

Introductory Course on Getting to Know Journals and on “Browsing” a Research Paper: First Steps to Proficiency in Scientific Communication

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Aim To evaluate the effectiveness and appropriateness of a course that promotes familiarity with biomedical periodicals and teaches efficient reading skills.

Methods A 16-hour course was designed to help inexperienced readers gain confidence navigating the contents of a research paper (instead of reading only abstracts), and make the first steps to critical appraisal. The course consisted of short lessons and small group work in which research papers were read and presented to the class. Participants learned a method called “browsing” that guides the first, superficial reading of a research paper and substitutes abstract reading. The course was administered to 15 hospital physicians and 40 graduate students of molecular medicine, in 4 separate sessions.

Results At course entry, 45 of 55 participants normally read the abstract before consulting the body of a research paper. An end-of-course questionnaire, completed by 47 participants, revealed that only 3 would still read the abstract first, while 33 would perform browsing, 7 would scan figures and tables, and 4 would consult another section of a paper outside of their research interests; similar responses were given for a research paper within their fields. For 43 participants, the course was effective in developing reading skills. On a final comprehension test, participants had a median score of 69% correct responses (interquartile range, 56%-80%).

Conclusion This introductory course on reading scientific articles is effective in overcoming abstract-only reading and in developing confidence with the research literature. Considering participants’ subjective evaluation and test scores, the course contents are appropriate for both physicians and young researchers.

Reading the research literature is a fundamental activity for all health care professionals and biomedical researchers. Obstacles to a regular reading habit include lack of time and access to the full-text, limited budget for subscription journals, difficulties with reading English, and inexperience in navigating the contents of a research paper. Although physicians spend up to 4 hours each week reading the periodical literature (1-3), a survey revealed that 83% of interviewees considered this time insufficient (4). Most often "reading" consists of scanning tables of contents and reading the most important abstracts (3,4).

There are several pitfalls of reading the abstract as a surrogate for the full-text of a research paper. When well written, abstracts are concise and information-rich, and therefore may be difficult to read. Abstracts often lack key methodological features and results essential to understanding the strength of the evidence (5,6). Abstracts may not reveal a study's limitations or weaknesses, and may overly simplify a complex story (7). Furthermore, abstracts are often "deficient," i.e. containing information inconsistent with or absent from the body of the article (8). Leading medical journals addressed these problems in the 1990s by introducing the structured abstract and by increasing prepublication attention to this part of text (7,9). Nonetheless, problematic abstracts are still common (6,10).

The increasing availability of online, full-text archives of biomedical journals is eliminating one major reason for abstract-only reading, but whether this translates into more full-text reading is unknown. For the inexperienced, reading a research paper is difficult and time-consuming; for those for whom English is a second language, reading is even more troublesome. Practical training, such as that provided in graduate journal clubs, helps develop personal approaches to reading an article, often by focusing on methods and results. While experi-

enced scientists often read the various sections of a research paper out of order (11), inexperienced readers are likely to start at the abstract and introduction and read to the end; this does not permit them to "consume" a sufficient number of articles on a regular basis, especially considering the low readability of concise scientific English (12).

The ability to read and critically appraise the research literature is an important part of evidence-based practice and is equally important to support basic research. A competent reading habit is also fundamental to proficient scientific writing: this is the working hypothesis I developed from my experience as scientific-linguistic editor for several small European medical journals. At prepublication editing, I observed many manuscripts with flaws and deficiencies suggesting unfamiliarity with the research literature. Thus, I designed an introductory course on getting to know journals and on "browsing" a research paper, with the aim of providing a framework in which to develop critical reading skills and to prepare for learning to write a research paper. Here, I describe the course design and evaluate the appropriateness and effectiveness of the course in teaching graduate students and hospital physicians.

Participants and methods

Effective Medical Reading is a practical, introductory course on biomedical literature, which uses a structured reading method called browsing to promote good reading habits and to prepare participants for learning to write research papers. Participants may be private practitioners, clinicians, or basic biomedical researchers, with the only requirement that they are able to read English. The course is given in the participants' language (Italian) to facilitate learning in a short time, but English terminology is frequently used; only articles written in English are read and discussed.

Course contents and teaching strategy

The course consists of 4 half-day sessions, each with 2 short lectures followed by small-group work. The main topics addressed in the lectures and developed in the practice sessions are listed in Box 1. During the first lecture, print issues of a broad selection of journals are distributed for the participants to examine and share. Irrespective of the group’s professional interests, I provide general science journals, general medicine journals, and numerous specialty journals (of varying quality); participants discuss the characteristics of the journals provided. The successive lectures are followed by work in groups of 3-5 persons; they are given 15-20 minutes to read a research article and then present it to the class. The time for each article is brief, but participants are provided with a structured reading method called browsing; this method also guides the presentations. Working in groups is advantageous in that participants pool knowledge of both English and science. The first set of articles includes provocative editorials and letters (post-publication peer review). Thereafter, only full research papers are read. Typically,

Box 1. Main topics addressed by the Effective Medical Reading course
Types and characteristics of biomedical journals
Types and characteristics of articles published in biomedical journals
The process from manuscript to published work: peer review, editorial selection, prepublication editing, post-publication peer review
The scientific method and scientific hypotheses
Structure of a research paper, and how it relates to the scientific method
Types and qualities of abstracts, and problems of abstract-only reading
How to “browse” a research paper
Types and characteristics of figures and tables, and implications for reading them
Accuracy and precision, and main issues of descriptive statistics
Basic concepts of hypothesis testing (inferential statistics)
Basic concepts of clinical research design (optional topic in course for physicians)
Critical appraisal: definition and role in support of professional work
New trends in biomedical literature, and implications for readers and authors

each group reads and presents 6 research papers, for a total of 12-16 papers discussed; this fact testifies to the intense nature of the course.

An important characteristic of this course, different from journal clubs, is that papers are read on a variety of topics and are not selected for quality, in order to best expose the problems of poor scientific writing. The papers are sampled from PubMed Central and my personal library, with the only requirement that they have several tables and figures. Short and apparently simple papers are used in earlier sessions, but I do not read the texts beforehand. Only a few articles relate to the participants’ areas of interest.

During the group presentations, articles are projected on the screen and the speaker is provided with a laser pointer. For each article that a group presents, 1-2 students speak in turns. They are expected to discuss the article according to the method of browsing, and to refer continuously to the projected text, since the other participants do not have a copy of the article discussed.

At the end of the course, students are expected to: 1) appreciate the nature of biomedical journals and their contributions to the advancement of scientific knowledge, 2) be knowledgeable about the structure of a research paper and feel confident navigating its contents, 3) realize that published papers are not final words on a subject and are meant to be critically appraised (and that difficult comprehension is not always the reader’s fault), and 4) understand the importance of clarity and rigor in the communication of scientific information (and expect this from journals). This brief course cannot guarantee that participants comprehend all topics presented in the lectures, but it establishes a framework in which they continue to learn independently.

The method of browsing

Browsing is the name given to a fast, superficial but structured approach for the first evaluation of a research paper, and is proposed as an alter-

native to abstract reading. Compared to abstract reading, with browsing one dedicates about the same amount of time and reads about the same number of words. However, with browsing the reader obtains graphical information and makes a first step toward critical appraisal. Browsing is a tool to help inexperienced readers feel comfortable delving into the text of a research paper without reading from start to finish. As readers gain experience, it is natural that they apply browsing loosely according to their needs; it is not intended that all readers follow this method at all times. Browsing is useful for research papers (clinical and basic research), but is not appropriate for reviews or guidelines.

The goals of browsing are to: 1) identify key points of a paper, 2) make a preliminary assessment of quality, and 3) decide if the paper is interesting and important enough to be read in further detail. This is achieved in 6 steps (Table 1). Browsing is taught just after discussing the structure of a research paper, since the two are intrinsically connected.

Course evaluation

The course was evaluated to determine the appropriateness of the contents and the effectiveness of the teaching approach. Thus, information was collected on participants' reading habits

before the course and on their opinions and understanding of the course contents at the end. The present evaluation refers to four editions of the course given to a total of 55 participants. In 2005, the course was administered to 27 first-year graduate students in molecular medicine at the University of Milan, Italy, divided into 2 sessions. In 2006, the course was administered to another set of 13 graduate students from the same department, as well as to a group of 15 physicians employed at a non-university hospital in Veneto Region, Italy. Graduate students were obliged to attend the course as part of their training; the course for physicians was open to all interested and physicians from 9 different hospital departments chose to attend. The course for physicians was a continuing medical education (CME) event worth 19 credits toward the 50 credits required by law in 2006.

At the beginning of the course, all participants responded to a brief questionnaire on reading habits. Moreover, to understand how participants normally read a research paper, on the first day of the 2005 editions of the course, participants were given 15 minutes to read an article and respond to 6 questions. I used this time to observe how they read and find information in a paper. Afterwards, we discussed the answers to the questions but their responses were not

Table 1. Six steps of browsing, a fast, superficial but structured approach for the first evaluation of a research paper, designed to substitute abstract reading*

Step	Action	Key issues
Title	Determine the paper's main subject and its investigative approach, in context of the journal in which it is published	Titles stating research conclusions
Authors	Take note of authors' names and affiliations. Refer to endnotes for authors' contributions, funding sources, conflicts of interest and other information giving perspective to the study	Relationship between the fame of authors (and institutions) and the quality of research. Importance of recognizing groups of researchers in one's own field. How a conflict of interest can lead to biased results and conclusions
Study objectives	Focus on end of the Introduction for a statement of the hypothesis tested and, ideally, a statement of action (experimental approach)	Problems posed by Introduction sections summarizing results
Graphic elements	Examine each table and figure in sequence, collecting information on study materials, tests performed, main outcome measures and key findings. Read figure legends and table titles and footnotes in detail	Graphic elements should be understandable without referring to the text. Distinction between well written and poorly written papers, regarding presentation of results
Authors' interpretation	Refer to the Discussion for summary of key outcomes. Assess authors' interpretation in light of what emerged from a rapid reading of figures and tables	Despite a proposal for structured Discussion sections (13), this section is often written freely, making this the most difficult step of browsing
References	Scan citations for a preliminary evaluation of: overall interest and orientation of the subject (cited journals); urgency or novelty of the subject and authors' awareness of the recent literature (dates of citations); strength of the supporting evidence (types of cited documents)	These parameters are not absolute indicators of importance and quality but permit an immediate evaluation

*This method is taught immediately following a lesson on the characteristics and structure of a research paper.

graded. This reading exercise was not repeated in 2006 to save teaching time.

At the end of the course, a second questionnaire was used to assess the short-term impact of the course on reading habits and to obtain subjective feedback regarding the course contents. Finally, the extent to which the participants learned the theoretical concepts presented in the course was assessed on a test containing multiple-choice and free-answer questions on biomedical journals (5 questions), research papers (7 questions), descriptive statistics (4 questions), and clinical research design (4 questions, only in the course for physicians). Graduate students completed the test anonymously as per department policy, while the physicians' work was signed and graded for CME credit. Satisfactory performance was defined as $\geq 65\%$ correct responses.

Statistical analysis

The relationships between professional status (physician or graduate student) and subjective responses on the questionnaires (baseline reading habits and course evaluation) were assessed using the χ^2 test or Fisher exact test. The difference between the two professional groups regarding scores on the final test of comprehension was assessed using the Mann-Whitney U test with large sample approximation. Statistical significance was accepted at $P < 0.05$. Statistical analysis was performed manually using the spreadsheet of OpenOffice.org v. 1.1.5 (OpenOffice.org Project; <http://www.openoffice.org>) and checked for accuracy using online statistical calculators (http://schnoodles.com/cgi-bin/web_chi_form.cgi; <http://www.psych.ku.edu/preacher/fisher/fisher.htm>; <http://eatworms.swmed.edu/~leon/stats/utest.html>).

Results

The questionnaire administered at the beginning of Effective Medical Reading assessed the participants' familiarity with medical journals

Table 2. Course participants' familiarity with journals and baseline reading habits, by professional status

Questionnaire item	No. of participants			P
	total (n=55)	physicians (n=15)	graduate students (n=40)	
Personal subscriptions to journals	24	14	10	<0.001*
Print journals in workplace	39	15	24	0.004*
Able to name a journal editor	6	4	2	0.041†
Types of articles read:				
research papers	54	14	40	0.273‡
reviews	42	11	31	0.746*
editorials	7	5	2	0.013†
letters to editor	6	2	4	0.660†
Time spent reading weekly (hours):				0.568**
<1	8	3	5	
1-4	41	10	31	
>4	5	2	3	
no response	1	0	1	
Reading approach (after title):				0.522**§
abstract	45	13	32	
other section	8	2	6	
figures and tables	2	0	2	

* χ^2 test.

†Fisher exact test for comparisons between physicians and graduate students.

‡For the comparison <1 h vs ≥ 1 h.

§Abstract vs any other part of text.

and current reading habits (Table 2). Of the 55 participants, 24 (43.6%) had personal subscriptions to journals and 39 (70.9%) received printed copies of journals in the workplace, but physicians had significantly greater access to journals than graduate students. Few course participants could name an editor of any biomedical periodical. Most participants read original research papers and reviews, but surprisingly few read editorials and letters to editor. The majority of participants dedicated 1-4 hours to reading the periodical literature each week. However, 52 respondents (94.5%) indicated that the amount of time reading was insufficient, citing lack of time (44 respondents) and too much to read (14 respondents); only 7 participants (2 physicians and 5 graduate students) cited difficulty with English as an obstacle to reading. When surveyed on what part of the text they consulted after the title, 45 respondents (81.8%) read the abstract, 8 (14.5%) read another section depending on their interests, and 2 (3.6%) consulted figures and tables. The tendency to read the abstract first was confirmed during the reading exercise on the first day, when I observed many participants

Table 3. Participants' subjective evaluation of the teaching approach and of the effectiveness of the Effective Medical Reading course*

Questionnaire item	Participants (No., %)
In its mission of developing good reading skills and preparing for a future course on scientific writing, the course was:	
ineffective (I did not learn anything useful)	0 (0)
partially effective (I confirmed things that I already knew)	4 (8.5) [†]
effective (I know more about the research literature that helps me be a better reader)	30 (63.8)
highly effective (My approach to reading the literature has changed greatly as a result of the course)	13 (27.7)
Reading articles outside research interests was:	
irrelevant and did not contribute to my professional development	0 (0)
difficult and hampered my learning to critically read and write papers	1 (2.1)
difficult but helpful in learning to critically read and write papers	36 (76.6)
appropriate and helpful in learning to critically read and write papers	10 (21.3)

*Of 55 participants who began the course, 47 (85%) completed the end-of-course evaluation.

[†]Specifically, 1 physician and 3 graduate students; $P=1.000$ for the association between professional status and evaluation (partially effective vs effective or highly effective), Fisher exact test.

highlighting and underlining passages of abstract rather than consulting the body of the text.

At the end of the course, 47 participants (85%) provided subjective feedback by questionnaire. They were asked what their first approach to reading a research paper would now be (Figure 1), considering two scenarios: a friend's paper (outside of their research areas) and a competitor's paper (ie, of great research interest). In both scenarios, few students would continue to read the abstract carefully before reading further; the majority would apply browsing, a superficial but

structured method for the first reading of a research paper. However, a sizable minority would first scan figures and tables (step 4 of browsing) before identifying, for example, the authors' roles and financial sources or the research hypothesis (steps 2 and 3, respectively). These results suggest that the course was successful in getting students to immediately consult the text rather than rely on the abstract. Moreover, in certain cases, participants felt confident to apply the method of browsing lightly and to search out key scientific information from the graphic elements.

Most participants found the course relevant to their professional development (highly relevant, 10 respondents; relevant, 25; somewhat relevant, 10; not relevant, 1; no response, 1); there was no significant relationship between professional status and this evaluation (χ^2 , $P=0.311$). They overwhelmingly found the course effective in its mission of developing good reading skills and preparing for a course on scientific writing (Table 3). When questioned about having to read articles from a wide variety of subjects, all participants except one graduate student indicated it was helpful rather than detrimental to learning. However, the majority considered this aspect of the course to be difficult.

The last questions investigated preference for the language of future courses of this type, especially since these editions were given in Italian by a native English speaker. The group was discordant about the best language in which to learn about the medical literature. At the proposal to

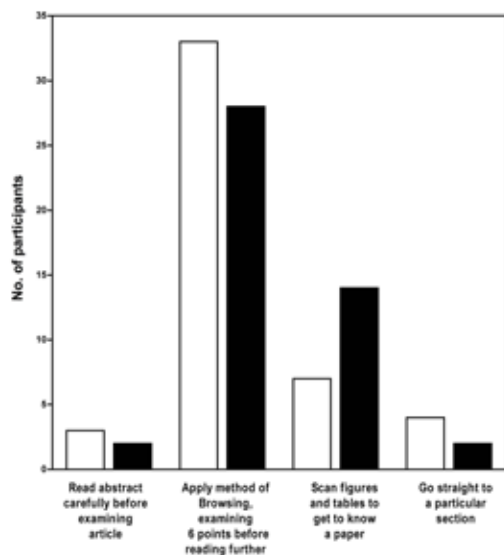


Figure 1. Approach to reading a research paper after the training provided by the course, for 47 participants who completed the evaluation questionnaire. The question considered two scenarios: a friend's paper (outside one's research interests; open bars) and a competitor's paper (one of great research interest; closed bars). One participant did not respond to the second question. Prior to the course, 45 of 55 participants (82%) read the title and abstract carefully before examining an article.

give the course in English (by a native English speaker), 19 participants (including 4 physicians) were favorable but 14 (7 physicians) were decisively against this; 14 others were undecided. On the other hand, at the proposal to give the course in Italian (by a native Italian speaker), only 4 participants (all physicians) were favorable and 27 were contrary; 16 were undecided. These results suggest that the instructor's ability to switch between Italian and English and to use English terminology correctly was an added value.

A final test on comprehension was completed by 49 participants (89%), who had a median score of 69% correct responses (Figure 2). The performance of graduate students was highly variable and significantly worse than that of physicians, who all performed satisfactorily ($P < 0.001$, Mann-Whitney U test). This difference may reflect a variable level of preparation of first-year graduate students, but also a greater motivation of physicians to perform well in order to obtain CME credit.

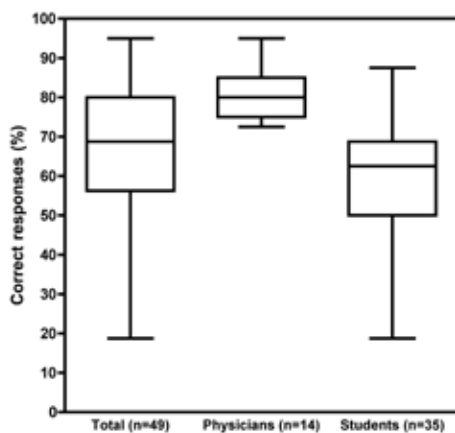


Figure 2. Percentage of correct responses to a final comprehension test completed by 14 physicians (20 questions) and 35 graduate students (16 questions). A satisfactory performance was defined as $\geq 65\%$ correct responses. Data are median, interquartile range, minimum and maximum. $P < 0.001$ for the comparison physicians vs graduate students, Mann-Whitney U test.

Discussion

Effective Medical Reading is a short course that introduces participants to the biomedical literature and teaches a method called browsing that

helps overcome difficulties of reading research papers. The course had a positive impact on participants' reading habits, in terms of how they approach a research paper. Prior to the training provided by this course, most participants read a paper by focusing on the concise abstract, rather than consulting specific parts of the body of the text. After having learned and practiced browsing, participants felt confident bypassing the abstract and navigating the text, extracting key information.

Almost all participants indicated that the time available for reading the literature (1-4 hours/wk for three-quarters of participants) was insufficient, in agreement with previous studies (1-4). Few noted difficulty with English as an obstacle to reading, in line with the requirement that they be able to read English to attend the course. Compared to first-year graduate students, hospital physicians were more familiar with biomedical periodicals, as they had greater access to print journals and were more likely to read editorials and be able to name a journal editor. Nonetheless, the distribution of physicians' scores on the final comprehension test suggests that the level of difficulty of the course was appropriate. Finally, both groups considered the course relevant to their professional development and effective in developing good reading habits. Therefore, the selection of course contents can be considered appropriate for both professional groups.

This study is limited by the fact that the analysis of the course's effectiveness and appropriateness was based on the participants' subjective evaluation of its short-term impact. It was not possible to perform more extensive testing of the changes in participants' reading habits, nor of the long-term impact of the course, principally because the course is offered as a paid service by an external consultant rather than as an intrinsic part of a university educational program.

The short duration of the course (4 half-day sessions) was initially selected to match the busy schedules of physicians, and was considered ap-

appropriate by university officials for an end of year graduate seminar. A similar format (17 hours of mostly practical exercises) was chosen for a CME event for young academic physicians in Croatia and received high ratings from participants (14). In its present format, Effective Medical Reading is successful in developing familiarity with journals and confidence in reading a research paper. Based on participants' comments and performances on the comprehension test, the course is inadequate regarding descriptive statistics. Although not the main focus of the course, understanding basic concepts of statistics is fundamental to critically reading a research paper. Learning on this topic could be improved by assigning homework, although in a course of this format participants do not always comply. A more effective solution may be a successive course on statistics that draws examples from the literature.

Ideally, the topics touched on in Effective Medical Reading would be addressed in a year-long course for medical and graduate students. Numerous universities worldwide have introduced courses in evidence-based medicine (EBM) that include modules on reading the literature, and some have documented the development of these programs (14,15). The success of these courses may depend on a multidisciplinary teaching team. At a medical university in the US, the literature module of an EBM course was developed and implemented by medical librarians because few members of the teaching faculty were adequately prepared (15). At a European medical school (14), the development of a similar course was initiated by editors of the national medical journal, since they were familiar with problems that authors faced in writing about research (16).

Effective Medical Reading was developed around the hypothesis that competent reading skills are essential to good scientific writing, and that teaching reading is the key to teaching how to write a research paper. How this course impacts scientific writing skills is presently un-

known. However, since the 2005 participants are now following a sequel course in scientific writing (Effective Biomedical Writing), it should soon be possible to make a preliminary evaluation regarding the course's real effectiveness. In summary, by learning the reading method called browsing, students appreciate the value of accurate and clear documentation of research activities and begin to distinguish between well written and poorly written papers. They also understand how others will critically read their papers. These learning experiences regarding reading are the first steps to proficiency in scientific writing.

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