluations of their effectiveness, if performed, have seldom been published[5,9]. We consider these activities to be educational interventions, and as such they should have valid study designs under the principles of implementation research [14], which seeks to understand and work within real world conditions, rather than try to control for these conditions or to remove their influence as causal effects, as is the case in experimental trials. In this regard, the impact of distance learning and more specifically massive open online courses (MOOC) on scientific writing should also be assessed.

Some limitations of our study must be considered. First of all, the study measures the perceived gains rather than objectively assessed gains. Secondly selection bias can lead to overestimation of results in satisfaction surveys, since more satisfied students may be more likely to participate (although the contrary effect is also possible); however, the response rate in the baseline (satisfaction) survey (nearly 77%) can be considered optimal. On the other hand, the response rate to the follow-up questionnaire was low, and it decreased in the successive waves from 29% to 27% and 22%. This might reflect difficulties in reaching participants who were in training when they did the course, making them more likely to have changed jobs and professional email addresses. Further studies should ensure follow-up at a fixed time not very long (1 or 2 years) after the course and baseline survey; the ideal time would be long enough to detect the changes supposedly due to the intervention but short enough to minimize attrition and recall bias. Furthermore, the positive effects we observed could be partly due to students' posterior participation in other activities to improve scientific writing. Unfortunately, the follow-up questionnaire did not collect information about such activities. However, we collected information on the impact of the course on collaboration in the writing of papers, as in other studies[13,15–17].

Finally, some strengths of our study merit attention. This is the first regularly held course on scientific writing in Spain, currently with 40 editions in 15 years and more than 1,000 participants to date, and the course is still running being held. To our

knowledge, this is also the first report of a systematic evaluation of students' satisfaction and improvements in knowledge, skills, and attitudes acquired through a course of these characteristics in Spain. Although simultaneous assessment of prior and posterior knowledge and skills after the course could be considered a weakness in terms of causal inference, it may actually be a strength since the students are more aware and provide more coherent information of the items evaluated and the changes suffered.

In conclusion, the format and contents of the course satisfied the students' needs and improved their skills related to scientific writing and publishing. Participants strongly agreed that health professionals need training in scientific writing during the course of their undergraduate and/or postgraduate studies. Academic institutions, at least in countries with a lesser tradition of publishing, should provide training on scientific writing to improve the reporting of research results.

Acknowledgments

The authors wish to thank all the students who participated in the surveys and Pol Morales, Elisabet Caballeria, and Laura García from the Esteve Foundation for their contributions to the running of the course and to the evaluation processes. We also thank John Giba for reviewing and revising the English version of the manuscript.

Contributorship statement

EF, AMG, and FB conceived and designed the study. All the authors designed the questionnaires. EF and AMG designed the analysis strategy, ES and FB analyzed the data, and all the authors contributed to its interpretation. EF and FB wrote the first draft of the manuscript; all authors contributed substantially to subsequent versions of the manuscript, and all authors approved the final version.

Competing interests

EF and AMG received fees as lecturers for conducting these courses, but did not receive any fee for the design, analysis, or writing of this paper. ES and FB are employees of the Esteve

Foundation, a private nonprofit foundation under Spanish Law. ES and FB have participated in the courses and the preparation of this paper as part of their paid work.

Funding statement

The training course described in this study was funded by the Esteve Foundation, a private nonprofit foundation under Spanish Law. Some editions of the course have received partial funding from third parties, such as public universities, public hospitals, public research centers, and scientific societies. EF was partly funded by the Department of Universities and Research, Government of Catalonia (2014SGR999).

Data sharing statement

A full data set of results is available from the corresponding author.

References

[1] Marusic A, Marusic M. Small scientific journals from small countries: breaking from a vicious circle of inadequacy. Croat Med J. 1999;40:508–514.

[2] Albert T. Writing for journals: a paradigm lost? J Epidemiol Community Health. 2000;54:642–643.

[3] Day RA. How to write and publish a scientific paper. Phoenix: The Oryx Press; 1998.

[4] Huston P. Resolving writer ’s block. Can Fam Physician. 1998;44:92–97.

[5] Galipeau J, Moher D, Campbell C, Hendry P, Cameron DW, Palepu A, et al. A systematic review highlights a knowledge gap regarding the effectiveness of health-related training programs in journalology. J Clin Epidemiol. 2015;68:257–265.

[6] Morales P, García L, Bosch F. Dos décadas de actividades puente entre la farmacología, la epidemiología y la salud pública en España. Gac Sanit. 2015;29:224–227.

[7] Huth EJ. How to write and publish papers in the medical sciences. Philadelphia: ISI Press; 1982.

[8] Mabrouki K, Bosch F. Redacción científica en biomedicina: Lo que hay que saber. Barcelona: Fundación Dr. Antonio Esteve; 2007.

[9] McGrail MR, Rickard CM, Jones R. Publish or perish: a systematic review of interventions to increase academic publication rates. High Educ Res Dev. 2006;25:19–35.

[10] Phadtare A, Bahmani A, Shah A, Pietrobon R. Scientific writing: a randomized controlled trial comparing standard and on-line instruction. BMC Med Educ. 2009;9:27.

[11] Jawaid M, Masood Z, Alam SN, Jawaid SA. An analysis of interactive hands-on workshops on medical writing. J Pak Med Assoc. 2011;61:66–70.

[12] Sridhar ARM, Willett LL, Castiglioni A, Heudebert G, Landry M, Centor RM, et al. Scholarship opportunities for trainees and clinician educators: Learning outcomes from a case report writing workshop. J Gen Intern Med. 2009;24:398–401.

[13] Guydish J, Masson C, Flentje A, Shopshire M, Sorensen JL. Scientific writing seminar for early-stage investigators in substance abuse research. Subst Abus. 2016;37:238–241.

[14] Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it. BMJ. 2013;347:f6753.

[15] Files JA, Blair JE, Mayer AP, Ko MG. Facilitated peer mentorship: a pilot program for academic advancement of female medical faculty. J Womens Health (Larchmt). 2008;17:1009–1015.

[16] Rickard CM, McGrail MR, Jones R, O’Meara P, Robinson A, Burley M, et al. Supporting academic publication: Evaluation of a writing course combined with writers’ support group. Nurse Educ Today. 2009;29:516–521.

[17] Steinert Y, McLeod PJ, Liben S, Snell L. Writing for publication in medical education: the benefits of a faculty development workshop and peer writing group. Med Teach. 2008;30:e280-285.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract **OK, a) page 1** **b) page 2**	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale OK, page 4	2	Explain the scientific background and rationale for the investigation being reported
Objectives OK, page 4	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design OK, pages 4-6	4	Present key elements of study design early in the paper
Setting OK, pages 4-6	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants OK, a) page 6	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables OK, pages 4-6	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement NA	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias OK, page 6 and 14	9	Describe any efforts to address potential sources of bias
Study size OK, page 6 and 7	10	Explain how the study size was arrived at
Quantitative variables OK, page 7	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods OK, a) b) c) d) pages 6, 7	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account

		of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants OK a) b) pages 6,7. c) Flowdiagram not necessary	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data OK, page 7	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data OK, page 7-8	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results OK, page 7-8-9	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses OK, page 10	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results OK, page 13	18	Summarise key results with reference to study objectives
Limitations (and strengths) OK, pages 14-15	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation Ok, pages 13-14	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability Ok, pages 13-14	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding Ok, pages 16	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at

http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Students' satisfaction and perceived impact on knowledge, attitudes, and skills after a two-day course in scientific writing: a prospective longitudinal study.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-018657.R1
Article Type:	Research
Date Submitted by the Author:	18-Oct-2017
Complete List of Authors:	Fernandez, Esteve; Institut català d'Oncologia, Tobacco Control Unit Garcia, Ana; Universitat de València Serés, Elisabet; Fundació Antoni Esteve Bosch, Fèlix; Fundació Antoni Esteve
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Medical publishing and peer review
Keywords:	Journalology, Publishing, EDUCATION & TRAINING (see Medical Education & Training), observationl study

Students' satisfaction and perceived impact on knowledge, attitudes, and skills after a two-day course in scientific writing: a prospective longitudinal study ‡

Short title: A scientific writing course: satisfaction and perceived impact

Esteve Fernández[1,2,3,]*, Ana M. García[4], Elisabet Serés[5], Fèlix Bosch[5,6]

[1] Tobacco Control Unit, Cancer Control and Prevention Programme, Institut Català d'Oncologia (ICO), Barcelona, Spain.

[2] Cancer Prevention and Control Group, Institut d'Investigació Biomèdica de Bellvitge (IDIBELL), L'Hospitalet de Llobregat, Barcelona, Spain.

[3]Department of Clinical Sciences, School of Medicine, Campus de Bellvitge, Universitat de Barcelona, L'Hospitalet del Llobregat, Barcelona, Spain.

[4] Department of Preventive Medicine and Public Health, University of Valencia, Valencia, Spain.

[5] Esteve Foundation, Barcelona, Spain.

[6] Department of Experimental and Health Sciences, School of Health and Life Sciences, Universitat Pompeu Fabra, Barcelona, Spain.

* **Corresponding Author:** efernandez@iconcologia.net (EF)

‡ Preliminary results of this study were presented at the 7th International Congress on Peer Review and Biomedical Publications, September 8-10, 2013, Chicago IL USA. Poster communication: Fernández E, García AM, Serés E, Bosch F. Ten years' experience teaching health professionals to write and to publish articles. Available at: http://www.peerreviewcongress.org/abstracts_2013.html#4

Abstract

Objectives: This study aimed to determine students' satisfaction with a two-day course on scientific writing in health sciences and to assess their perceptions of the long-term impact on their knowledge, attitudes, and skills.

Setting: 27 iterations of a two-day course on writing and publishing scientific articles in health sciences

Participants: 741 students attending the 27 courses

Design: Prospective longitudinal study

Primary and secondary outcome measures: Immediately after each course, students completed a first questionnaire, rating their satisfaction with different aspects of the classroom sessions on a Likert scale (0–5). Approximately two years after the course, students completed a follow-up questionnaire, using a Likert scale (0–4) to rate their knowledge, skills, and attitudes in relation to scientific writing before and after attending the course.

Results: 741 students (70.0% women) participated in the 27 iterations of the course; 568 (76.8%) completed the first questionnaire and 182 (24.6%) completed the follow-up questionnaire. The first questionnaire reflected high overall satisfaction (mean score, 4.6). In the second questionnaire, students reported that the course had improved their knowledge (mean improvement: 1.6; 95%CI 1.6–1.7), attitudes (mean improvement: 1.3; 95%CI 1.2–1.4), and skills (mean improvement: 1.4; 95%CI 1.3-1.4) related to writing and publishing scientific papers. Most respondents (n=145, 79.7%) had participated in drafting a scientific paper after the course; in this subgroup, all the specific writing skills assessed in the second questionnaire significantly improved.

Conclusions: Students were satisfied with the format and the contents of the course, and those followed-up, considered that the course had improved their knowledge, attitudes, and skills in relation to scientific writing and publishing. courses are particularly necessary in countries without strong traditions in scientific publication.

Word count: 276 words

Strengths and limitations of this study

- The study analyzed 10 years' experience including 27 iterations of a two-day course completed by more than 700 health science researchers
- This is the first systematic evaluation of students' satisfaction and improvements in knowledge, skills, and attitudes acquired of such a course in Spain.
- The study measures the perceived gains rather than objectively assessed gains.
- Selection bias could lead to overestimation of results in the satisfaction survey: more satisfied students might be more likely to participate.
- The response rate to the follow-up questionnaire was low.

Keywords: Journalology; Program Evaluation; Publishing; Questionnaires; Teaching; Writing

Introduction

Publications are the measurable results of scientific activity. However, most health science researchers, especially in non-English-speaking countries, receive little training in scientific writing [1]. Writing is challenging for researchers, especially for newcomers, who also need publications to advance their careers [2].

Most researchers are expected to acquire the skills to write scientific papers without formal training, through "learning by doing"[3]. Inadequate training in scientific writing can make postgraduate students and established researchers reluctant to write [4]. In recent decades, the number of courses and workshops on scientific writing has increased, but the effectiveness of these endeavors remains to be determined [5].

Given the lack of undergraduate courses on scientific writing in Spain, in 2003 we designed and launched a two-day course on writing and publishing scientific articles for researchers in the health sciences in the early stages of their careers [6]. This study aimed to determine students' satisfaction with this course and their perceptions regarding its long-term impact on their knowledge, attitudes, and skills.

Methods

The following sections describe the course, the questionnaire administered in the classroom to evaluate students' immediate satisfaction with the course, and the follow-up questionnaire sent to participants to evaluate their perceptions of the impact of the course.

Course characteristics

We designed an intensive two-day classroom course for Spanish-speaking undergraduate, graduate, or postgraduate degrees in health sciences to cover the basic skills involved in scientific writing based on classic books about scientific writing [3,7]. The main objectives of the course were to provide basic advice about scientific writing, to present the structure and contents of standard scientific articles, and to explain the editorial and peer review processes for health science journals. The course imparted this knowledge over 15 hours, combining lectures with individual and group

exercises based on real examples. The syllabus for the first day (8 hours) covered scientific writing style, scientific publishing formats, and the structure and contents of the original article; the syllabus for the second day (7 hours) covered ethical principles in scientific publishing, selecting a target journal, preparing manuscripts for submission, and the editorial and peer review processes. The main topics are detailed in Table 1, the full program of the course is available at http://www.esteve.org/en/?wpdmact=process&did=MTUzNy5ob3RsaW5r (in Spanish), and most of the contents are included in a book used for reference in the course [8]. The Esteve Foundation (www.esteve.org) offered the course to institutions throughout Spain. The course targets health science researchers in training or in the initial stages of their careers (e.g., graduate and postgraduate students, postdoctoral fellows, medical residents, etc.), since most undergraduate and postgraduate curricula in the health sciences in Spain did not include formal training in scientific writing. Two lecturers (AMG and EF) and the promoter (FB) developed all the contents. The lecturers are professors of epidemiology and public health and have recognized experience as authors, reviewers, and editors in national and international journals. During the course, both lecturers are present and actively participate in all the sessions. While one explains a topic, the other stimulates the audience with questions or suggestions, making the teaching more dynamic and participative. The number of students in each edition ranged between 17 and 40 [6]. After a pilot edition during the Minorca Public Health Summer School in 2003, the first edition took place in Valencia in January 2004, and the most recent (39th edition) took place in Barcelona in October 2016. The present study includes data from 741 students participating in the 27 iterations held between 2004 and 2013. The course has been accredited [No. 09/013214-MD] by the Catalan Council for Continuing Education in the Health Professions with the approval of the National Health System's Committee on Continuing Education under Spain's Ministry of Health.

First satisfaction questionnaire

We administered a satisfaction questionnaire at the end of each edition of the course. Each student anonymously rated items on a Likert scale (0–5) presented on printed form. The items queried students about their satisfaction with the course overall,

materials, contents of the lectures, contents of the practical exercises, lecturers, and organizational aspects. The questionnaire is available at http://www.esteve.org/en/rc-encuesta. We used the same questionnaire without changes in the 27 iterations of the course.

Follow-up questionnaire

We designed a follow-up questionnaire (available at http://www.esteve.org/en/rc-encuesta-diferido) to collect sociodemographic data and to assess students' perception of the effect of attending the course on their knowledge (5 items), attitudes (3 items), opinions (3 items), and skills (16 items: 3 general skills and 13 specific skills) with regard to scientific writing. The follow-up questionnaire also reassessed students' overall satisfaction with the course through a new question: "Would you recommend this course to a colleague?". Respondents rated all items on a Likert scale (0–4). To analyze the impact of the course on specific skills, we restricted the analysis to students who had collaborated in publishing a scientific article after doing the course. We emailed the follow-up questionnaire to the first 174 students (29.3% responded) in 2006 and to the subsequent 91 students (27.5% responded) in 2007. In 2013, we emailed the remaining 475 students, asking them to fill out the questionnaire online (22.3% responded).

Statistical analyses

We computed means, medians, ranges, standard deviations (SD), 95% confidence intervals (CI), and interquartile ranges for the responses to each item in the questionnaire. To compare the characteristics of the subgroup of students in whom the specific writing skills were analyzed with those of the entire group of respondents to the second questionnaire, we used chi-square and Student's t-tests. To compare the responses on the items in the follow-up questionnaire asking about students' perceptions of their knowledge, skills, and attitudes before and after the course, we used the Wilcoxon non-parametric test for paired samples (before-after comparisons). The distribution of the scores (including the pre-post difference in scores) is presented using traditional boxplots. We used SigmaPlot™ 11.0 (Systat Software Inc, Chicago, IL, USA) for data processing and statistical analysis.

Table 1. Programme of the course

First day

- Introduction to the course
- Writing styles
  - Scientific style and other styles
  - Characteristics of scientific writing style
  - Types of texts in scientific publications
  - Starting to write: sentences and paragraphs
  - Exercise: scientific writing styles
  - Exercise: writing of paragraphs
- The original article: introduction
  - Definition and general characteristics of the original article
  - Structure of the original article
  - The title: the article's business card
  - Exercise: good and bad titles
- The abstract of the original article
  - The abstract: essential information
  - Types of abstracts (structured and non-structured) and contents
  - Key words and the Medical Subject Headings (MeSH)
  - Exercise: editing of an abstract
- The core of the original article (I)
  - The IMR&D format
  - The Introduction: the background and study's aim
  - The methods: what have we done?
  - Exercise: writing an Introduction
- The core of the original article (II)
  - The Results: what have we found?
  - Principles for text and data presentation
  - The balance between text, tables and figures
  - Exercise: building a table
- The core of the original article (III)
  - The Discussion: what does our results mean?
  - Structure of the Discussion section
  - The conclusions
  - Exercise: analysis of a Discussion
- The bibliography and additional sections of the original article
  - Use of bibliography and formats
  - Acknowledgments
  - Funding
  - Competing interests

Second day

- How to publish an article
  - Exercise: where to I submit it?
  - Choosing the adequate journal
  - The target audience, language, open access
  - The bibliographic impact factor
- Preparing the article for submission
  - The cover letter
  - Final check
  - On-line submission
  - Exercise: writing of a cover letter

- The editorial process
  - The peer review process
  - Standard phases of the editorial process
  - Editorial decision criteria
  - Answering peer review
- Ethical aspects of scientific publication
  - Authorship: the ICJME criteria
  - Repetitive publication
  - Competing interests
  - Other ethical aspects for authors, editors and publishers
- Comprehensive exercise with a manuscript

Ethical requirements

Participants provided informed consent to participate in the study (oral consent for the first satisfaction questionnaire and written consent for the follow-up questionnaire). As the surveys were conducted as part of the routine evaluation of the course, as approved by the Council for Continuing Education, no further ethics approval was required.

Results

A total of 741 students (70.0% women) attended one of the 27 iterations of the course. The response rate to the first questionnaire was 76.8% (n=569). Overall, they rated the experience as very positive (mean 4.6, SD 0.6, of a maximum 5). Students' ratings of satisfaction with the course handouts, theoretical sessions, teachers, and overall organization were above 4.5 (Fig 1); only satisfaction with the practical sessions was rated below 4.5 (mean 4.2, SD 0.8).

In the follow-up questionnaire, we obtained a total of 182 responses from 741 students (24.6% response rate). Table 2 summarizes the general characteristics of these students (age, 39.1; 131 (72%) women) who responded to the follow-up questionnaire and of the subgroup who went on to collaborate in the publication of a scientific paper (n=145, 79.7% of the students who responded to the follow-up questionnaire). In the overall group, students had degrees in medicine (36.3%),

pharmacy (11.5%), biology (11.0%), or other related fields such as nursing, psychology, biochemistry, biotechnology, or statistics (41.2%); slightly more than half (52.2%) were involved in basic research. Students in the subgroup were similar to the entire group of respondents to the follow-up questionnaire in terms of age, gender, and undergraduate training, but not in the type of research in which they were mainly involved.

FIG. 1 ABOUT HERE

Fig 1. Results of the first questionnaire: students' (n=569) satisfaction with different aspects of classroom sessions in the 27 iterations of the scientific writing course in Spain, 2004-2013.

FOOTNOTE TO FIG 1. Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For all 6 variables, the median coincides with the upper line of the box. The whiskers represent the 90th and 10th percentiles and the dots represent outliers (each dot represents at least one response).

Table 2. Characteristics of the students who answered the follow-up questionnaire about the course on scientific writing (27 iterations). Spain, 2004-2013.

	Total	Students who went on to collaborate in preparing a paper for publication	p-value
Trainees, n	182	145	
Age, mean (SD) [years]	39.1 (9.4)	38.8 (9.6)	0.849 [a]
Gender, n (%)			
Women	131 (72.0)	103 (71.0)	0.902 [b]
Men	51 (28.0)	42 (29.0)	
Field of degree, n (%)			
Medicine	66 (36.3)	56 (38.4)	0.981 [b]
Pharmacy	21 (11.5)	17 (11.6)	
Biology	20 (11.0)	15 (10.3)	
Others	75 (41.2)	58 (39.7)	
Main type of research, n (%)			
Clinical research	41 (22.5)	37 (25.3)	0.036 [b]
Basic research	95 (52.2)	89 (61.0)	
Others	46 (25.3)	20 (13.7)	

[a] Student's t-test; [b] chi-square test

FIG. 2 ABOUT HERE

Fig 2. Perceived change in overall competences among students (n=182) who completed the follow-up questionnaire about the scientific writing course (27 iterations in Spain, 2004-2013).

FOOTNOTE TO FIG.2

The increase in general competences was calculated for each item from individual scores; individual scores were calculated by subtracting the rating on the item asking about competence after attending the seminar from the rating on the item asking about competence before attending the seminar. Significant gains were observed for all general competences ($p<0.001$; Wilcoxon signed-rank test). Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For variables A and B, the median coincides with the upper line of the box, and for variables C, E, G, H, I, J, and K the median coincides with the bottom line. The whiskers represent the 90th and 10th percentiles, and the dots represent extreme values.

FIG. 3 ABOUT HERE

Fig 3. Changes in specific writing skills in students who went on to publish after the scientific writing course (n=145) (27 iterations in Spain, 2004-2013).

FOOTNOTE TO FIG.3

The increase in specific writing skills was calculated for each item from individual scores; individual scores were calculated by subtracting the rating on the item asking about competence after attending the seminar from the rating on the item asking about competence before attending the seminar. Significant gains were observed for all general competences ($p<0.001$; Wilcoxon signed-rank test). Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For variables A and B, the median coincides with the upper line of the box, and for variables C, E, G, H, I, J, and K the median coincides with the bottom line. The whiskers represent the 90th and 10th percentiles, and the dots represent extreme values.

The mean scores for all the items that assessed students' perceptions of their knowledge, skills, and attitudes after the course were higher than those for their perceptions of these dimensions before the course (Fig 2). Overall increases in scores for knowledge (mean 1.6; 95% CI 1.6-1.7), attitudes (mean 1.3; 95% CI 1.2-1.4), and skills (mean 1.4; 95% CI 1.3-1.4) after the course were significant ($p<0.001$). Among the items about knowledge (Fig 2, Panel I), we observed the greatest improvement (2 points) in the understanding of the editorial process. All but 5 assessments (by 4 students) yielded higher post-course scores regarding attitudes toward publishing (Fig

2, Panel II). Students also indicated the need for training in scientific writing at both the undergraduate (mean score 3.1; 95% CI 2.9-3.3, of a maximum 4) and postgraduate level (mean score 3.9; 95% CI 3.8-4.0). The mean score on the question asking about students' overall degree of satisfaction with the course was 3.8 (SD 0.4).

Fig 3 shows the change in perceptions of specific writing skills before and after the course in the subgroup of students who went on to collaborate in the publication of scientific paper. Statistically significant improvements were observed for all the skills ($p<0.001$; Wilcoxon signed-rank test). Average improvements ranged between 1.0 (95% CI 0.8-1.2) points for citing and writing references to 1.5 (95% CI 1.3-1.7) for preparing cover letters, with improvements in the remaining skills lying between these values: determining eligibility for authorship (1.3, 95% CI 1.1-1.5), writing introductions (1.3, 95% CI 1.1-1.5), writing abstracts (1.2, 95% CI 1.0-1.4), writing discussions (1.2, 95% CI 1.0-1.4), and responding to editors' and reviewers' comments (1.2, 95% CI 1.0-1.4).

Discussion

This study analyzed 10 years' experience including 27 iterations of a two-day course on how to write scientific articles completed by more than 700 health science researchers. The two surveys showed high satisfaction with the two-day format and the contents of the course. Moreover, the second survey showed that students considered that the course had improved their overall knowledge, attitudes, and skills as well as some specific writing skills. Importantly, students expressed the need for this type of training at both the undergraduate and postgraduate levels.

Our results are similar to those of other published experiences, most of which were included in two systematic reviews [5,9] that evaluated different outcomes. Like other authors [10], we analyzed students' satisfaction with the course. Most published accounts report experiences in English-speaking countries (United States, Australia, New Zealand)[5]. Galipeau et al.'s systematic review [5] included 12 studies focused on writing for publication; most of these had shortcomings like small samples, low validity, or biases, so the authors concluded that there are important gaps in our knowledge of how to improve scientific writing.

Jawaid et al.[11] reported an experience from Pakistan (language of course not stated), with 120 attendees who participated in a three-month course based on four interactive workshops. Through a pre- and post-workshop questionnaire comprising 14 questions, the authors concluded their course improved attendees' knowledge and skills related to writing. One study from the United States [12] not included in Galipeau et al.'s systematic review [5] assessed improvements in writing after a 60- to 90-minute case report writing workshop. In a three-year period, 214 students (mainly clinicians and educators) attended the workshops, and pre-post evaluation found a significant improvement in self-rated writing competence and in the perceived probability of submitting a case report. In another study from the United States, Guydish et al.[13] assessed the impact of a scientific writing seminar aiming to encourage manuscript writing and dissemination of addiction research. Over a 14-year period, a total of 113 postdoctoral students in 14 cohorts completed the six-month seminar. After the course, between 75% and 100% of the students from each cohort submitted papers and between 60% to 100% of these were published. The authors concluded that writing seminars may be useful among early-stage investigators.

Regardless of whether scientific writing courses yield positive or negative results, evaluations of their effectiveness, if performed, have seldom been published[5,9]. We consider these activities to be educational interventions, and as such they should have valid study designs under the principles of implementation research [14], which seeks to understand and work within real world conditions, rather than try to control for these conditions or to remove their influence as causal effects, as is the case in

experimental trials. In this regard, the impact of distance learning and more specifically massive open online courses (MOOC) on scientific writing should also be assessed.

Some limitations of our study must be considered. First of all, the satisfaction questionnaire used has not had a formal validation, and the study measures the perceived gains rather than objectively assessed gains. Secondly selection bias can lead to overestimation of results in satisfaction surveys, since more satisfied students may be more likely to participate (although the contrary effect is also possible); however, the response rate in the baseline (satisfaction) survey (nearly 77%) can be considered optimal. On the other hand, the response rate to the follow-up questionnaire was low, and it decreased in the successive waves from 29% to 27% and 22%. This might reflect difficulties in reaching participants who were in training when they did the course, making them more likely to have changed jobs and professional email addresses. A likely explanation of the low response rate is that students who responded were likely to be those who got the most out of the workshop or had best outcomes to report. Another limitation is the lack of a control group, as it is desirable in the evaluation of any intervention. Further studies should ensure follow-up at a fixed time not very long (1 or 2 years) after the course and baseline survey; the ideal time would be long enough to detect the changes supposedly due to the intervention but short enough to minimize attrition and recall bias. Furthermore, the positive effects we observed could be partly due to students' posterior participation in other activities to improve scientific writing. Unfortunately, the follow-up questionnaire did not collect information about such activities. However, we collected information on the impact of the course on collaboration in the writing of papers, as in other studies [13,15–17].

Finally, some strengths of our study merit attention. This is the first regularly held course on scientific writing in Spain, currently with 40 iterations in 15 years and more than 1,000 participants to date, and the course is still running being held. To our knowledge, this is also the first report of a systematic evaluation of students' satisfaction and improvements in knowledge, skills, and attitudes acquired through a course of these characteristics in Spain. Although simultaneous assessment of prior and posterior knowledge and skills after the course could be considered a weakness in terms of causal inference, it may actually be a strength since the students are more

aware and provide more coherent information of the items evaluated and the changes suffered.

In conclusion, the format and contents of the course satisfied the students' needs and, among the sample of those who were followed-up, there was an improvement of their skills related to scientific writing and publishing. Participants strongly agreed that health professionals need training in scientific writing during the course of their undergraduate and/or postgraduate studies. Academic institutions, at least in countries with a lesser tradition of publishing, should provide training on scientific writing to improve the reporting of research results.

Acknowledgments

The authors wish to thank all the students who participated in the surveys and Pol Morales, Elisabet Caballeria, and Laura García from the Esteve Foundation for their contributions to the running of the course and to the evaluation processes. We also thank John Giba for reviewing and revising the English version of the manuscript.

Contributorship statement

EF, AMG, and FB conceived and designed the study. All the authors designed the questionnaires. EF and AMG designed the analysis strategy, ES and FB analyzed the data, and all the authors contributed to its interpretation. EF and FB wrote the first draft of the manuscript; all authors contributed substantially to subsequent versions of the manuscript, and all authors approved the final version.

Competing interests

EF and AMG received fees as lecturers for conducting these courses, but did not receive any fee for the design, analysis, or writing of this paper. ES and FB are employees of the Esteve Foundation, a private nonprofit foundation under Spanish Law. ES and FB have participated in the courses and the preparation of this paper as part of their paid work.

Funding statement

The training course described in this study was funded by the Esteve Foundation, a private nonprofit foundation under Spanish Law. Some iterations of the course have received partial funding from third parties, such as public universities, public hospitals, public research centers, and scientific societies. EF was partly funded by the Department of Universities and Research, Government of Catalonia (2014SGR999).

Data sharing statement

A full data set of results is available from the corresponding author.

References

[1] Marusic A, Marusic M. Small scientific journals from small countries: breaking from a vicious circle of inadequacy. Croat Med J. 1999;40:508–514.

[2] Albert T. Writing for journals: a paradigm lost? J Epidemiol Community Health. 2000;54:642–643.

[3] Day RA. How to write and publish a scientific paper. Phoenix: The Oryx Press; 1998.

[4] Huston P. Resolving writer ’s block. Can Fam Physician. 1998;44:92–97.

[5] Galipeau J, Moher D, Campbell C, Hendry P, Cameron DW, Palepu A, et al. A systematic review highlights a knowledge gap regarding the effectiveness of health-related training programs in journalology. J Clin Epidemiol. 2015;68:257–265.

[6] Morales P, García L, Bosch F. Dos décadas de actividades puente entre la farmacología, la epidemiología y la salud pública en España. Gac Sanit. 2015;29:224–227.

[7] Huth EJ. How to write and publish papers in the medical sciences. Philadelphia: ISI Press; 1982.

[8] Mabrouki K, Bosch F. Redacción científica en biomedicina: Lo que hay que saber. Barcelona: Fundación Dr. Antonio Esteve; 2007.

[9] McGrail MR, Rickard CM, Jones R. Publish or perish: a systematic review of interventions to increase academic publication rates. High Educ Res Dev. 2006;25:19–35.

[10] Phadtare A, Bahmani A, Shah A, Pietrobon R. Scientific writing: a randomized controlled trial comparing standard and on-line instruction. BMC Med Educ. 2009;9:27.

[11] Jawaid M, Masood Z, Alam SN, Jawaid SA. An analysis of interactive hands-on workshops on medical writing. J Pak Med Assoc. 2011;61:66–70.

[12] Sridhar ARM, Willett LL, Castiglioni A, Heudebert G, Landry M, Centor RM, et al. Scholarship opportunities for trainees and clinician educators: Learning outcomes from a case report writing workshop. J Gen Intern Med. 2009;24:398–401.

[13] Guydish J, Masson C, Flentje A, Shopshire M, Sorensen JL. Scientific writing seminar for early-stage investigators in substance abuse research. Subst Abus. 2016;37:238–241.

[14] Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it. BMJ. 2013;347:f6753.

[15] Files JA, Blair JE, Mayer AP, Ko MG. Facilitated peer mentorship: a pilot program for academic advancement of female medical faculty. J Womens Health (Larchmt). 2008;17:1009–1015.

[16] Rickard CM, McGrail MR, Jones R, O’Meara P, Robinson A, Burley M, et al. Supporting academic publication: Evaluation of a writing course combined with writers’ support group. Nurse Educ Today. 2009;29:516–521.

[17] Steinert Y, McLeod PJ, Liben S, Snell L. Writing for publication in medical education: the benefits of a faculty development workshop and peer writing group. Med Teach. 2008;30:e280-285.

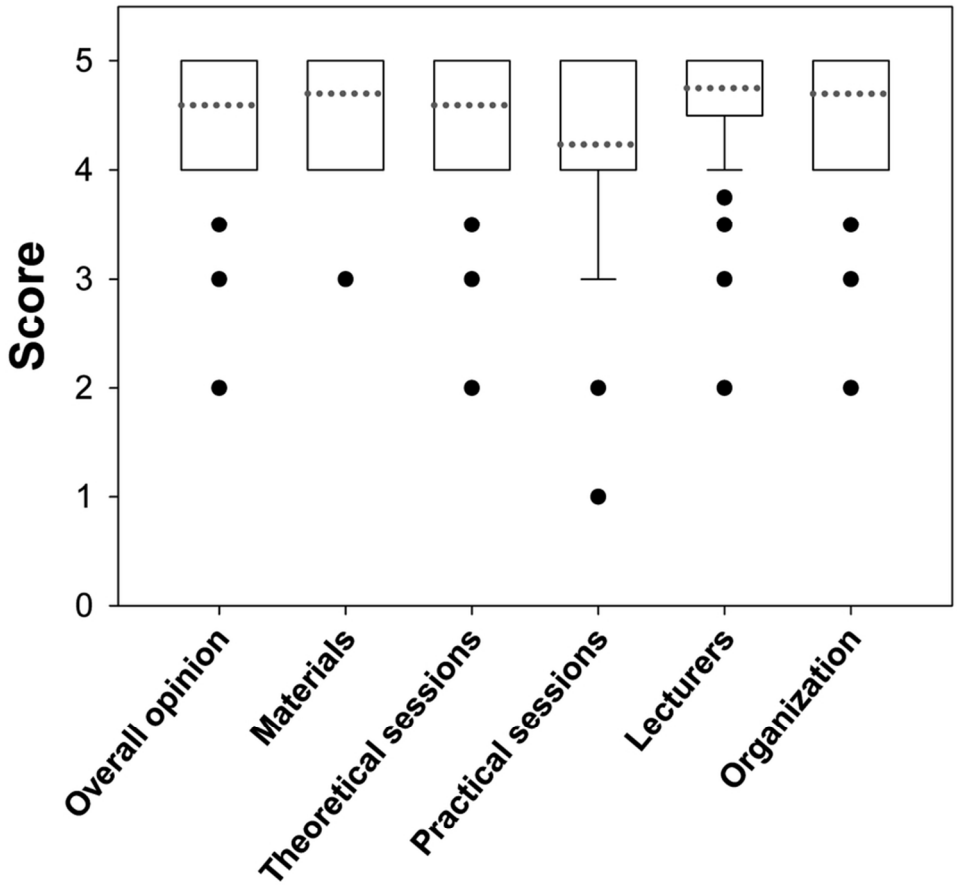


FIGURE 1

81x82mm (300 x 300 DPI)

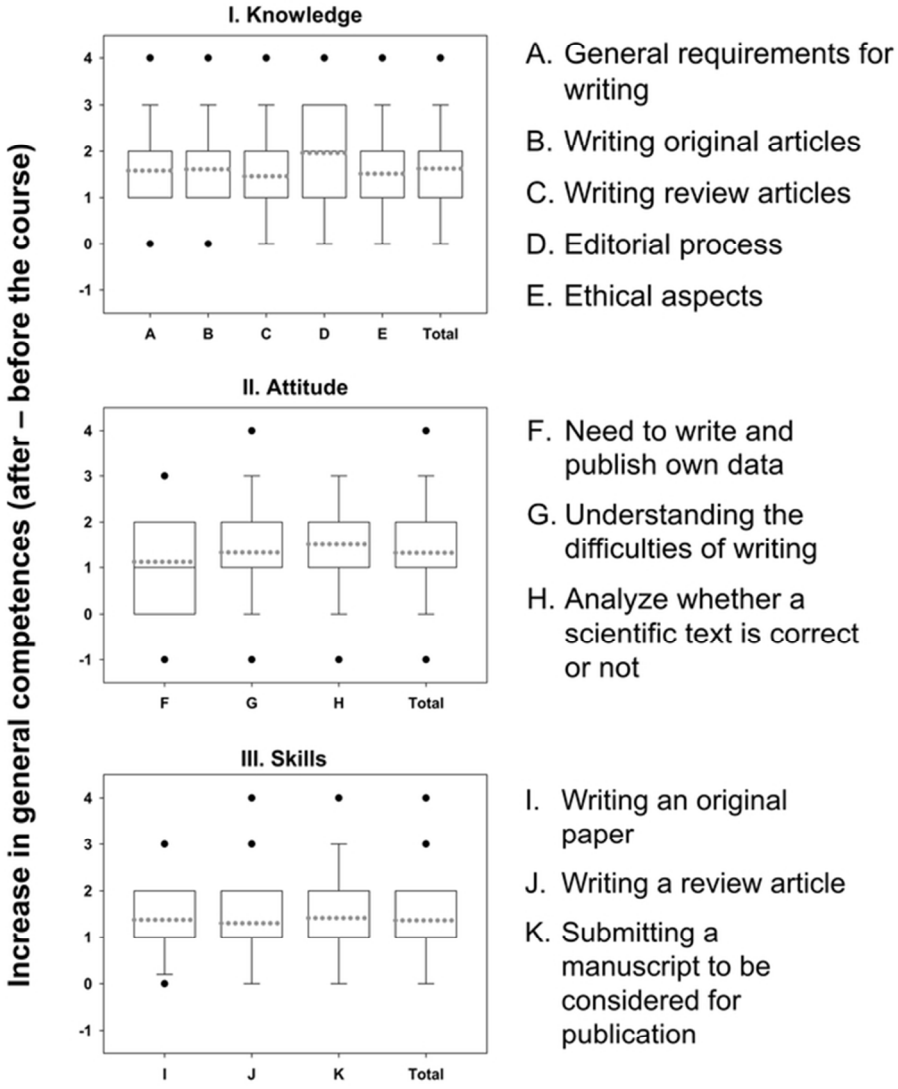


FIGURE 2

30x36mm (600 x 600 DPI)

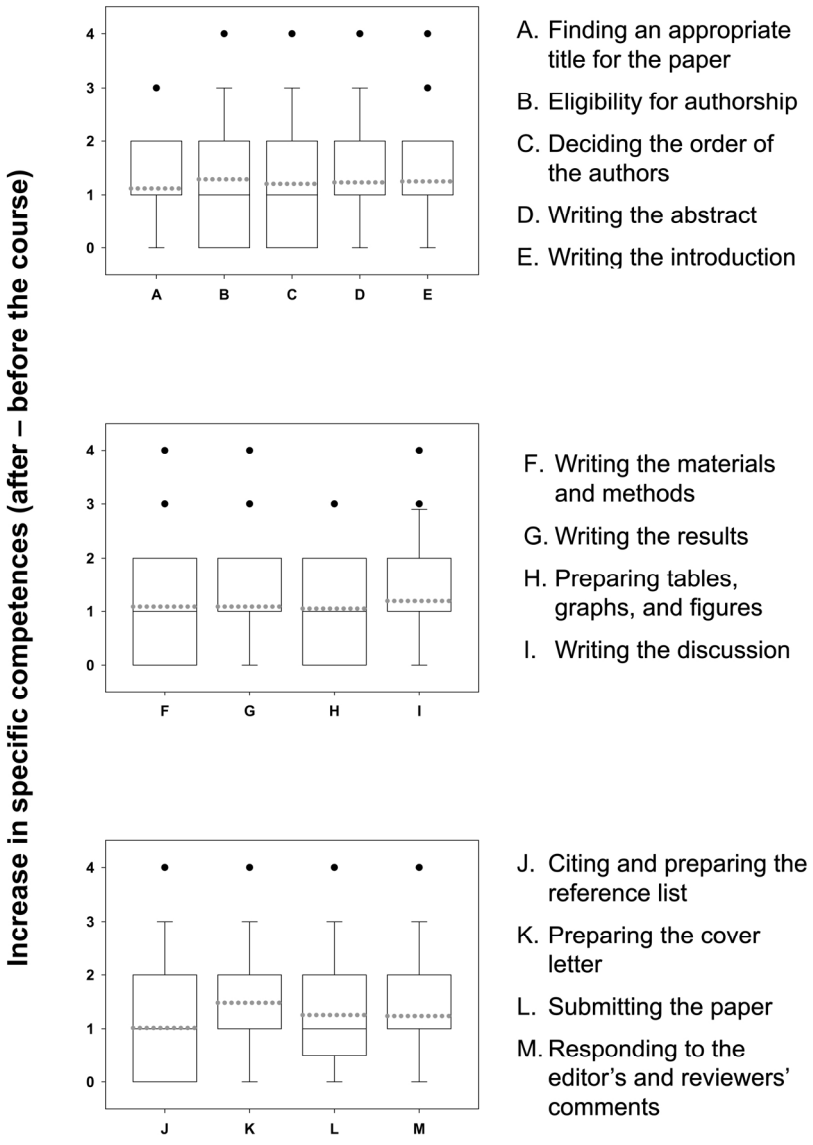


FIGURE 3

677x935mm (72 x 72 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract **OK, a) page 1** **b) page 2**	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale OK, page 4	2	Explain the scientific background and rationale for the investigation being reported
Objectives OK, page 4	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design OK, pages 4-6	4	Present key elements of study design early in the paper
Setting OK, pages 4-6	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants OK, a) page 6	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables OK, pages 4-6	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement NA	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias OK, page 6 and 14	9	Describe any efforts to address potential sources of bias
Study size OK, page 6 and 7	10	Explain how the study size was arrived at
Quantitative variables OK, page 7	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods OK, a) b) c) d) pages 6, 7	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account

		of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants OK a) b) pages 6,7. c) Flowdiagram not necessary	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data OK, page 7	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data OK, page 7-8	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results OK, page 7-8-9	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses OK, page 10	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results OK, page 13	18	Summarise key results with reference to study objectives
Limitations (and strengths) OK, pages 14-15	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation Ok, pages 13-14	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability Ok, pages 13-14	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding Ok, pages 16	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at

http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Students' satisfaction and perceived impact on knowledge, attitudes, and skills after a two-day course in scientific writing: a prospective longitudinal study.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-018657.R2
Article Type:	Research
Date Submitted by the Author:	13-Nov-2017
Complete List of Authors:	Fernandez, Esteve; Institut català d'Oncologia, Tobacco Control Unit Garcia, Ana; Universitat de València Serés, Elisabet; Fundació Antoni Esteve Bosch, Fèlix; Fundació Antoni Esteve
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Medical publishing and peer review
Keywords:	Journalology, Publishing, EDUCATION & TRAINING (see Medical Education & Training), observationl study

Students' satisfaction and perceived impact on knowledge, attitudes, and skills after a two-day course in scientific writing: a prospective longitudinal study ‡

Short title: A scientific writing course: satisfaction and perceived impact

Esteve Fernández[1,2,3,]*, Ana M. García[4], Elisabet Serés[5], Fèlix Bosch[5,6]

[1] Tobacco Control Unit, Cancer Control and Prevention Programme, Institut Català d'Oncologia (ICO), Barcelona, Spain.

[2] Cancer Prevention and Control Group, Institut d'Investigació Biomèdica de Bellvitge (IDIBELL), L'Hospitalet de Llobregat, Barcelona, Spain.

[3]Department of Clinical Sciences, School of Medicine, Campus de Bellvitge, Universitat de Barcelona, L'Hospitalet del Llobregat, Barcelona, Spain.

[4] Department of Preventive Medicine and Public Health, University of Valencia, Valencia, Spain.

[5] Esteve Foundation, Barcelona, Spain.

[6] Department of Experimental and Health Sciences, School of Health and Life Sciences, Universitat Pompeu Fabra, Barcelona, Spain.

* **Corresponding Author:** efernandez@iconcologia.net (EF)

‡ Preliminary results of this study were presented at the 7th International Congress on Peer Review and Biomedical Publications, September 8-10, 2013, Chicago IL USA. Poster communication: Fernández E, García AM, Serés E, Bosch F. Ten years' experience teaching health professionals to write and to publish articles. Available at: http://www.peerreviewcongress.org/abstracts_2013.html#4

Abstract

Objectives: This study aimed to determine students' satisfaction with a two-day course on scientific writing in health sciences and to assess their perceptions of the long-term impact on their knowledge, attitudes, and skills.

Setting: 27 iterations of a two-day course on writing and publishing scientific articles in health sciences

Participants: 741 students attending the 27 courses

Design: Prospective longitudinal study

Primary and secondary outcome measures: Immediately after each course, students completed a first questionnaire, rating their satisfaction with different aspects of the classroom sessions on a Likert scale (0–5). Approximately two years after the course, students completed a follow-up questionnaire, using a Likert scale (0–4) to rate their knowledge, skills, and attitudes in relation to scientific writing before and after attending the course.

Results: 741 students (70.0% women) participated in the 27 iterations of the course; 568 (76.8%) completed the first questionnaire and 182 (24.6%) completed the follow-up questionnaire. The first questionnaire reflected high overall satisfaction (mean score, 4.6). In the second questionnaire, students reported that the course had improved their knowledge (mean improvement: 1.6; 95%CI 1.6–1.7), attitudes (mean improvement: 1.3; 95%CI 1.2–1.4), and skills (mean improvement: 1.4; 95%CI 1.3-1.4) related to writing and publishing scientific papers. Most respondents (n=145, 79.7%) had participated in drafting a scientific paper after the course; in this subgroup, all the specific writing skills assessed in the second questionnaire significantly improved.

Conclusions: Students were satisfied with the format and the contents of the course, and those who responded to the follow-up survey considered that the course had improved their knowledge, attitudes, and skills in relation to scientific writing and publishing. Courses are particularly important in countries without strong traditions in scientific publication.

Word count: 281 words

Strengths and limitations of this study

- The study analyzed 10 years' experience including 27 iterations of a two-day course completed by more than 700 health science researchers
- This is the first systematic evaluation of students' satisfaction and improvements in knowledge, skills, and attitudes acquired of such a course in Spain.
- The study measures the perceived gains rather than objectively assessed gains.
- The response rate to the follow-up questionnaire was low.
- Selection bias could have led to overestimation of positive results in the follow-up survey: the more satisfied students, or those with more writing successes to report, may have been more likely to participate.

Keywords: Journalology; Program Evaluation; Publishing; Questionnaires; Teaching; Writing

Introduction

Publications are the measurable results of scientific activity. However, most health science researchers, especially in non-English-speaking countries, receive little training in scientific writing [1]. Writing is challenging for researchers, especially for newcomers, who also need publications to advance their careers [2].

Most researchers are expected to acquire the skills to write scientific papers without formal training, through "learning by doing"[3]. Inadequate training in scientific writing can make postgraduate students and established researchers reluctant to write [4]. In recent decades, the number of courses and workshops on scientific writing has increased, but the effectiveness of these endeavors remains to be determined [5].

Given the lack of undergraduate courses on scientific writing in Spain, in 2003 we designed and launched a two-day course on writing and publishing scientific articles for researchers in the health sciences in the early stages of their careers [6]. This study aimed to determine students' satisfaction with this course and their perceptions regarding its long-term impact on their knowledge, attitudes, and skills.

Methods

The following sections describe the course, the questionnaire administered in the classroom to evaluate students' immediate satisfaction with the course, and the follow-up questionnaire sent to participants to evaluate their perceptions of the impact of the course.

Course characteristics

We designed an intensive two-day classroom course for Spanish-speaking undergraduate, graduate, or postgraduate degrees in health sciences to cover the basic skills involved in scientific writing based on classic books about scientific writing [3,7]. The main objectives of the course were to provide basic advice about scientific writing, to present the structure and contents of standard scientific articles, and to explain the editorial and peer review processes for health science journals. The course imparted this knowledge over 15 hours, combining lectures with individual and group

exercises based on real examples. The syllabus for the first day (8 hours) covered scientific writing style, scientific publishing formats, and the structure and contents of the original article; the syllabus for the second day (7 hours) covered ethical principles in scientific publishing, selecting a target journal, preparing manuscripts for submission, and the editorial and peer review processes. The main topics are detailed in Table 1, the full program of the course is available at http://www.esteve.org/en/?wpdmact=process&did=MTUzNy5ob3RsaW5r (in Spanish), and most of the contents are included in a book used for reference in the course [8]. The Esteve Foundation (www.esteve.org) offered the course to institutions throughout Spain. The course targets health science researchers in training or in the initial stages of their careers (e.g., graduate and postgraduate students, postdoctoral fellows, medical residents, etc.), since most undergraduate and postgraduate curricula in the health sciences in Spain did not include formal training in scientific writing. Two lecturers (AMG and EF) and the promoter (FB) developed all the contents. The lecturers are professors of epidemiology and public health and have recognized experience as authors, reviewers, and editors in national and international journals. During the course, both lecturers are present and actively participate in all the sessions. While one explains a topic, the other stimulates the audience with questions or suggestions, making the teaching more dynamic and participative. The number of students in each edition ranged between 17 and 40 [6]. After a pilot edition during the Minorca Public Health Summer School in 2003, the first edition took place in Valencia in January 2004, and the most recent (39th edition) took place in Barcelona in October 2016. The present study includes data from 741 students participating in the 27 iterations held between 2004 and 2013. The course has been accredited [No. 09/013214-MD] by the Catalan Council for Continuing Education in the Health Professions with the approval of the National Health System's Committee on Continuing Education under Spain's Ministry of Health.

First satisfaction questionnaire

We administered a satisfaction questionnaire at the end of each edition of the course. Each student anonymously rated items on a Likert scale (0–5) presented on printed form. The items queried students about their satisfaction with the course overall,

materials, contents of the lectures, contents of the practical exercises, lecturers, and organizational aspects. The questionnaire is available at http://www.esteve.org/en/rc-encuesta. We used the same questionnaire without changes in the 27 iterations of the course.

Follow-up questionnaire

We designed a follow-up questionnaire (available at http://www.esteve.org/en/rc-encuesta-diferido) to collect sociodemographic data and to assess students' perception of the effect of attending the course on their knowledge (5 items), attitudes (3 items), opinions (3 items), and skills (16 items: 3 general skills and 13 specific skills) with regard to scientific writing. The follow-up questionnaire also reassessed students' overall satisfaction with the course through a new question: "Would you recommend this course to a colleague?". Respondents rated all items on a Likert scale (0–4). To analyze the impact of the course on specific skills, we restricted the analysis to students who had collaborated in publishing a scientific article after doing the course. We emailed the follow-up questionnaire to the first 174 students (29.3% responded) in 2006 and to the subsequent 91 students (27.5% responded) in 2007. In 2013, we emailed the remaining 475 students, asking them to fill out the questionnaire online (22.3% responded).

Statistical analyses

We computed means, medians, ranges, standard deviations (SD), 95% confidence intervals (CI), and interquartile ranges for the responses to each item in the questionnaire. To compare the characteristics of the subgroup of students in whom the specific writing skills were analyzed with those of the entire group of respondents to the second questionnaire, we used chi-square and Student's t-tests. To compare the responses on the items in the follow-up questionnaire asking about students' perceptions of their knowledge, skills, and attitudes before and after the course, we used the Wilcoxon non-parametric test for paired samples (before-after comparisons). The distribution of the scores (including the pre-post difference in scores) is presented using traditional boxplots. We used SigmaPlot™ 11.0 (Systat Software Inc, Chicago, IL, USA) for data processing and statistical analysis.

Table 1. Programme of the course

First day

- Introduction to the course
- Writing styles
  - Scientific style and other styles
  - Characteristics of scientific writing style
  - Types of texts in scientific publications
  - Starting to write: sentences and paragraphs
  - Exercise: scientific writing styles
  - Exercise: writing of paragraphs
- The original article: introduction
  - Definition and general characteristics of the original article
  - Structure of the original article
  - The title: the article's business card
  - Exercise: good and bad titles
- The abstract of the original article
  - The abstract: essential information
  - Types of abstracts (structured and non-structured) and contents
  - Key words and the Medical Subject Headings (MeSH)
  - Exercise: editing of an abstract
- The core of the original article (I)
  - The IMR&D format
  - The Introduction: the background and study's aim
  - The methods: what have we done?
  - Exercise: writing an Introduction
- The core of the original article (II)
  - The Results: what have we found?
  - Principles for text and data presentation
  - The balance between text, tables and figures
  - Exercise: building a table
- The core of the original article (III)
  - The Discussion: what does our results mean?
  - Structure of the Discussion section
  - The conclusions
  - Exercise: analysis of a Discussion
- The bibliography and additional sections of the original article
  - Use of bibliography and formats
  - Acknowledgments
  - Funding
  - Competing interests

Second day

- How to publish an article
  - Exercise: where to I submit it?
  - Choosing the adequate journal
  - The target audience, language, open access
  - The bibliographic impact factor
- Preparing the article for submission
  - The cover letter
  - Final check
  - On-line submission
  - Exercise: writing of a cover letter

- The editorial process
  - The peer review process
  - Standard phases of the editorial process
  - Editorial decision criteria
  - Answering peer review
- Ethical aspects of scientific publication
  - Authorship: the ICJME criteria
  - Repetitive publication
  - Competing interests
  - Other ethical aspects for authors, editors and publishers
- Comprehensive exercise with a manuscript

Ethical requirements

Participants provided informed consent to participate in the study (oral consent for the first satisfaction questionnaire and written consent for the follow-up questionnaire). As the surveys were conducted as part of the routine evaluation of the course, as approved by the Council for Continuing Education, no further ethics approval was required.

Results

A total of 741 students (70.0% women) attended one of the 27 iterations of the course. The response rate to the first questionnaire was 76.8% (n=569). Overall, they rated the experience as very positive (mean 4.6, SD 0.6, of a maximum 5). Students' ratings of satisfaction with the course handouts, theoretical sessions, teachers, and overall organization were above 4.5 (Fig 1); only satisfaction with the practical sessions was rated below 4.5 (mean 4.2, SD 0.8).

In the follow-up questionnaire, we obtained a total of 182 responses from 741 students (24.6% response rate). Table 2 summarizes the general characteristics of these students (age, 39.1; 131 (72%) women) who responded to the follow-up questionnaire and of the subgroup who went on to collaborate in the publication of a scientific paper (n=145, 79.7% of the students who responded to the follow-up questionnaire). In the overall group, students had degrees in medicine (36.3%),

pharmacy (11.5%), biology (11.0%), or other related fields such as nursing, psychology, biochemistry, biotechnology, or statistics (41.2%); slightly more than half (52.2%) were involved in basic research. Students in the subgroup were similar to the entire group of respondents to the follow-up questionnaire in terms of age, gender, and undergraduate training, but not in the type of research in which they were mainly involved.

FIG. 1 ABOUT HERE

Fig 1. Results of the first questionnaire: students' (n=569) satisfaction with different aspects of classroom sessions in the 27 iterations of the scientific writing course in Spain, 2004-2013.

FOOTNOTE TO FIG 1. Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For all 6 variables, the median coincides with the upper line of the box. The whiskers represent the 90th and 10th percentiles and the dots represent outliers (each dot represents at least one response).

Table 2. Characteristics of the students who answered the follow-up questionnaire about the course on scientific writing (27 iterations). Spain, 2004-2013.

	Total	Students who went on to collaborate in preparing a paper for publication	p-value
Trainees, n	182	145	
Age, mean (SD) [years]	39.1 (9.4)	38.8 (9.6)	0.849 [a]
Gender, n (%)			
Women	131 (72.0)	103 (71.0)	0.902 [b]
Men	51 (28.0)	42 (29.0)	
Field of degree, n (%)			
Medicine	66 (36.3)	56 (38.4)	0.981 [b]
Pharmacy	21 (11.5)	17 (11.6)	
Biology	20 (11.0)	15 (10.3)	
Others	75 (41.2)	58 (39.7)	
Main type of research, n (%)			
Clinical research	41 (22.5)	37 (25.3)	0.036 [b]
Basic research	95 (52.2)	89 (61.0)	
Others	46 (25.3)	20 (13.7)	

[a] Student's t-test; [b] chi-square test

FIG. 2 ABOUT HERE

Fig 2. Perceived change in overall competence among students (n=182) who completed the follow-up questionnaire about the scientific writing course (27 iterations in Spain, 2004-2013).

FOOTNOTE TO FIG.2

The increase in general competence was calculated for each item from individual scores; individual scores were calculated by subtracting the rating on the item asking about competence after attending the seminar from the rating on the item asking about competence before attending the seminar. Significant gains were observed for all competencies ($p<0.001$; Wilcoxon signed-rank test). Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For variables A and B, the median coincides with the upper line of the box, and for variables C, E, G, H, I, J, and K the median coincides with the bottom line. The whiskers represent the 90th and 10th percentiles, and the dots represent extreme values.

FIG. 3 ABOUT HERE

Fig 3. Changes in specific writing skills in students who went on to publish after the scientific writing course (n=145) (27 iterations in Spain, 2004-2013).

FOOTNOTE TO FIG.3

The increase in specific writing skills was calculated for each item from individual scores; individual scores were calculated by subtracting the rating on the item asking about competence after attending the seminar from the rating on the item asking about competence before attending the seminar. Significant gains were observed for all general competences ($p<0.001$; Wilcoxon signed-rank test). Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For variables A and B, the median coincides with the upper line of the box, and for variables C, E, G, H, I, J, and K the median coincides with the bottom line. The whiskers represent the 90th and 10th percentiles, and the dots represent extreme values.

The mean scores for all the items that assessed students' perceptions of their knowledge, skills, and attitudes after the course were higher than those for their perceptions of these dimensions before the course (Fig 2). Overall increases in scores for knowledge (mean 1.6; 95% CI 1.6-1.7), attitudes (mean 1.3; 95% CI 1.2-1.4), and skills (mean 1.4; 95% CI 1.3-1.4) after the course were significant ($p<0.001$). Among the items about knowledge (Fig 2, Panel I), we observed the greatest improvement (2 points) in the understanding of the editorial process. All but 5 assessments (by 4 students) yielded higher post-course scores regarding attitudes toward publishing (Fig

2, Panel II). Students also indicated the need for training in scientific writing at both the undergraduate (mean score 3.1; 95% CI 2.9-3.3, of a maximum 4) and postgraduate level (mean score 3.9; 95% CI 3.8-4.0). The mean score on the question asking about students' overall degree of satisfaction with the course was 3.8 (SD 0.4).

Fig 3 shows the change in perceptions of specific writing skills before and after the course in the subgroup of students who went on to collaborate in the publication of scientific paper. Statistically significant improvements were observed for all the skills ($p<0.001$; Wilcoxon signed-rank test). Average improvements ranged between 1.0 (95% CI 0.8-1.2) points for citing and writing references to 1.5 (95% CI 1.3-1.7) for preparing cover letters, with improvements in the remaining skills lying between these values: determining eligibility for authorship (1.3, 95% CI 1.1-1.5), writing introductions (1.3, 95% CI 1.1-1.5), writing abstracts (1.2, 95% CI 1.0-1.4), writing discussions (1.2, 95% CI 1.0-1.4), and responding to editors' and reviewers' comments (1.2, 95% CI 1.0-1.4).

Discussion

This study analyzed 10 years of experience that included 27 iterations of a two-day course on how to write scientific articles. The course was completed by more than 700 health science researchers. The two surveys showed high satisfaction with the two-day format and the contents of the course. Moreover, the second survey showed that students considered that the course had improved their overall knowledge, attitudes, and skills as well as some specific writing skills. Importantly, students expressed the need for this type of training at both the undergraduate and postgraduate levels.

Our results are similar to those of other published experiences, most of which were included in two systematic reviews [5,9] that evaluated different outcomes. Like other authors [10], we analyzed students' satisfaction with the course. Most published accounts report experiences in English-speaking countries (United States, Australia, New Zealand)[5]. Galipeau et al.'s systematic review [5] included 12 studies focused on writing for publication; most of these had shortcomings like small samples, low validity, or biases, so the authors concluded that there are important gaps in our knowledge of how to improve scientific writing.

Jawaid et al.[11] reported an experience from Pakistan (language of course not stated), with 120 attendees who participated in a three-month course based on four interactive workshops. Through a pre- and post-workshop questionnaire comprising 14 questions, the authors concluded their course improved attendees' knowledge and skills related to writing. One study from the United States [12] not included in Galipeau et al.'s systematic review [5] assessed improvements in writing after a 60- to 90-minute case report writing workshop. In a three-year period, 214 students (mainly clinicians and educators) attended the workshops, and pre-post evaluation found a significant improvement in self-rated writing competence and in the perceived probability of submitting a case report. In another study from the United States, Guydish et al.[13] assessed the impact of a scientific writing seminar aiming to encourage manuscript writing and dissemination of addiction research. Over a 14-year period, a total of 113 postdoctoral students in 14 cohorts completed the six-month seminar. After the course, between 75% and 100% of the students from each cohort submitted papers and between 60% to 100% of these were published. The authors concluded that writing seminars may be useful among early-stage investigators.

Regardless of whether scientific writing courses yield positive or negative results, evaluations of their effectiveness has seldom been published[5,9]. We consider these activities to be educational interventions, and as such they should have valid study designs under the principles of implementation research [14], which seeks to understand and work within real world conditions, rather than try to control for these conditions or to remove their influence as causal effects, as is the case in experimental trials.

Some limitations of our study must be considered. First of all, the satisfaction questionnaire used has not had a formal validation, and the study measures perceived gains rather than objectively assessed gains. Secondly , while the response rate in the initial satisfaction baseline survey was robust (nearly 77%), it was low for the follow-up survey, and it decreased in the successive waves from 29% to 27% and 22%. Therefore, selection bias can lead to overestimation of results in satisfaction surveys, since more satisfied students may be more likely to participate (although the contrary effect is also possible). This might reflect difficulties in reaching participants who were in training when they did the course, making them more likely to have changed jobs and professional email addresses. A likely explanation of the low response rate is that students who responded were likely to be those who got the most out of the workshop or had best outcomes to report. Another limitation is the lack of a control group, which can clarify interpretation of changes in competence in evaluations of interventions. Further studies should ensure follow-up at a fixed time not very long (1 or 2 years) after the course and baseline survey; the ideal time would be long enough to detect the changes supposedly due to the intervention but short enough to minimize attrition and recall bias. Furthermore, the positive effects we observed could be partly due to students' post-course participation in other activities to improve scientific writing. The follow-up questionnaire did not collect information about such activities. However, we collected information on the impact of the course on collaboration in the writing of papers, as in other studies [13,15–17].

Finally, some strengths of our study merit attention. This is the first regularly held course on scientific writing in Spain, currently with 40 iterations in 15 years and more than 1,000 participants to date, and the course is still running. To our knowledge, this is also the first report of a systematic evaluation of students' satisfaction and improvements in knowledge, skills, and attitudes acquired through a course of these characteristics in Spain. Although simultaneous assessment of prior and posterior knowledge and skills after the course could be considered a weakness in terms of causal inference, it may actually be a strength since the students are more aware and provide more coherent information about the items evaluated and the changes suffered.

In conclusion, the format and contents of the course satisfied the students' needs and, among the sample of those who responded to the follow-up survey reported improvement in their skills related to scientific writing and publishing. Participants strongly agreed that health professionals need training in scientific writing during the course of their undergraduate and/or postgraduate studies. Academic institutions, at least in countries with a lesser tradition of publishing, should provide training on scientific writing to improve the reporting of research results.

Acknowledgments

The authors wish to thank all the students who participated in the surveys and Pol Morales, Elisabet Caballeria, and Laura García from the Esteve Foundation for their contributions to the running of the course and to the evaluation processes. We also thank John Giba for reviewing and revising the English version of the manuscript.

Contributorship statement

EF, AMG, and FB conceived and designed the study. All the authors designed the questionnaires. EF and AMG designed the analysis strategy, ES and FB analyzed the data, and all the authors contributed to its interpretation. EF and FB wrote the first draft of the manuscript; all authors contributed substantially to subsequent versions of the manuscript, and all authors approved the final version.

Competing interests

EF and AMG received fees as lecturers for conducting these courses, but did not receive any fee for the design, analysis, or writing of this paper. ES and FB are employees of the Esteve Foundation, a private nonprofit foundation under Spanish Law. ES and FB have participated in the courses and the preparation of this paper as part of their paid work.

Funding statement

The training course described in this study was funded by the Esteve Foundation, a private nonprofit foundation under Spanish Law. Some iterations of the course have received partial funding from third parties, such as public universities, public hospitals, public research centers,

and scientific societies. EF was partly funded by the Department of Universities and Research, Government of Catalonia (2014SGR999).

Data sharing statement

A full data set of results is available from the corresponding author.

References

[1] Marusic A, Marusic M. Small scientific journals from small countries: breaking from a vicious circle of inadequacy. Croat Med J. 1999;40:508–514.

[2] Albert T. Writing for journals: a paradigm lost? J Epidemiol Community Health. 2000;54:642–643.

[3] Day RA. How to write and publish a scientific paper. Phoenix: The Oryx Press; 1998.

[4] Huston P. Resolving writer ’s block. Can Fam Physician. 1998;44:92–97.

[5] Galipeau J, Moher D, Campbell C, Hendry P, Cameron DW, Palepu A, et al. A systematic review highlights a knowledge gap regarding the effectiveness of health-related training programs in journalology. J Clin Epidemiol. 2015;68:257–265.

[6] Morales P, García L, Bosch F. Dos décadas de actividades puente entre la farmacología, la epidemiología y la salud pública en España. Gac Sanit. 2015;29:224–227.

[7] Huth EJ. How to write and publish papers in the medical sciences. Philadelphia: ISI Press; 1982.

[8] Mabrouki K, Bosch F. Redacción científica en biomedicina: Lo que hay que saber. Barcelona: Fundación Dr. Antonio Esteve; 2007.

[9] McGrail MR, Rickard CM, Jones R. Publish or perish: a systematic review of interventions to increase academic publication rates. High Educ Res Dev. 2006;25:19–35.

[10] Phadtare A, Bahmani A, Shah A, Pietrobon R. Scientific writing: a randomized controlled trial comparing standard and on-line instruction. BMC Med Educ. 2009;9:27.

[11] Jawaid M, Masood Z, Alam SN, Jawaid SA. An analysis of interactive hands-on workshops on medical writing. J Pak Med Assoc. 2011;61:66–70.

[12] Sridhar ARM, Willett LL, Castiglioni A, Heudebert G, Landry M, Centor RM, et al. Scholarship opportunities for trainees and clinician educators: Learning outcomes from a case report writing workshop. J Gen Intern Med. 2009;24:398–401.

[13] Guydish J, Masson C, Flentje A, Shopshire M, Sorensen JL. Scientific writing seminar for early-stage investigators in substance abuse research. Subst Abus. 2016;37:238–241.

[14] Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it. BMJ. 2013;347:f6753.

[15] Files JA, Blair JE, Mayer AP, Ko MG. Facilitated peer mentorship: a pilot program for academic advancement of female medical faculty. J Womens Health (Larchmt). 2008;17:1009–1015.

[16] Rickard CM, McGrail MR, Jones R, O’Meara P, Robinson A, Burley M, et al. Supporting academic publication: Evaluation of a writing course combined with writers’ support group. Nurse Educ Today. 2009;29:516–521.

[17] Steinert Y, McLeod PJ, Liben S, Snell L. Writing for publication in medical education: the benefits of a faculty development workshop and peer writing group. Med Teach. 2008;30:e280-285.

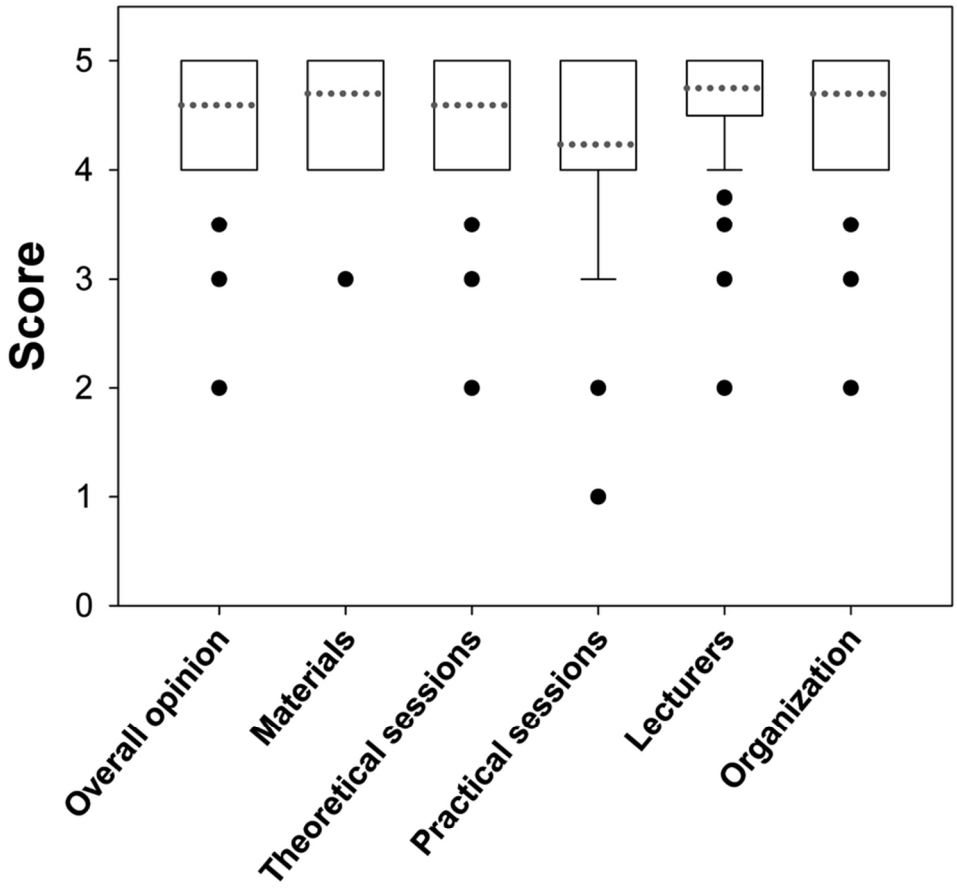


FIGURE 1

81x82mm (300 x 300 DPI)

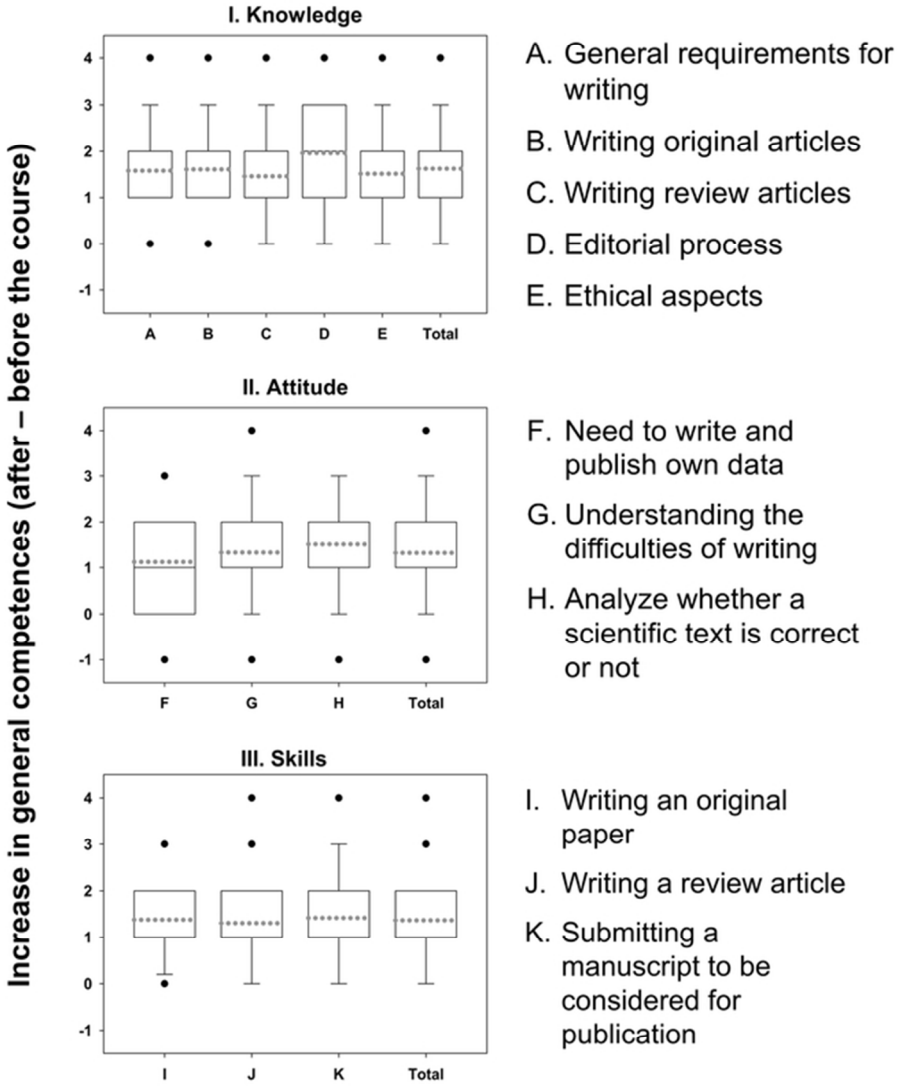


FIGURE 2

30x36mm (600 x 600 DPI)

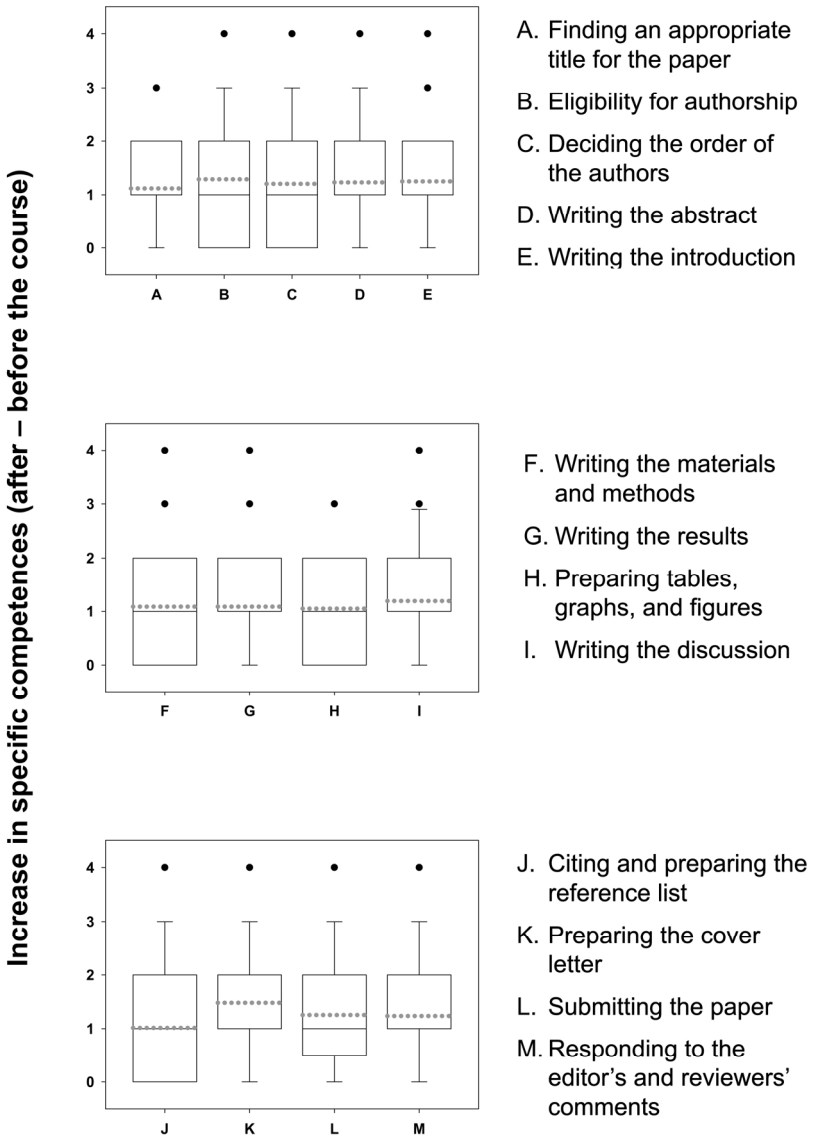


Figure 3 Hi resolution

162x224mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract **OK, a) page 1** **b) page 2**	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale OK, page 4	2	Explain the scientific background and rationale for the investigation being reported
Objectives OK, page 4	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design OK, pages 4-6	4	Present key elements of study design early in the paper
Setting OK, pages 4-6	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants OK, a) page 6	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables OK, pages 4-6	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement NA	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias OK, page 6 and 14	9	Describe any efforts to address potential sources of bias
Study size OK, page 6 and 7	10	Explain how the study size was arrived at
Quantitative variables OK, page 7	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods OK, a) b) c) d) pages 6, 7	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account

		of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants OK a) b) pages 6,7. c) Flowdiagram not necessary	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data OK, page 7	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data OK, page 7-8	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results OK, page 7-8-9	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses OK, page 10	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results OK, page 13	18	Summarise key results with reference to study objectives
Limitations (and strengths) OK, pages 14-15	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation Ok, pages 13-14	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability Ok, pages 13-14	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding Ok, pages 16	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at

http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Students' satisfaction and perceived impact on knowledge, attitudes, and skills after a two-day course in scientific writing: a prospective longitudinal study in Spain.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-018657.R3
Article Type:	Research
Date Submitted by the Author:	23-Nov-2017
Complete List of Authors:	Fernandez, Esteve; Institut català d'Oncologia, Tobacco Control Unit; University of Barcelona, Department of Clinical Sciences Garcia, Ana; Universitat de València Serés, Elisabet; Fundació Antoni Esteve Bosch, Fèlix; Fundació Antoni Esteve; Universitat Pompeu Fabra, Department of Experimental and Health Sciences
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Medical publishing and peer review
Keywords:	Journalology, Publishing, EDUCATION & TRAINING (see Medical Education & Training), observationl study

Students' satisfaction and perceived impact on knowledge, attitudes, and skills after a two-day course in scientific writing: a prospective longitudinal study in Spain ‡

Short title: A scientific writing course: satisfaction and perceived impact

Esteve Fernández[1,2,*], Ana M. García[3], Elisabet Serés[4], Fèlix Bosch[4,5]

[1] Tobacco Control Unit, Institut Català d'Oncologia (ICO-IDIBELL), Barcelona, Spain.

[2] Department of Clinical Sciences, School of Medicine, Campus de Bellvitge, Universitat de Barcelona, L'Hospitalet del Llobregat, Barcelona, Spain.

[3] Department of Preventive Medicine and Public Health, University of Valencia, Valencia, Spain.

[4] Esteve Foundation, Barcelona, Spain.

[5] Department of Experimental and Health Sciences, School of Health and Life Sciences, Universitat Pompeu Fabra, Barcelona, Spain.

* **Corresponding Author:** Dr. Esteve Fernández, efernandez@iconcologia.net

‡ Preliminary results of this study were presented at the 7th International Congress on Peer Review and Biomedical Publications, September 8-10, 2013, Chicago IL USA. Poster communication: Fernández E, García AM, Serés E, Bosch F. Ten years' experience teaching health professionals to write and to publish articles. Available at: http://www.peerreviewcongress.org/abstracts_2013.html#4

Abstract

Objectives: This study aimed to determine students' satisfaction with a two-day course on scientific writing in health sciences and to assess their perceptions of the long-term impact on their knowledge, attitudes, and skills.

Setting: 27 iterations of a two-day course on writing and publishing scientific articles in health sciences

Participants: 741 students attending the 27 courses

Design: Prospective longitudinal study

Primary and secondary outcome measures: Immediately after each course, students completed a first questionnaire, rating their satisfaction with different aspects of the classroom sessions on a Likert scale (0–5). Approximately two years after the course, students completed a follow-up questionnaire, using a Likert scale (0–4) to rate their knowledge, skills, and attitudes in relation to scientific writing before and after attending the course.

Results: 741 students (70.0% women) participated in the 27 iterations of the course; 568 (76.8%) completed the first questionnaire and 182 (24.6%) completed the follow-up questionnaire. The first questionnaire reflected high overall satisfaction (mean score, 4.6). In the second questionnaire, students reported that the course had improved their knowledge (mean improvement: 1.6; 95%CI 1.6–1.7), attitudes (mean improvement: 1.3; 95%CI 1.2–1.4), and skills (mean improvement: 1.4; 95%CI 1.3-1.4) related to writing and publishing scientific papers. Most respondents (n=145, 79.7%) had participated in drafting a scientific paper after the course; in this subgroup, all the specific writing skills assessed in the second questionnaire significantly improved.

Conclusions: Students were satisfied with the format and the contents of the course, and those who responded to the follow-up survey considered that the course had improved their knowledge, attitudes, and skills in relation to scientific writing and publishing. Courses are particularly important in countries without strong traditions in scientific publication.

Word count: 281 words

Strengths and limitations of this study

- The study analyzed 10 years' experience including 27 iterations of a two-day course completed by more than 700 health science researchers
- This is the first systematic evaluation of students' satisfaction and improvements in knowledge, skills, and attitudes acquired of such a course in Spain.
- The study measures the perceived gains rather than objectively assessed gains.
- The response rate to the follow-up questionnaire was low.
- Selection bias could have led to overestimation of positive results in the follow-up survey: the more satisfied students, or those with more writing successes to report, may have been more likely to participate.

Keywords: Journalology; Program Evaluation; Publishing; Questionnaires; Teaching; Writing

Introduction

Publications are the measurable results of scientific activity. However, most health science researchers, especially in non-English-speaking countries, receive little training in scientific writing [1]. Writing is challenging for researchers, especially for newcomers, who also need publications to advance their careers [2].

Most researchers are expected to acquire the skills to write scientific papers without formal training, through "learning by doing"[3]. Inadequate training in scientific writing can make postgraduate students and established researchers reluctant to write [4]. In recent decades, the number of courses and workshops on scientific writing has increased, but the effectiveness of these endeavors remains to be determined [5].

Given the lack of undergraduate courses on scientific writing in Spain, in 2003 we designed and launched a two-day course on writing and publishing scientific articles for researchers in the health sciences in the early stages of their careers [6]. This study aimed to determine students' satisfaction with this course and their perceptions regarding its long-term impact on their knowledge, attitudes, and skills.

Methods

The following sections describe the course, the questionnaire administered in the classroom to evaluate students' immediate satisfaction with the course, and the follow-up questionnaire sent to participants to evaluate their perceptions of the impact of the course.

Course characteristics

We designed an intensive two-day classroom course for Spanish-speaking undergraduate, graduate, or postgraduate degrees in health sciences to cover the basic skills involved in scientific writing based on classic books about scientific writing [3,7]. The main objectives of the course were to provide basic advice about scientific writing, to present the structure and contents of standard scientific articles, and to explain the editorial and peer review processes for health science journals. The course imparted this knowledge over 15 hours, combining lectures with individual and group

exercises based on real examples. The syllabus for the first day (8 hours) covered scientific writing style, scientific publishing formats, and the structure and contents of the original article; the syllabus for the second day (7 hours) covered ethical principles in scientific publishing, selecting a target journal, preparing manuscripts for submission, and the editorial and peer review processes. The main topics are detailed in Table 1, the full program of the course is available at http://www.esteve.org/en/?wpdmact=process&did=MTUzNy5ob3RsaW5r (in Spanish), and most of the contents are included in a book used for reference in the course [8]. The Esteve Foundation (www.esteve.org) offered the course to institutions throughout Spain. The course targets health science researchers in training or in the initial stages of their careers (e.g., graduate and postgraduate students, postdoctoral fellows, medical residents, etc.), since most undergraduate and postgraduate curricula in the health sciences in Spain did not include formal training in scientific writing. Two lecturers (AMG and EF) and the promoter (FB) developed all the contents. The lecturers are professors of epidemiology and public health and have recognized experience as authors, reviewers, and editors in national and international journals. During the course, both lecturers are present and actively participate in all the sessions. While one explains a topic, the other stimulates the audience with questions or suggestions, making the teaching more dynamic and participative. The number of students in each edition ranged between 17 and 40 [6]. After a pilot edition during the Minorca Public Health Summer School in 2003, the first edition took place in Valencia in January 2004, and the most recent (39th edition) took place in Barcelona in October 2016. The present study includes data from 741 students participating in the 27 iterations held between 2004 and 2013. The course has been accredited [No. 09/013214-MD] by the Catalan Council for Continuing Education in the Health Professions with the approval of the National Health System's Committee on Continuing Education under Spain's Ministry of Health.

First satisfaction questionnaire

We administered a satisfaction questionnaire at the end of each edition of the course. Each student anonymously rated items on a Likert scale (0–5) presented on printed form. The items queried students about their satisfaction with the course overall,

materials, contents of the lectures, contents of the practical exercises, lecturers, and organizational aspects. The questionnaire is available at http://www.esteve.org/en/rc-encuesta. We used the same questionnaire without changes in the 27 iterations of the course.

Follow-up questionnaire

We designed a follow-up questionnaire (available at http://www.esteve.org/en/rc-encuesta-diferido) to collect sociodemographic data and to assess students' perception of the effect of attending the course on their knowledge (5 items), attitudes (3 items), opinions (3 items), and skills (16 items: 3 general skills and 13 specific skills) with regard to scientific writing. The follow-up questionnaire also reassessed students' overall satisfaction with the course through a new question: "Would you recommend this course to a colleague?". Respondents rated all items on a Likert scale (0–4). To analyze the impact of the course on specific skills, we restricted the analysis to students who had collaborated in publishing a scientific article after doing the course. We emailed the follow-up questionnaire to the first 174 students (29.3% responded) in 2006 and to the subsequent 91 students (27.5% responded) in 2007. In 2013, we emailed the remaining 475 students, asking them to fill out the questionnaire online (22.3% responded).

Statistical analyses

We computed means, medians, ranges, standard deviations (SD), 95% confidence intervals (CI), and interquartile ranges for the responses to each item in the questionnaire. To compare the characteristics of the subgroup of students in whom the specific writing skills were analyzed with those of the entire group of respondents to the second questionnaire, we used chi-square and Student's t-tests. To compare the responses on the items in the follow-up questionnaire asking about students' perceptions of their knowledge, skills, and attitudes before and after the course, we used the Wilcoxon non-parametric test for paired samples (before-after comparisons). The distribution of the scores (including the pre-post difference in scores) is presented using traditional boxplots. We used SigmaPlot™ 11.0 (Systat Software Inc, Chicago, IL, USA) for data processing and statistical analysis.

Table 1. Programme of the course

First day

- Introduction to the course
- Writing styles
  - Scientific style and other styles
  - Characteristics of scientific writing style
  - Types of texts in scientific publications
  - Starting to write: sentences and paragraphs
  - Exercise: scientific writing styles
  - Exercise: writing of paragraphs
- The original article: introduction
  - Definition and general characteristics of the original article
  - Structure of the original article
  - The title: the article's business card
  - Exercise: good and bad titles
- The abstract of the original article
  - The abstract: essential information
  - Types of abstracts (structured and non-structured) and contents
  - Key words and the Medical Subject Headings (MeSH)
  - Exercise: editing of an abstract
- The core of the original article (I)
  - The IMR&D format
  - The Introduction: the background and study's aim
  - The methods: what have we done?
  - Exercise: writing an Introduction
- The core of the original article (II)
  - The Results: what have we found?
  - Principles for text and data presentation
  - The balance between text, tables and figures
  - Exercise: building a table
- The core of the original article (III)
  - The Discussion: what does our results mean?
  - Structure of the Discussion section
  - The conclusions
  - Exercise: analysis of a Discussion
- The bibliography and additional sections of the original article
  - Use of bibliography and formats
  - Acknowledgments
  - Funding
  - Competing interests

Second day

- How to publish an article
  - Exercise: where to I submit it?
  - Choosing the adequate journal
  - The target audience, language, open access
  - The bibliographic impact factor
- Preparing the article for submission
  - The cover letter
  - Final check
  - On-line submission
  - Exercise: writing of a cover letter

- The editorial process
  - The peer review process
  - Standard phases of the editorial process
  - Editorial decision criteria
  - Answering peer review
- Ethical aspects of scientific publication
  - Authorship: the ICJME criteria
  - Repetitive publication
  - Competing interests
  - Other ethical aspects for authors, editors and publishers
- Comprehensive exercise with a manuscript

Results

A total of 741 students (70.0% women) attended one of the 27 iterations of the course. The response rate to the first questionnaire was 76.8% (n=569). Overall, they rated the experience as very positive (mean 4.6, SD 0.6, of a maximum 5). Students' ratings of satisfaction with the course handouts, theoretical sessions, teachers, and overall organization were above 4.5 (Fig 1); only satisfaction with the practical sessions was rated below 4.5 (mean 4.2, SD 0.8).

In the follow-up questionnaire, we obtained a total of 182 responses from 741 students (24.6% response rate). Table 2 summarizes the general characteristics of these students (age, 39.1; 131 (72%) women) who responded to the follow-up questionnaire and of the subgroup who went on to collaborate in the publication of a scientific paper (n=145, 79.7% of the students who responded to the follow-up questionnaire). In the overall group, students had degrees in medicine (36.3%), pharmacy (11.5%), biology (11.0%), or other related fields such as nursing, psychology, biochemistry, biotechnology, or statistics (41.2%); slightly more than half (52.2%) were involved in basic research. Students in the subgroup were similar to the entire group of respondents to the follow-up questionnaire in terms of age, gender, and undergraduate training, but not in the type of research in which they were mainly involved.

FIG. 1 ABOUT HER

Table 2. Characteristics of the students who answered the follow-up questionnaire about the course on scientific writing (27 iterations). Spain, 2004-2013.

	Total	Students who went on to collaborate in preparing a paper for publication	p-value
Trainees, n	182	145	
Age, mean (SD) [years]	39.1 (9.4)	38.8 (9.6)	0.849 [a]
Gender, n (%)			
Women	131 (72.0)	103 (71.0)	0.902 [b]
Men	51 (28.0)	42 (29.0)	
Field of degree, n (%)			
Medicine	66 (36.3)	56 (38.4)	0.981 [b]
Pharmacy	21 (11.5)	17 (11.6)	
Biology	20 (11.0)	15 (10.3)	
Others	75 (41.2)	58 (39.7)	
Main type of research, n (%)			
Clinical research	41 (22.5)	37 (25.3)	0.036 [b]
Basic research	95 (52.2)	89 (61.0)	
Others	46 (25.3)	20 (13.7)	

[a] Student's t-test; [b] chi-square test

FIG. 2 ABOUT HERE

FIG. 3 ABOUT HERE

The mean scores for all the items that assessed students' perceptions of their knowledge, skills, and attitudes after the course were higher than those for their perceptions of these dimensions before the course (Fig 2). Overall increases in scores for knowledge (mean 1.6; 95% CI 1.6-1.7), attitudes (mean 1.3; 95% CI 1.2-1.4), and skills (mean 1.4; 95% CI 1.3-1.4) after the course were significant ($p<0.001$). Among the items about knowledge (Fig 2, Panel I), we observed the greatest improvement (2 points) in the understanding of the editorial process. All but 5 assessments (by 4 students) yielded higher post-course scores regarding attitudes toward publishing (Fig 2, Panel II). Students also indicated the need for training in scientific writing at both the undergraduate (mean score 3.1; 95% CI 2.9-3.3, of a maximum 4) and postgraduate level (mean score 3.9; 95% CI 3.8-4.0). The mean score on the question asking about students' overall degree of satisfaction with the course was 3.8 (SD 0.4).

Fig 3 shows the change in perceptions of specific writing skills before and after the course in the subgroup of students who went on to collaborate in the publication of scientific paper. Statistically significant improvements were observed for all the skills ($p<0.001$; Wilcoxon signed-rank test). Average improvements ranged between 1.0 (95% CI 0.8-1.2) points for citing and writing references to 1.5 (95% CI 1.3-1.7) for preparing cover letters, with improvements in the remaining skills lying between these values: determining eligibility for authorship (1.3, 95% CI 1.1-1.5), writing introductions (1.3, 95% CI 1.1-1.5), writing abstracts (1.2, 95% CI 1.0-1.4), writing discussions (1.2, 95% CI 1.0-1.4), and responding to editors' and reviewers' comments (1.2, 95% CI 1.0-1.4).

Discussion

This study analyzed 10 years of experience that included 27 iterations of a two-day course on how to write scientific articles. The course was completed by more than 700

health science researchers. The two surveys showed high satisfaction with the two-day format and the contents of the course. Moreover, the second survey showed that students considered that the course had improved their overall knowledge, attitudes, and skills as well as some specific writing skills. Importantly, students expressed the need for this type of training at both the undergraduate and postgraduate levels.

Our results are similar to those of other published experiences, most of which were included in two systematic reviews [5,9] that evaluated different outcomes. Like other authors [10], we analyzed students' satisfaction with the course. Most published accounts report experiences in English-speaking countries (United States, Australia, New Zealand)[5]. Galipeau et al.'s systematic review [5] included 12 studies focused on writing for publication; most of these had shortcomings like small samples, low validity, or biases, so the authors concluded that there are important gaps in our knowledge of how to improve scientific writing.

Jawaid et al.[11] reported an experience from Pakistan (language of course not stated), with 120 attendees who participated in a three-month course based on four interactive workshops. Through a pre- and post-workshop questionnaire comprising 14 questions, the authors concluded their course improved attendees' knowledge and skills related to writing. One study from the United States [12] not included in Galipeau et al.'s systematic review [5] assessed improvements in writing after a 60- to 90-minute case report writing workshop. In a three-year period, 214 students (mainly clinicians and educators) attended the workshops, and pre-post evaluation found a significant improvement in self-rated writing competence and in the perceived probability of submitting a case report. In another study from the United States, Guydish et al.[13] assessed the impact of a scientific writing seminar aiming to encourage manuscript writing and dissemination of addiction research. Over a 14-year period, a total of 113 postdoctoral students in 14 cohorts completed the six-month seminar. After the course, between 75% and 100% of the students from each cohort submitted papers and between 60% to 100% of these were published. The authors concluded that writing seminars may be useful among early-stage investigators.

Regardless of whether scientific writing courses yield positive or negative results, evaluations of their effectiveness have seldom been published[5,9]. We consider these

activities to be educational interventions, and as such they should have valid study designs under the principles of implementation research [14], which seeks to understand and work within real world conditions, rather than try to control for these conditions or to remove their influence as causal effects, as is the case in experimental trials.

Some limitations of our study must be considered. First of all, the satisfaction questionnaire used has not had a formal validation, and the study measures perceived gains rather than objectively assessed gains. Secondly , while the response rate in the initial satisfaction baseline survey was robust (nearly 77%), it was low for the follow-up survey, and it decreased in the successive waves from 29% to 27% and 22%. This might reflect difficulties in reaching participants who were in training when they did the course, making them more likely to have changed jobs and professional email addresses. A likely explanation of the low response rate is that students who responded were likely to be those who got the most out of the workshop or had best outcomes to report. Selection bias can lead to overestimation of of either positive or negative results in satisfaction surveys. Another limitation is the lack of a control group, which can clarify interpretation of changes in competence in evaluations of interventions. Further studies should ensure follow-up at a fixed time not very long (1 or 2 years) after the course and baseline survey; the ideal time would be long enough to detect the changes supposedly due to the intervention but short enough to minimize attrition and recall bias. Furthermore, the positive effects we observed could be partly due to students' post-course participation in other activities to improve scientific writing. The follow-up questionnaire did not collect information about such activities. However, we collected information on the impact of the course on collaboration in the writing of papers, as in other studies [13,15–17].

Finally, some strengths of our study merit attention. This is the first regularly held course on scientific writing in Spain, currently with 40 iterations in 15 years and more than 1,000 participants to date, and the course is still running. To our knowledge, this is also the first report of a systematic evaluation of students' satisfaction and improvements in knowledge, skills, and attitudes acquired through a course of these characteristics in Spain. Although simultaneous assessment of prior and posterior

knowledge and skills after the course could be considered a weakness in terms of causal inference, it may actually be a strength since the students are more aware and provide more coherent information about the items evaluated and the changes suffered.

In conclusion, the format and contents of the course satisfied the students' needs, and participants who responded to the follow-up survey reported improvement in their skills related to scientific writing and publishing. Participants strongly agreed that health professionals need training in scientific writing during the course of their undergraduate and/or postgraduate studies. Academic institutions, at least in countries with a less robust tradition of publishing, should provide training on scientific writing to improve the reporting of research results.

Acknowledgments

The authors wish to thank all the students who participated in the surveys and Pol Morales, Elisabet Caballeria, and Laura García from the Esteve Foundation for their contributions to the running of the course and to the evaluation processes. We also thank John Giba for reviewing and revising the English version of the manuscript.

Contributorship statement

EF, AMG, and FB conceived and designed the study. All the authors designed the questionnaires. EF and AMG designed the analysis strategy, ES and FB analyzed the data, and all the authors contributed to its interpretation. EF and FB wrote the first draft of the manuscript; all authors contributed substantially to subsequent versions of the manuscript, and all authors approved the final version.

Competing interests

EF and AMG received fees as lecturers for conducting these courses, but did not receive any fee for the design, analysis, or writing of this paper. ES and FB are employees of the Esteve Foundation, a private nonprofit foundation under Spanish Law. ES and FB have participated in the courses and the preparation of this paper as part of their paid work.

Ethical requirements

Participants provided informed consent to participate in the study (oral consent for the first satisfaction questionnaire and written consent for the follow-up questionnaire). As the surveys were conducted as part of the routine evaluation of the course, as approved by the Council for Continuing Education, no further ethics approval was required.

Funding statement

The training course described in this study was funded by the Esteve Foundation, a private nonprofit foundation under Spanish Law. Some iterations of the course have received partial funding from third parties, such as public universities, public hospitals, public research centers, and scientific societies. EF was partly funded by the Department of Universities and Research, Government of Catalonia (2014SGR999).

Data sharing statement

A full data set of results is available from the corresponding author.

Figure legends

Fig 1. Results of the first questionnaire: students' (n=569) satisfaction with different aspects of classroom sessions in the 27 iterations of the scientific writing course in Spain, 2004-2013.

FOOTNOTE TO FIG 1. Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For all 6 variables, the median coincides with the upper line of the box. The whiskers represent the 90th and 10th percentiles and the dots represent outliers (each dot represents at least one response).

Fig 2. Perceived change in overall competence among students (n=182) who completed the follow-up questionnaire about the scientific writing course (27 iterations in Spain, 2004-2013).

FOOTNOTE TO FIG. 2 The increase in general competence was calculated for each item from individual scores; individual scores were calculated by subtracting the rating on the item asking about competence after attending the seminar from the rating on the item asking about competence before attending the seminar. Significant gains were observed for all competencies ($p<0.001$; Wilcoxon signed-rank test). Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For variables A and B, the median coincides with the upper line of the box, and for variables C, E, G, H, I, J, and K the median coincides with the bottom line. The whiskers represent the 90th and 10th percentiles, and the dots represent extreme values.

Fig 3. Changes in specific writing skills in students who went on to publish after the scientific writing course (n=145) (27 iterations in Spain, 2004-2013).

FOOTNOTE TO FIG.3

The increase in specific writing skills was calculated for each item from individual scores; individual scores were calculated by subtracting the rating on the item asking about competence after attending the seminar from the rating on the item asking about competence before attending the seminar. Significant gains were observed for all general competences ($p<0.001$; Wilcoxon signed-rank test). Boxes represent interquartile ranges. Solid lines represent medians, and dotted lines represent means. For variables A and B, the median coincides with the upper line of the box, and for variables C, E, G, H, I, J, and K the median coincides with the bottom line. The whiskers represent the 90th and 10th percentiles, and the dots represent extreme values.

References

[1] Marusic A, Marusic M. Small scientific journals from small countries: breaking from a vicious circle of inadequacy. Croat Med J. 1999;40:508–514.

[2] Albert T. Writing for journals: a paradigm lost? J Epidemiol Community Health. 2000;54:642–643.

[3] Day RA. How to write and publish a scientific paper. Phoenix: The Oryx Press; 1998.

[4] Huston P. Resolving writer ’s block. Can Fam Physician. 1998;44:92–97.

[5] Galipeau J, Moher D, Campbell C, Hendry P, Cameron DW, Palepu A, et al. A systematic review highlights a knowledge gap regarding the effectiveness of health-related training programs in journalology. J Clin Epidemiol. 2015;68:257–265.

[6] Morales P, García L, Bosch F. Dos décadas de actividades puente entre la farmacología, la epidemiología y la salud pública en España. Gac Sanit. 2015;29:224–227.

[7] Huth EJ. How to write and publish papers in the medical sciences. Philadelphia: ISI Press; 1982.

[8] Mabrouki K, Bosch F. Redacción científica en biomedicina: Lo que hay que saber. Barcelona: Fundación Dr. Antonio Esteve; 2007.

[9] McGrail MR, Rickard CM, Jones R. Publish or perish: a systematic review of interventions to increase academic publication rates. High Educ Res Dev. 2006;25:19–35.

[10] Phadtare A, Bahmani A, Shah A, Pietrobon R. Scientific writing: a randomized controlled trial comparing standard and on-line instruction. BMC Med Educ. 2009;9:27.

[11] Jawaid M, Masood Z, Alam SN, Jawaid SA. An analysis of interactive hands-on workshops on medical writing. J Pak Med Assoc. 2011;61:66–70.

[12] Sridhar ARM, Willett LL, Castiglioni A, Heudebert G, Landry M, Centor RM, et al. Scholarship opportunities for trainees and clinician educators: Learning outcomes from a case report writing workshop. J Gen Intern Med. 2009;24:398–401.

[13] Guydish J, Masson C, Flentje A, Shopshire M, Sorensen JL. Scientific writing seminar for early-stage investigators in substance abuse research. Subst Abus. 2016;37:238–241.

[14] Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it. BMJ. 2013;347:f6753.

[15] Files JA, Blair JE, Mayer AP, Ko MG. Facilitated peer mentorship: a pilot program for academic advancement of female medical faculty. J Womens Health (Larchmt). 2008;17:1009–1015.

[16] Rickard CM, McGrail MR, Jones R, O’Meara P, Robinson A, Burley M, et al. Supporting academic publication: Evaluation of a writing course combined with writers’ support group. Nurse Educ Today. 2009;29:516–521.

[17] Steinert Y, McLeod PJ, Liben S, Snell L. Writing for publication in medical education: the benefits of a faculty development workshop and peer writing group. Med Teach. 2008;30:e280-285.

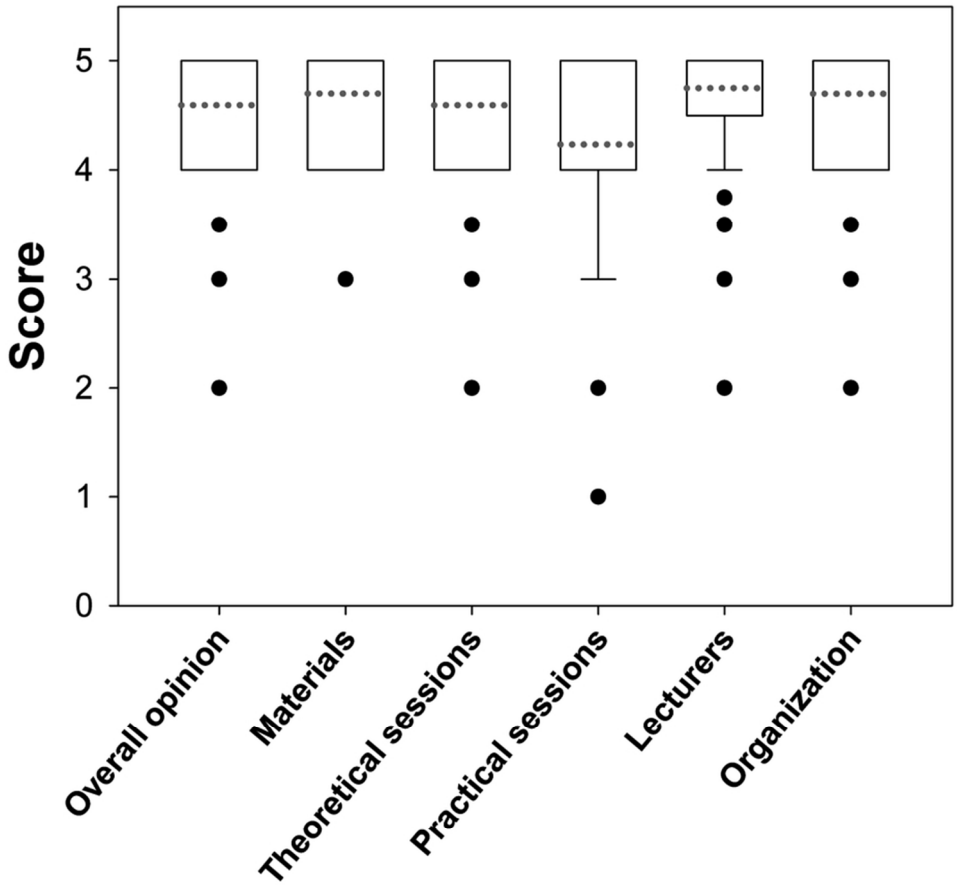


FIGURE 1

81x82mm (300 x 300 DPI)

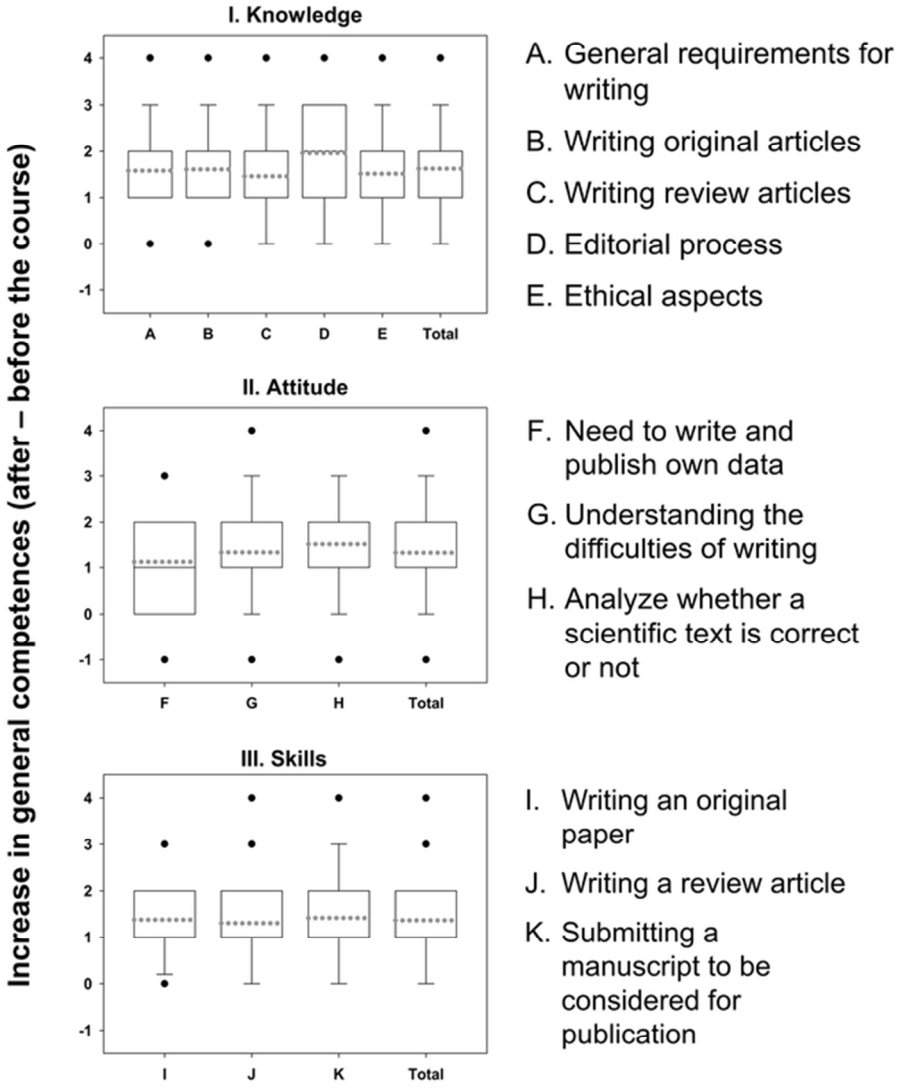


FIGURE 2

30x36mm (600 x 600 DPI)

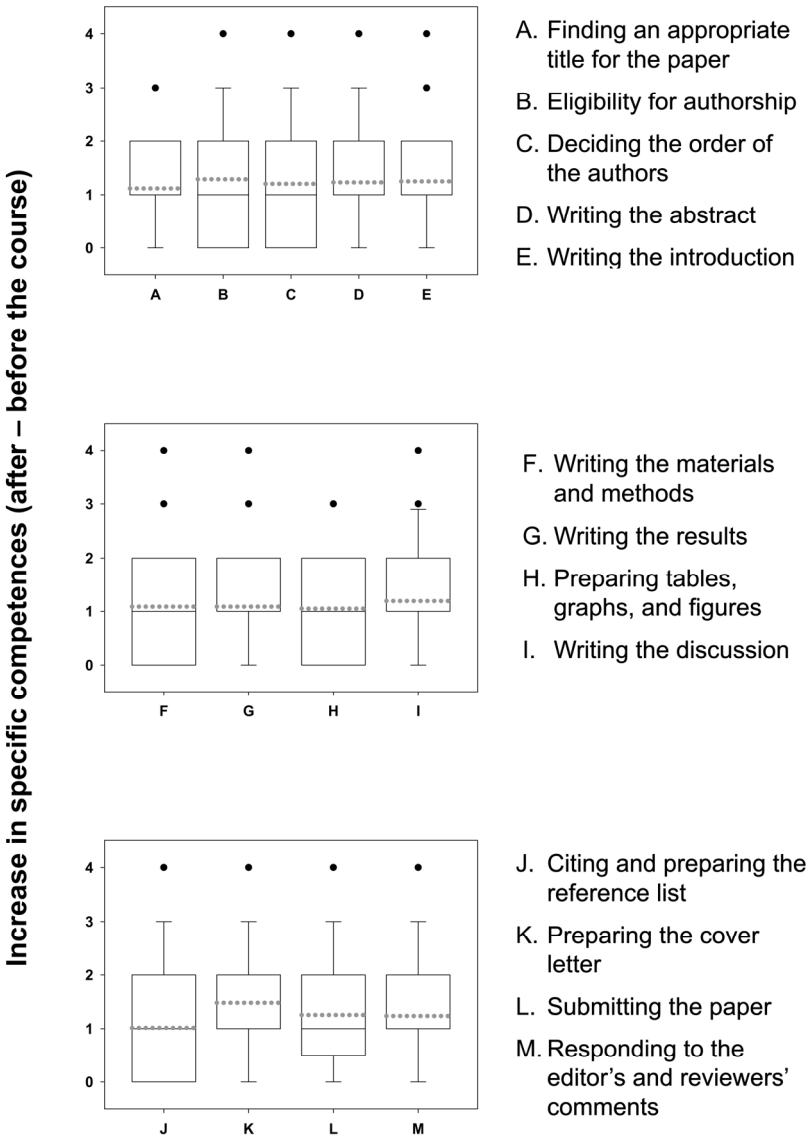


Figure 3 Hi resolution

162x224mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract **OK, a) page 1** **b) page 2**	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale OK, page 4	2	Explain the scientific background and rationale for the investigation being reported
Objectives OK, page 4	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design OK, pages 4-6	4	Present key elements of study design early in the paper
Setting OK, pages 4-6	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants OK, a) page 6	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables OK, pages 4-6	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement NA	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias OK, page 6 and 14	9	Describe any efforts to address potential sources of bias
Study size OK, page 6 and 7	10	Explain how the study size was arrived at
Quantitative variables OK, page 7	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods OK, a) b) c) d) pages 6, 7	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account

		of sampling strategy
		(*e*) Describe any sensitivity analyses
Results		
Participants OK a) b) pages 6,7. c) Flowdiagram not necessary	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data OK, page 7	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data OK, page 7-8	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results OK, page 7-8-9	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses OK, page 10	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results OK, page 13	18	Summarise key results with reference to study objectives
Limitations (and strengths) OK, pages 14-15	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation Ok, pages 13-14	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability Ok, pages 13-14	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding Ok, pages 16	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at

http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.