

# Development of a Scientific Writing Course to Increase Fellow Scholarship

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## ABSTRACT

Physicians in training are often taught how to conduct original research but may lack the skills necessary to write their results in a paper for the peer-reviewed medical literature. To help our critical care fellows increase their publication rates, we implemented an 8-hour scientific writing course that provides a structured approach to writing an academic research paper. We have demonstrated an increase in publication rate during fellowship from an average of 0.7 manuscripts per fellow just before course inception to 3.7 manuscripts per fellow in the current graduating class. We highlight strategies for developing a writing course aligned with adult learning theory within three key areas: planning, pedagogy, and implementation. Planning strategies center around creating a case for change, including multiple stakeholders with diverse backgrounds, including the research mentor, and ensuring accountability among stakeholders. Pedagogical strategies focus on harnessing the power of experiential learning, considering a flipped classroom approach, and peer teaching to leverage social and cognitive congruence. Implementation strategies include breaking down the writing process into manageable tasks, organizing the writing process according to learner needs, using peer review processes to drive learning, and celebrating the accomplishments of learners within the course. These strategies represent broad initiatives that can be tailored to local training needs and instituted across a wide variety of teaching platforms.

### Keywords:

graduate medical education; research activities; authorship; teaching; curriculum

(Received in original form February 28, 2022; accepted in final form July 27, 2022)

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This article has a data supplement, which is accessible from this issue's table of contents at [www.atsjournals.org](http://www.atsjournals.org).

ATS Scholar Vol 3, Iss 3, pp 390–398, 2022  
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DOI: 10.34197/ats-scholar.2022-0023PS

Knowing how to write and publish a research paper is an important skill for physicians in training. Academic training programs frequently encourage trainees to participate in research and publish their results in peer-reviewed medical journals. However, lack of prior writing experience, poor organization of thought, absence of a writing culture or mentorship, and language or cultural differences can hamper writing and publication success (1, 2). The implications of this are potentially far-reaching because trainees often go on to become mentors to future trainees, and academic promotion and leadership opportunities are often tied to publication success (3). Programs may defer this process to a capable mentor (if one exists) or to a “trial and error” approach (4).

At the Cleveland Clinic, Critical Care Medicine fellows are required to participate in a research project. Many of these are presented as abstracts during professional society conferences, suggesting that the data collection and analyses for those projects are complete or are nearly complete. Despite this, a review of PubMed from July 2017 through July 2019 (the year before course inception) showed that our six graduating fellows had published a total of four manuscripts during their fellowship training. Of these, only one included the fellow as the first or last author. When we queried our fellows, most reported that they lacked adequate time and training in how to write a manuscript. Several faculty felt that a lack of a writing culture within the fellowship was part of the problem.

In response, we created a scientific writing curriculum that provides a structured approach to writing an academic research paper. The course is offered annually to current fellows as well as residents who have recently been matched into our

program. The directors agreed that the metric for assessing the strength of our curriculum would be the number of PubMed citations identified for each fellow during the time they were enrolled in our fellowship. In the 3 years our course has existed, we have increased publication during fellowship from an average of 0.7 manuscripts per fellow to an average of 3.7 manuscripts per fellow. We offer a brief overview of our course, followed by strategies we believe were instrumental to our success (Table 1).

## COURSE OVERVIEW

Our scientific writing course consists of 8 1-hour sessions that review the basics of writing a research paper (Table 2). The course uses a flipped-classroom approach to learning. Before each session, fellows complete an online learning module developed by one of the authors (A.L.M.). Modules focus on specific elements of the research manuscript: the content and organization of each section, the importance of telling the story behind the research project (i.e., narrative style) (5, 6), and topics relevant to manuscript submission and writing ethics. At the beginning of each session, a designated fellow leads a discussion of the key points covered in the previously reviewed online modules. Between sessions, fellows also write a section of their manuscript on the basis of what they reviewed in the prior session. Completed sections of the manuscript are submitted to the course director before the following session so that they can be read by a course instructor. During the second half of each session, fellows are split up so they can review their submitted manuscript section with a course instructor. The instructor provides verbal and written feedback on the relevant section with regard to how well the fellow

**Table 1.** Strategies for planning and implementing a scientific writing course

## Planning

- Create a case for change
- Include multiple stakeholders with diverse backgrounds
- Include the research mentor
- Ensure accountability

## Pedagogy

- Harness the power of experiential learning
- Consider the flipped-classroom approach to maximize synchronous learning
- Implement peer teaching to leverage social and cognitive congruence

## Implementation

- Break down the writing process into small, manageable tasks
- Organize the writing process according to the needs of your learners
- Use peer review processes to drive learning
- Celebrate accomplishments

adhered to the elements of writing structure and narrative style covered in the modules. Each faculty member provides feedback to two preassigned fellows throughout the duration of the course. This allows fellows the opportunity to learn from their own manuscripts but also to learn from others in the peer review

process. After this review, fellows are responsible for discussing critiques, revising sections, and assembling the final manuscript with their research mentor. Fellows can, and often do, resubmit revised work to course instructors for additional feedback. At the conclusion of the course, fellows present their work to

**Table 2.** Cleveland Clinic structured writing curriculum for critical care fellows\*

- Session 1: Course introduction and learning goals
- Session 2: Selecting a target journal and introduction
- Session 3: Methods
- Session 4: Authorship and plagiarism
- Session 5: References, tables, and figures
- Session 6: Results
- Session 7: Discussion
- Session 8: Title and abstract

\*All sessions are 60 min in length (30 min for class discussion and 30 min for peer review).

the entire department during our Critical Care Grand Rounds.

## PLANNING

### Create a Case for Change

Most of our fellows aspire to academic careers in which advancement and leadership potential are reflected, in part, through the lens of one's writing success. To help our fellows better realize these goals, we needed to create a culture in which writing was a core element of the fellowship experience. Although we believed our writing curriculum would serve as a significant part of that culture change, our success also depended on convincing department leaders, mentors, and fellows that it was necessary (7). We did this by employing elements of Kotter's eight-stage model for change (8). Among faculty, we presented data about the fellowship's publication history, highlighted the multidisciplinary background of leaders planning the writing course, presented clear curricular goals, provided a rationale for how the course could support mentor–mentee relationships, and provided ongoing transparency of progress via regular email updates about fellow and faculty publications. For fellows, we highlighted the importance of writing as a part of early academic success. We incorporated this narrative into our recruitment strategy and invited incoming fellows to join our course, if interested, before officially matriculating into the fellowship. We also redoubled our efforts to set clear expectations among current fellows regarding expected writing deliverables. Within the course itself, we conveyed the value of the curriculum by ensuring we taught in a way that was immediately relevant to attendees. With each new course, we asked fellows to fill out a learning goal worksheet so we could

tailor the course to their needs. For example, if most people in the course were conducting a retrospective chart review, we worked to highlight examples of this type of writing throughout the course.

### Include Stakeholders with Diverse Backgrounds

Recruiting faculty members with diverse roles helps ensure that learners are exposed to a variety of instructional approaches, enhancing synthesis and integration (9). This is crucial because stylistic nuance varies across publication formats, and publication practices can vary depending on the field. The faculty for our course had a diverse set of writing backgrounds and included clinician–scientists with expertise in benchtop and clinical research, clinician–educators, and a medical journal editor. Using a shared decision-making process, we were able to leverage the education expertise of all group members to ensure that the curricular framework was relevant, comprehensive, and followed established pedagogy.

### Include the Research Mentor

Many novice researchers lack formal scientific writing training and/or experience and may not be familiar with available writing and publishing resources and best practices. Mentors may lack confidence in their own skills as writers, which can affect how they teach trainees. In evaluating the need for our curriculum, we noted that many of our faculty (and subsequently, mentors) were early- to mid-career physicians. To a practical degree, engagement with fellows on research projects seemed disproportionate to the number of manuscripts reaching publication. It is possible that while mentors had broad content expertise, they lacked writing

experience and/or confidence in their own ability to guide a fellow through the writing process. Although mentorship plays an essential role in guiding and supporting novice researchers (10), we felt additional resources could improve the fruits of these relationships. The writing course provides added guidance and writing accountability without jeopardizing the mentor's role in the process.

It is important to recognize that the course instructors do not serve as proxy mentors. We believe strongly that serving in this role would detract from the mentor–mentee relationship. We communicate with the participants and mentors that our goal is to act as an adjunct resource in two ways. First, we want to ensure fellows are accountable for producing a manuscript. Second, we want to provide editorial guidance within the writing process. Throughout the course, mentors are expected to remain engaged with the fellow and serve as the final arbiter in all writing and editing decisions.

### Ensure Accountability

Prioritizing time for research and writing can be challenging. Numerous clinical, educational, and personal priorities compete with similarly important but less pressing activities such as research and writing.

We identified three ways to improve accountability and prioritization of writing around our course. First, we provided learners with a clear timeline of expected progress and deadlines for the writing process (Figure 1). This allowed them to plan ahead and avoid confusion or ambiguity around expected deliverables. Second, progress on manuscripts was reported semiannually by fellows and mentors to the Fellowship Clinical Competency Committee. Although this step was not directly tied to the course, it did support our course objective by emphasizing the importance of writing within the larger fellowship curriculum. Third, we dedicated a portion of each session to reviewing submitted manuscript sections for every fellow. We suspect that this expectation motivated them to prioritize writing tasks that otherwise may have languished.

## PEDAGOGY

### Harness the Power of Experiential Learning

Experiential learning emphasizes learning by doing. It provides learners with opportunities to actively engage with and solve authentic work-based problems through action and reflection. To enhance learner engagement, knowledge retention, and motivation, we structured the writing process so that it followed Kolb's four-part learning cycle (11). We addressed Kolb's

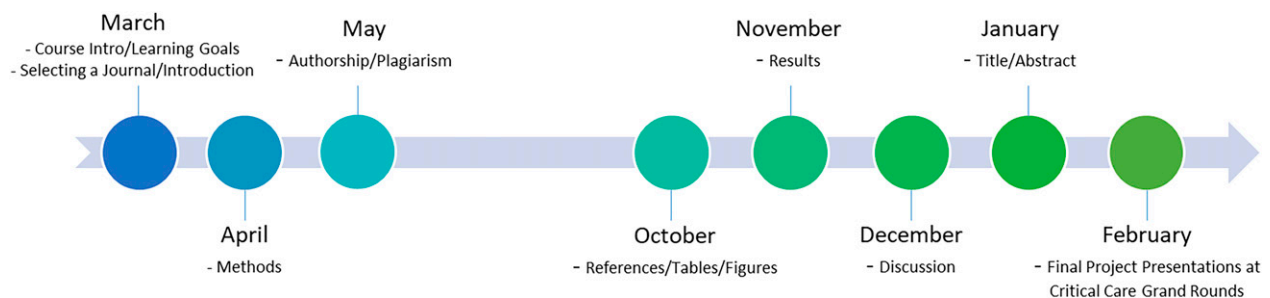


Figure 1. Timeline of writing curriculum.

concept of concrete experience by engaging our fellows in an immersive, structured writing process. Within this process, it was important to provide a forum for fellows to reflect on their writing. What went well? What was challenging? Were there knowledge gaps? This helped us to ensure they understood concepts and were engaged with the course objectives. It also provided a forum for learners to share their own struggles and successes and fostered a “we’re going to succeed together” atmosphere among attendees. This supported the writing culture we envisioned and the attitude that writing a manuscript is achievable.

In our course, didactic teaching about a section of the manuscript preceded the actual writing assignment. Participants must be able to grasp concepts to apply them on their own. To facilitate this, we provided tools to demonstrate appropriate structure and content for each section of the manuscript. This included conceptual frameworks, checklists, and examples from published manuscripts for review. Active experimentation occurs during the writing and review process itself. For each section of the manuscript, our fellows wrote a rough draft, submitted it for review, and then received direct feedback about how well they applied the learning objectives. They were then expected to address the remaining gaps and apply those to future manuscript revisions.

### **Consider a Flipped-classroom Approach to Maximize Synchronous Learning**

The flipped classroom is an instructional approach in which students engage with information about a topic (e.g., watching videos, reviewing text, and/or completing worksheets) before a class. This allows

faculty to devote class time to facilitating knowledge application via problem-solving activities. Its use within health professions education is well established (12).

Research suggests that the flipped-classroom approach improves learning outcomes in health professions education compared with the traditional classroom (13). It is also a useful approach for increasing learner motivation and engagement in medical education (14).

In our writing course, prework consisted of completing online learning modules. At the end of each module, users self-assessed their learning by taking a five-question multiple choice quiz designed to test lower-degree thinking skills: remembering (e.g., What is the purpose of the discussion section?), understanding (e.g., Summarize best practices for writing the discussion.), and applying (e.g., Which transition/phrase would you use to signal that you are writing the concluding paragraph?). Completing modules before class enabled faculty to devote class time to facilitating knowledge synthesis and application using higher-degree thinking skills: analyzing (e.g., Is this discussion section structured correctly?), evaluating (e.g., Are there any essential elements missing from this discussion?), and creating (e.g., What suggestions do you have for revising this discussion?).

### **Implement Peer Teaching to Leverage Social and Cognitive Congruence**

Peer teaching can be defined as “people from similar social groupings, who are not professional teachers, helping each other to learn and learning themselves by teaching” (15). Incorporating peer-to-peer instruction into medical education, in which students at the same degree alternatively serve as both the tutors and tutees, offers a number of benefits. Importantly, it leverages the concept of

cognitive congruence, which posits that a teacher with a knowledge base similar to that of fellow learners is more effective than one who has a dissimilar base. As such, the peer instructor may better understand the problems and challenges faced by their peers and target instruction to meet the needs of learners. At the same time, peer instructors and fellow learners are more socially congruent, meaning that they share similar social roles and styles of communication, which can help create a more relaxed and less intimidating instructional setting. Peer learning can also increase learner engagement and enhance deep learning in the peer tutor (i.e., “to teach is to learn twice”).

We incorporated peer-to-peer instruction into our writing course by designating one fellow to lead each class discussion.

During this time, the leader provided an informal overview of what they learned in the learning module. To help facilitate knowledge synthesis, integration, and peer participation, we provided a series of questions and reflection prompts for the discussion leader to use. Faculty also shared their own experiences and provided feedback and additional instruction as needed. A final question-and-answer period rounded out this portion of the session.

## IMPLEMENTATION

### Break Down the Writing Process into Small, Manageable Tasks

In our course, we chose to employ the concept of “content chunking” (16) (breaking down bulk information into small, meaningful parts, starting with the basics before moving on to the complex). By focusing each session of the course on a distinct section of the manuscript, participants were able to break down the

writing process. They tackled small portions of the manuscript on a fairly regular basis rather than attempting to write the entire paper all at once. This strategy is similar to a concept popularized by Robert Boice, who found that the most successful academic writers were more likely to write regularly for short periods rather than in long, infrequent sessions (17). In fact, Boice found that writers with strict accountability (i.e., writing daily) produce more work and more ideas than those with less or no accountability (17).

Content chunking occasionally led to disjointed transitions between individual sections at the conclusion of the course. However, participants who completed the course largely felt that having the sections in hand motivated them to go back, smooth these transitions, and complete their manuscript.

### Organize the Writing Process According to the Needs of Your Learners

A typical research paper starts with the title and abstract and follows the IMRAD (introduction, methods, results, and discussion) format. But is that the order in which the sections should be written?

There does not seem to be a consensus, and most writing resources do not address this issue. A few suggest starting with sections that are easier to write (e.g., the methods section) (18, 19), as this can help build writing momentum.

With this in mind, we believe that the particular order of writing is not as important as the need to tailor the content to the learners. For example, to accommodate the research schedule of our fellows, we decided to have them write the introduction and methods sections during the early stages of their research.

Although the writing element was not a

substitute for ensuring sound research methodology, the process of writing the introduction and methods sections early helped fellows consider the robustness of their research question, hypothesis, aims, and methodology. Course faculty should also consider external time constraints imposed by other fellowship initiatives to create a curriculum that is both deliberate and responsive to the learner.

### **Use Peer Review Processes to Drive Learning**

Within any instructional setting, assessment practices should align with the learning objectives and learning activities. Our main goal was to assist fellows in writing and submitting manuscripts for publication. We did not evaluate fellows using summative assessment techniques (e.g., there were no high-stakes examinations). Instead, we used formative assessments via a process of individualized verbal and written feedback as sections of a manuscript were reviewed. This was especially helpful for participants who were not native English speakers as the peer review process aided not only with vocabulary and grammar but also with identifying stylistic idiosyncrasies that influenced the tone and flow of the manuscript. Fellows were able to take this feedback to improve the manuscript in its revised form. In situations in which deep cultural or language barriers exist, additional resources may be necessary. Table E1 in the data supplement contains resources for nonnative English speakers, as well as general scientific writing publications and websites that we highly recommend.

### **Celebrate Accomplishments**

For most researchers, the task of writing is labor intensive. One of the keys to success

in our attempt to improve the writing culture was to celebrate accomplishments (8). Some participants have reported that the positive impact of working on their project in a group format, receiving consistent support, and seeing the manuscript develop in manageable chunks helped them persevere to the end. Beyond iterative positive feedback, participants were also invited to present the culmination of their work to a larger audience at our Critical Care Grand Rounds. For this event, we invited department leaders and influential individuals from outside our department to support the success of the fellows. We also celebrated publications by sending a department-wide email each month highlighting fellow and faculty publications. Although we cannot quantify the impact of providing iterative and summative support, this concept is well-described in the literature as a key to both impactful and sustained change efforts (20, 21).

## **CONCLUSIONS**

Teaching scientific writing skills will always require a tailored approach that considers many factors, including program culture, mentor experience, schedules, and specific learning needs. Careful attention to planning, pedagogy, and implementation of programs is vital to early and sustained program success. The strategies reviewed here were successful in our program and may be useful for other programs facing similar scholarship hurdles.

**Author disclosures are available with the text of this article at [www.atsjournals.org](http://www.atsjournals.org).**



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