Scientific Writing of Novice Researchers: What Difficulties and Encouragements Do They Encounter?

Jatin Shah, BAMS, Anand Shah, MD, MPH, and Ricardo Pietrobon, MD, PhD, MBA

Abstract

Purpose

Writing scientific articles is a daunting task for novice researchers. In this qualitative study carried out in 2007, the authors evaluated the experiences of a group of novice researchers engaged in the writing process, to elucidate the main difficulties and sources of encouragement they encountered.

Method

Sixteen novice researchers were interviewed. Most were women (10), and most were enrolled in programs of medicine (9), followed by nursing (4) and physical therapy (3). These were drawn via convenience sampling from a randomized control trial in which 48 of them were equally assigned to either an online or a face-to-face course of instruction. On completion, interviews were conducted in focus groups of four students each. The interviews were transcribed and read independently by two of the authors, who then encoded the material based on the principles of grounded theory. Initial categories were converted to major emerging themes, which were validated when participants were asked to review the findings. Triangulation of results was carried out by discussing the emerging themes in an online forum with five specialists in college writing education.

Results

Classifying the diverse responses of participants led to the emergence of four major themes: cognitive burden, group support and mentoring, difficulty in distinguishing between content and structure, and backward design of manuscripts.

Conclusions

The themes produced by this study provide some insight into the challenges faced by novice researchers in their early attempts at scientific writing. Remedies that address these challenges are needed to substantially improve scientific writing instruction.

Acad Med. 2009; 84:511–516.

Writing scientific articles is a daunting task for novice researchers. We carried out the qualitative study described below to evaluate the experiences of a group of novice researchers engaged in the writing process, to elucidate the main difficulties and sources of encouragement they encountered.

Introduction

Clear communication of research findings is essential to sustain the ever-evolving biomedical research field. Serving as the mainstay for this purpose, scientific writing involves the consideration of numerous factors while building up an argument that would convince readers and possibly enable them to arrive at a decision. Those who report research must attend to the soundness of the subject matter, to the nature of the intended audience, and to questions of clarity, style, structure, precision, and accuracy. These factors, along with the weight of responsibility to the scientific community, make scientific writing a daunting task. Consequently, many researchers shy away from this critical element of research, which may impede the progress of science and their own scientific careers.

Ability to accurately and effectively communicate ideas, procedures, and findings according to readers' expectations are the primary skills required for scientific writing. Additionally, skills such as the ability to relate and interlink evidence, to lend permanence to thoughts and speech, to enable one's writing to serve as a future reference to others, and to protect intellectual property rights[1] need to be developed and tempered over a period of time. These skills are necessary for all researchers but especially for novice researchers in the beginnings of their careers so that they do not face failure and lose valuable time learning these skills later.

Individuals entering the research field with no or little experience with past publications qualify as novice researchers. Even clinicians intending to explore and publish findings about research questions based on their clinical practice need to learn these skills to effectively contribute to health care.

Instruction in scientific writing and subsequent publication in peer-reviewed journals will help novice researchers refine their ideas and increase their expertise, because the act of writing is itself a valuable tool for learning and for fostering the scientific thought process[2]—this aligns with the principles of the "writing to learn" movement.[3,4] Effective writing skills help new scientists take part in the ongoing, ever-evolving scientific conversation.[5] The practice of scientific writing develops habits of reflection[2] that make for better researchers, and publication in respected

Dr. Jatin Shah is research assistant, Duke-NUS Graduate Medical School, Singapore.

Dr. Anand Shah is a resident, Department of Radiology, University of Pennsylvania, Philadelphia, Pennsylvania, and consulting associate, Department of Surgery, Duke University Medical Center, Durham, North Carolina.

Dr. Pietrobon is associate vice chair of surgery, Research on Research Group, Department of Surgery, Duke University Medical Center, Durham, North Carolina.

Correspondence should be addressed to Dr. Pietrobon, Associate Vice Chair of Surgery, Center for Excellence in Surgical Outcomes, Department of Surgery, Duke University Medical Center, DUMC 3094, Durham, NC 27710; telephone: (919) 668-2054; e-mail: (rpietro@duke.edu).

journals strengthens the scientific process while playing a crucial role in career advancement. Failure to publish will adversely affect a researcher's reputation, funding opportunities, and overall success.[6] Thus, consistent efforts to understand the factors influencing scientific writing and to develop and apply new training techniques to groom writing skills are important.

There are a number of anecdotal accounts of various methods used to educate novice researchers.[7] A 2003 study surveyed investigators to identify the reasons for "failure to publish" after presenting abstracts at a national meeting. The prime culprits were time constraints (the most common reason), the ongoing status of the studies, and issues of coauthorship.[8] Rodgers and Rodgers[9] went a step further, identifying variables such as time constraints, institutional policy, work pressure, and motivation.

As it stands, novice researchers, often overwhelmed by their many commitments, find it difficult to hone their writing skills. To help novice researchers realize their true potential, there is a clear need for qualitative studies that can identify the barriers to good scientific writing. However, to this point, there have been few studies analyzing the various obstacles to their progress. We carried out the study reported here to qualitatively evaluate the scientific writing of a group of novice researchers to pinpoint the difficulties and encouragements they encounter while engaged in the writing process. We used a grounded theory approach and formed no preliminary hypotheses; rather, common themes emerged from a qualitative interpretation of the interviews. These themes were reconfirmed with students and mentors to identify and address any errors in the interpretation of the findings.

Method

The present study enrolled a subset of participants from a randomized controlled trial (RCT) in 2007. That RCT study's participants were students from Duke University's schools of medicine, nursing, and physical therapy. They were enrolled to compare (1) an intervention in which students wrote sections of scientific manuscripts in a virtual writing environment using text structure templates versus (2) a control group in which students wrote sections of scientific manuscripts in a local writing environment without any formal guidance or text structure templates.

Randomized controlled study

Sections of scientific manuscripts were defined as sections of formal peer-reviewed manuscripts (e.g., introduction, discussion, etc.) or sections of term papers written with research statements, including references to sources and presentation of acceptable evidence. Virtual writing environments were created with the application Writely, now known as Google Documents,[10] which allowed documents to be shared among study participants and investigators. Local environments included word processors residing on participants' computers, such as Microsoft Word or Open Office. *Text structure templates* were defined as a set of templates specifying the role of each *text block* (a subsection of a scientific manuscript that deals with a single idea or argument). For example, the template for the introduction specified that it should have four distinct subsections, or "text blocks": (1) a statement of the topic's significance, (2) a description of the information gap that the study addresses, (3) a literature review to support the claim of an information gap, and (4) the study objective. Each text block was represented by a title, a brief explanation of its role in the context of the manuscript, and previous examples of text blocks in the same category from peer-reviewed publications. The list of templates was made available at the Web site for the research on research (RoR) group.[11]

In the RCT, 48 participating students were randomly paired and divided into two groups (24 in each group) based on the instructional intervention involved. Each participant had a mentor who was either a faculty member from Duke University or a member of the RoR group. In the "online scientific writing workshop" group, the students used a virtual writing environment (i.e., text structure templates; e-mail and PowerPoint-based instruction were provided for guidance in using the virtual tools, such as Voice over Internet Protocol). The "standard writing guidance" group used a traditional local environment (i.e., without templates, but participants received instructions face-to-face in real time and could access mentors by e-mail or conference call when necessary). Based on the mutual areas of interest of the student pairs and their mentors, they were asked to design a research question, choosing from a list of topics that were logistically feasible within the study period of seven months. Research questions could also be formulated with the help of an experienced researcher from the RoR group under the supervision of one of the authors (R.P.). Criteria of novelty and accessibility were considered for the allocation of research projects.

Qualitative study

Following the convenience sampling method, a total of 16 novice researchers, who were students from the second and fourth years of their courses of study, were enrolled in the present qualitative study. Most students were women (10), and most were enrolled in medicine programs (9), followed by nursing (4) and physical therapy (3). Two of the students in medicine had previously worked on published manuscripts but had made only minor contributions and were not primary authors.

On completion of the writing task, we conducted interviews in four focus groups of four students each. To compare the experiences of the intervention and nonintervention participants, the focus groups combined participants from both groups. Students not available for face-to-face interviews participated through conference calls, although we did not combine face-to-face and telephone interviews within a given focus group, to avoid the unintentional exclusion of conference call interviewees. Two students who could not participate in the focus groups were interviewed individually. All interviews were audiotaped for future reference.

Interviews lasted between 73 and 95 minutes. Participants were informed that the study would not influence their grades or the likelihood of their manuscripts' acceptance for publication. They were told that the objective of the focus groups was to learn about the challenges they encountered while writing the manuscripts and their strategies for completing the project. We did not conduct pilot interviews; rather,

we used open-ended questions for the first interview and subsequently updated it as the contents of each interview were analyzed. Initial open-ended questions focused on (1) factors that made the writing process either easier or more difficult, (2) interaction with the mentor and other peers during the writing process, and (3) specific factors within the participant's allocated section (e.g., introduction) that posed difficulties or facilitated the process. Because qualitative analyses were performed after every interview, after a time, questions tended to focus more on what seemed to be emerging themes, clarifying them and obtaining further details on how these themes affected participants. After interviewing 14 of the participants, we determined that we had reached a saturation point at which all emerging themes had been extracted and consolidated.[12] Despite this, we continued until we had interviewed all 16 participants.

Data analysis

Interviews were transcribed and read independently four times each by two of us. One of us (R.P.) was trained in qualitative research from his PhD and had previous exposure to phenomenology. The other (A.S.) had previous experience with one qualitative study and participated in study groups discussing methodological aspects of grounded theory as well as ethnographic studies. Each of us independently coded the transcripts following principles of grounded theory.[13] After each coding, the coders exchanged files and discussed points of disagreement in a Web conference. Although it was not our primary aim to reach agreement on every portion of code, successive reviews led to greater agreement in coding. Initial categories were converted to major emerging themes, agreed on by both coders. Our initial emerging themes were then respondent-validated by asking all study participants to review the findings. Each emerging theme was accompanied by a brief explanation and anonymous quotes. This comparison led to a few clarifications of meaning for one quote, which was incorporated into our results, though we were careful not to let participants' individual observations interfere with the emerging themes drawn from data obtained from the group as a whole. We considered respondent validation an error-reducing measure rather than a strict validation. We triangulated our results by discussing the emerging themes in an online forum with five specialists in college writing education. Triangulation was used not to generate hypotheses about emerging themes but to validate them once they had been found. Rather than an attempt to achieve consensus, our aim in triangulation was to increase the comprehensiveness and reflexivity of our analysis. (*Reflexivity* acknowledges a researcher's contribution into the construction of meaning in a qualitative study by highlighting his or her assumptions and values that might influence the interview. It helps in ensuring that both data collection and interpretation are well within the premises of the researcher's knowledge.[14]) Hence, not all suggestions from these two sources (i.e., respondent validation and triangulation) were taken into account, and we did not use any further methods to achieve consensus. We also described negative cases in which emerging themes seemed not to be in complete agreement with outlier observations.

To provide adequate reflexivity regarding our analysis, we describe ourselves below. All of us are clinical researchers with prior experience mentoring novice researchers. None of us sponsor any particular educational school of thought, and none of us had strong preexisting opinions about the themes that would emerge from this qualitative analysis. Each of us, however, to a greater or lesser degree, had had experiences during our research careers that reflected the emerging themes described in our study.

This study received approval from Duke University's institutional review board. Informed consent was obtained from all participants before participation.

Results

Classifying the participants' diverse responses led to the emergence of four major themes (described in the following paragraphs): cognitive burden, group support and mentoring, difficulty in distinguishing between content and structure, and backward design of manuscript. The participants and their mentors confirmed the validity of these themes, which assisted in identifying communication gaps and major deviations from the themes.

Cognitive burden

The participants differed greatly in their perceptions and management of the writing task. Some considered the task excessively complex and demanding, even overwhelming, on top of their other responsibilities. For example, one respondent noted, "Every time I thought about my article I would always come up with an excuse not to do it. I either had to watch a movie because I was tired, or I had to go to the grocery store. . . . I am not lazy, but the task just seemed to be overwhelming." Constraints like lack of time, procrastination, anxiety, and apprehension found expression in different ways. One participant commented, "When I started the article I was excited. . . . Then, on the second day things started getting difficult and I just didn't feel like going back. . . . I was busy and just couldn't find the time to go back." Another said, "As the weeks passed, the idea that I had to write that article kept coming back to me and that kind of made me a little anxious . . . there was just too much going on." Efforts directed at self-motivation and difficulty in staying focused were also reported, which can be seen from "I kept trying to pace myself . . . and even told my boyfriend about my deadlines to see whether that would get me going . . . but every time my deadline was approaching I could pull an excuse and do something else. . . . I don't know, it's so hard to be focused" and "I was sitting for about 30 minutes and it seemed like a full afternoon. . . . I rewrote a single sentence a thousand times . . . things just didn't move."

Other participants reported diametrically opposite responses, emphasizing the challenge and sense of achievement on getting the job done (especially those who'd taken an organized, planned approach). For instance: "Creating steps helped me because I knew my task was not to get the whole manuscript done that day. I had a limited amount of text to write and . . . all of a sudden my task seemed easy . . . something that I could complete that day and would give me a sense of 'You've got the job done.'"

Group support and mentoring

Most of the respondents were open to, and even in favor of, the idea of group writing. This was reflected in responses that favored group loyalty—responsibility,

comfort zone, and encouragement. The responses point toward the role of colleagues, friends, and mentors in aiding the writing task. A typical comment was, "I felt like I owed it to my team. . . . We had a scheduled meeting and my role was to get that text written . . . so, I would just sit and write it." A friendly communal working relationship was encouraging and comfortable for some of the respondents: "For me, it was really nice that a good friend of mine was my 'writing bud. . . .' Friendship and group writing definitely go together. . . . I can see how this wouldn't work in a group that I didn't feel like working with." Healthy and productive peer competition was apparent from some of the responses such as "So, we talked on the phone and she [referring to her peer] had written a lot more than I did. . . . Okay, I had to catch up no matter what."

The role of mentors in guiding, encouraging, and supporting novice researchers was also substantial. Many researchers looked to mentors for support and reassurance. One respondent said, for example, "Well, I know I could get in touch with my mentor, but then I hadn't really done much. . . . So, would I send him an e-mail just to say 'Hey, I haven't done anything. . . . Can you give me a hand? . . . Cheer me up?'"

Difficulty in distinguishing between content and structure

Many participants' reflections regarding the distinction between content and structure revealed initially diverse views that converged to agreement. Slow yet significant steps were taken toward overcoming initial difficulties, understanding assigned roles, and drawing on similar past experiences. Some participants found it difficult to appreciate the difference between content and structure. They found resolution by taking small steps toward the goal of understanding the distinction. One commented, "At first I couldn't really tell the difference [between content and structure]. It helped me to start breaking the text into small portions [text blocks]." A relatively higher focus on content, based on what they had seen in other articles, along with a lack of stress on structure, context, and argument building, was also noted. This is evident from the comment, "He [the mentor] told me that my Introduction wasn't right. . . . I went back and fixed it to make it focus on the topic. . . . I guess I was just trying to add more text, looking at what I had seen in other articles." Some researchers had a sense of text structure but perceived it differently from the way it was communicated by the mentors: "I guess I have always thought about text structure, but just not the way you have put it." Some were helped by remembering previous instances in which similar methods were applied; experience guided them in differentiating between content and structure and, ultimately, helped them write more effectively. "In previous manuscripts I did something similar by taking an article that my mentor had written and then using it to guide me."

Backward design of manuscript

For some participants, comprehending the overall perspective of the manuscript was a turning point, whereas others lost focus when they began to write. Those participants who were able to have the overall perspective and visualize the completed manuscript were then able to work backward from that goal to plan and implement the steps of writing the manuscript, hence the theme "backward design of manuscript." The big picture dawned on one of the participants while analyzing text structure: "It may sound silly, but while I was going over the [text structure] templates, I suddenly realized the connection between the project itself and how the manuscript creates a nice flow that leads the reader from the start to finish." Clarity on the final goal assisted in avoiding time-consuming deviations. One participant communicated this through saying, "If you know where you are trying to get it, that just makes the whole writing much easier . . . makes it a straight line, no going around." In another instance, despite initial clarity, focus was lost: "I can see now how the two connect . . . after you go over this it seems obvious, but when you are writing your section it is quite hard to keep focused. I think that at some points I just ran out of things to say, and I went on a tangent . . . in a way I knew it didn't sound right, but I wasn't really sure what exactly was wrong."

Negative cases

Some responses highlighted critical aspects of the study that needed to be addressed. Missing important data could lead to an inaccurate article, and plagiarism was perceived as a serious threat. One of the participants had failed to note certain important points, leading to an inaccurate article: "When I got feedback about my texts I noticed that I had missed several points. [Name of mentor] asked me why I had missed them, and my answer was just that I didn't notice them." The participant was then asked what she would do in the future to prevent this from happening: "I would probably make documents that are easier to read . . . perhaps ask students [participants] to watch the video more than once . . . but I think that a lot of the learning comes from getting feedback from a real person instead of a set of instructions."

Suggested solutions included user-friendly documents and personal feedback. The participants also mentioned another problem, the risk of plagiarism while using templates. "I think there is a serious risk of plagiarism when you allow people to copy from templates. . . . I would be very concerned to use it unless I really knew the person I was working with." Another participant was asked what he would do to prevent this from happening, and he replied, "Today there are places on the Web where you can go, enter a text, and then check to see whether some of its portions were plagiarized." A second researcher also referred to online plagiarism-identifying tools as a means of reducing this risk.

Discussion

To our knowledge, this is the first qualitative study involving virtual and face-to-face scientific writing interventions among medical, nursing, and physical therapy students. The themes that emerged provide insight into the thought processes of novice researchers. The theme of "cognitive burden" emerged from the many constraints that limited participants' ability to complete the writing task. The constraints ranged from those arising from within the individual (subjective) to those associated with the task (objective). One or both types of constraint placed an intellectual burden on some but not all of the participants, which had far-reaching consequences on their quality of work and likelihood of completing the task. A preference for group writing and a mentor's guidance also surfaced during the analysis—this led to the theme

"group support and mentoring." Understanding the difference between content and structure is critical to a well-written scientific paper; the participants brought up many issues concerning the difficulty of making this distinction, which led to an important theme—"difficulty in distinguishing between content and structure." Other statements of participants described the importance of identifying the desired end result, then planning and implementing steps in reverse. This led to the theme "backward design of manuscript."

In our study, cognitive burden was seen to be a critical factor in the initiation, implementation, and completion of the writing task. In a similar study by Pololi et al[15] describing students' experiences in a writing project, it was observed that, consistent with adult learning principles, the students responded positively to self-determined goals and deadlines, which helped ease their cognitive burden. Furthermore, they viewed the project as a challenging experience that helped them develop their writing skills, increase their self-confidence as writers, gain access to valuable writing resources, positively provide and respond to feedback, and recognize the importance of writing in academic medicine.[15] In yet another study, it was observed that the significance of the written text can stimulate motivation.[16]

In contrast, other studies have noted preexisting barriers to effective writing that were related to cognitive burden. For example, lack of writing experience, unfamiliarity with writing for scholarly publication, writing-related anxiety, lack of confidence in one's ability, sensitivity or resistance to feedback, the perception of good writing skills as "nice" but not necessary for the job, bad habits, memories of tortuous writing experiences, and fear of failure may lead to failure in the writing process.[15,16]

Most participants in our study favored group writing. Pololi et al[15] have demonstrated that participants working in pairs produce shorter but better texts in terms of task fulfillment, grammatical accuracy, and complexity. In fact, most students in that study reported a positive experience with group writing, though some expressed reservations. Collaboration allows students to pool ideas and provide feedback.

Group support has also been shown to increase the frequency of faculty's publications by emphasizing the group process and respectful collaboration.[17] Collaborative collegiality was strongly apparent in all writing groups studied by Galligan et al.[18] However, significant conflicts (including task conflict characterized by disagreements on task content, affective conflict characterized by hostility or anger among group members, and process conflict characterized by approaches to the task at hand), which affect team performance, have been experienced in geographically distributed collaborative teams. This is more so in dispersed teams as opposed to localized teams.[19] Apart from these, concerns about a sociotechnical gap such as technical challenges, expanding and conflicting user needs, underuse of groupware technology attributable to insufficient incentives, subtle organizational nuances, and changing organizational structures could also mar collaborative work.[20] In addition to this, collaborators' backgrounds, expertise, and viewpoints, lack of rapid synchronous feedback, and other communication problems may adversely affect a group's progress.[21]

Making the distinction between structure and content is crucial. A well-structured research article helps disseminate scientific information, and the content and interpretation help readers make important decisions.[22] Readers have certain expectations regarding the placement of concepts in a scientific manuscript,[23] which enables them to search and access information more quickly and efficiently.[22,24]

Awareness of structure in scientific articles affects readers' reactions and feedback.[23] Poor placement of information confuses the reader,[24] and a weak structure causes confusion and misinterpretation. It draws the reader's focus away from the content because he or she must concentrate on unraveling the structure.[22] Coordinating the structure of a research paper is a difficult task, which may discourage researchers.[23]

Visualizing the completed manuscript and working backward from that goal to devise a series of manageable intermediate steps is crucial to the scientific writing process, as explained by Wiggins and McTighe.[25] The backward design method has been credited to be beneficial in writing logically organized research papers.[26]

Participants in our study who used backward design wrote logically structured paragraphs and well-organized papers. It is important to note, however, that it may be difficult to avoid bias in backward-design studies, which base their hypotheses on predetermined conclusions. Also, if the protocol studied in the backward design approach lacks certain features or has some limitations, these errors may be carried to the real manuscript.

Basic writing skills acquired as early as grade school lay the foundation for future attempts at writing in any context. These skills include composition, writing reports, theme-based write-ups, paraphrasing, reading comprehension, and letter writing. Over the years, their significance and application are frequently sidelined and undeveloped. Consequently, novice researchers lack confidence and often struggle with writing. The abilities they have retained need to be revived, honed, and applied to the goal of writing and publishing quality scientific research. Writing to learn is a novel and evolving concept with diverse and fragmented views.[27] In accord with this concept, informal writing as a way of enhancing personal understanding has numerous benefits, which have resulted in its wide application. At the same time, research and teaching methods aimed at disseminating scientific ideas via good writing have been misconstrued and underutilized.[2]

Our aim in undertaking a qualitative study was not to generate a statistically representative sample but, rather, to evaluate a restricted sample to bring about an in-depth discussion in the educational community of the issues involved. Our findings should be verified with additional studies, preferably using methods with greater potential for statistical validation, such as surveys or even large cohort studies. Furthermore, our study was focused exclusively on a comparison between virtual and face-to-face interventions, but the virtual environment is evolving, so some of our findings are likely to change over the years as technology improves. However, some themes, such as cognitive burden, are inherent to the writing process and

will probably evolve into other forms rather than simply disappear as a result of new technology. For example, writing in virtual groups might decrease the cognitive burden that would be higher in individual writing but that, presumably, would not extinguish it. Finally, we acknowledge the potential for unintentional bias in interpreting interview transcripts in our study. We minimized the bias by ensuring that interview transcripts were screened multiple times by at least two of us.

The themes produced by this study concern the mindsets and thought processes of novice researchers and the challenges they face in their early attempts at scientific writing. Remedies that address those challenges are needed to help break down the barriers to quality scientific writing. Common detrimental beliefs and perceptions, seen especially in novice researchers, can be alleviated by considering their root cause. Our study demonstrates a number of points to be considered when evaluating the scientific writing process; these findings have important implications for the education of novice researchers. Future studies should determine whether these findings can be generalized to larger populations.

Acknowledgments

This study was made possible by the following grants: (1) Grant Number 1 UL1 RR024128-01 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH) and NIH Roadmap for Medical Research; (2) DU CIT Scientific Writing Workshop using Online Instructional Technology Surgery; and (3) School of Nursing, Physical and Occupational Therapy, Community and Family Medicine, Duke University.

Disclaimer

The contents of this report are solely the responsibility of the authors and do not necessarily represent the official view of the NCRR or the NIH. Information on the NCRR is available at (http://www.ncrr.nih.gov). Information on Reengineering the Clinical Research Enterprise can be obtained from (http://nihroadmap.nih.gov/clinicalresearch/overview-translational.asp).

References

1 Yore LD, Hand B, Florence MK. Scientists' views of science, models of writing, and science writing practices. J Res Sci Teach. 2004;41:338–369.
2 Keys CW. Revitalizing instruction in scientific genres: Connecting knowledge production with writing to learn in science. Sci Educ. 1999;83:115–130.
3 Connally P. Writing and the ecology of learning. In: Connally P, Vilardi T, eds. Writing to Learn Mathematics and Science. New York, NY: Teachers College Press; 1989.
4 Rivard RL. A review of writing to learn in science: Implications for practice and research. J Res Sci Teach. 1994;31:969–983.
5 Bazerman C. From cultural criticism to disciplinary participation: Living with powerful words. In: Herrington A, Moran C, eds. Writing, Teaching, and Learning in the Disciplines. New York: Modern Language Association of America; 1992.
6 Peat J, Elliott E, Baur L, Keena V. Scientific Writing: Easy When You Know How. New York: BMJ Books; 2002.
7 Marusić A, Marusi78:1235–1239.
8 Sprague S, Bhandari M, Devereaux PJ, et al. Barriers to full-text publication following presentation of abstracts at annual orthopaedic meetings. J Bone Joint Surg Am. 2003;85A:158–163.
9 Rodgers R, Rodgers N. The sacred spark of academic research. J Public Admin Res Theory. 1999;9:473–492.
10 Google Docs. Available at: (http://docs.google.com). Accessed December 30, 2008.
11 Duke University Research on Research Group. Manuscript writing templates. Available at: (http://www.researchonresearch.org/?q=node/14). Accessed December 30, 2008.
12 Butler CC, Rollnick S, Pill R, Maggs-Rapport F, Stott N. Understanding the culture of prescribing: Qualitative study of general practitioners' and patients' perceptions of antibiotics for sore throats. BMJ. 1998;317:637–642.
13 Glaser BG, Strauss AL. The Discovery of Grounded Theory: Strategies for Qualitative Research. Chicago, Ill: Aldine; 1967.
14 McNair R, Taft A, Hegarty K. Using reflexivity to enhance in-depth interviewing skills for the clinician researcher. BMC Med Res Methodol. 2008;8:73.
15 Pololi L, Knight S, Dunn K. Facilitating scholarly writing in academic medicine. J Gen Intern Med. 2004;19:64–68.
16 Witt PA. Writing for publication: Rationale, process and pitfalls. J Park Recreation Admin. 1995;13:1–9.
17 Grzybowski SC, Bates J, Calam B, et al. A physician peer support writing group. Fam Med. 2003;35:195–201.
18 Galligan L, Cretchley P, George L, Martin McDonald K, McDonald J, Rankin J. Evolution and emerging trends of university writing groups. Queensl J Educ Res. 2003;19:28–41.
19 Hinds PJ, Bailey DE. Out of sight, out of sync: Understanding conflict in distributed teams. Organ Sci. 2003;14:615–632.
20 Weng C. Why it is hard to support group work in distributed healthcare organizations: Empirical knowledge of the social–technical gap. AMIA Annu Symp Proc. 2005:804–808.
21 Gennari JH, Weng C, Benedetti J, McDonald DW. Asynchronous communication among clinical researchers: A study for systems design. Int J Med Inform. 2005;74:797–807.
22 Gopen G, Swan J. The science of scientific writing. Am Sci. 1990;78:550–558.
23 Pietrobon R, Nielsen KC, Steele SM, Menezes AP, Martins H, Jacobs DO. Manuscript Architect: A Web application for scientific writing in virtual interdisciplinary groups. BMC Med Inform Decis Mak. 2005;5:15.
24 Zhou Y. Recipe for a Quality Scientific Paper: Fulfill Readers' and Reviewers' Expectations. Indiana University School of Informatics, Indiana University-Purdue University at Indianapolis Center for Computational Biology and Bioinformatics, Indiana University School of Medicine; 2007. Available at: (http://sparks.informatics.iupui.edu/Publications_files/write-english.php). Accessed January 31, 2009.
25 Wiggins G, McTighe J. Understanding by Design. 2nd ed. New York, NY: Prentice Hall; 2001.
26 Hogan R. The rationale, design, implementation, and evaluation of a composition program employing backward sequence. In: University Microfilms. Pittsburgh, Pa: University of Pittsburgh; 1975:229.
27 Holliday WG, Yore LD, Alvermann DE. The reading–science learning–writing connection: Breakthroughs, barriers, and promises. J Res Sci Teach. 1994;31:877–893.