

## **Creating a Course on Scientific Writing and Oral Presentation in English for Engineering and Science Graduate Students at an Elite Chinese University**

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### **Abstract**

The training of non-native English speakers in professional communication in English is a challenge faced in many fields. Herein we describe a course that we have developed to enhance writing and oral communication proficiency for early stage science and engineering Ph.D. students in this area. The course has been taken by approximately 750 students and has received generally favorable reviews. We have focused on the professional needs of our target audience, seeking to train them in how to write scientific journal articles efficiently, and how to generate attractive and clear posters for or give strong oral presentations at scientific conferences. Necessarily, these goals require some consideration of language skills like grammar, syntax and style, but scientific writing places a premium on conciseness and students need to learn how to tell a compelling story within the rigid constraints placed upon them by the structure of a scientific research paper. Our course is built around a series of lectures complemented with small tutorial groups where much of the learning takes place. We probe for improvement in student understanding throughout the course, thus permitting us to make minor adjustments if needed as we proceed. While this course was designed for science and engineering graduate students we believe that its format should be easily adaptable to satisfy the needs of other professions.

### **Keywords**

Scientific communication, professional training, teaching models, English language proficiency

## **1 Introduction**

The ability to communicate well in English oral and written forms is recognized among most professionals to be an essential skill for the 21st century. English has become the accepted universal

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technical language and failure to be well versed in its use can pose a major barrier to professional advancement. However, it is not simply general mastery of the language that is important, but rather how correct usage of English is constrained and shaped by the expectations of publishing and presenting work in one's profession. In science and engineering the presentation of work is highly structured and this often makes expression of one's ideas and thoughts difficult even for native English speakers. Non-native speakers must thus clear two hurdles: (1) to master the presentation norms of the profession, and (2) to do so in a new language. We have sought to develop and deliver a course for the Graduate School at Shanghai Jiao Tong University (SJTU), China which seeks to address these challenges and hope that the lessons we have learnt in so doing can prove useful to a wider audience.

We began our journey modestly, offering a course only to a small cohort of advanced Ph.D. students in the School of Biomedical Engineering at SJTU. The initial pool of students was chosen because (1) we wished to have a group of students who had already some significant experience in writing technical reports in English, and (2) Biomedical Engineering is the discipline in which both authors (the course organizers) work. The latter ensured that we understood extremely well the professional needs of our enrollees. Some junior faculty members also took the course at this time to strengthen their technical writing skills, and some of these faculty members subsequently assumed teaching roles for the course in later years. For this initial offering the focus was solely on scientific writing.

As the enrollment in this initial offering was low, we were able to place considerable emphasis on helping students and junior faculty members one-on-one with manuscripts they were working on at that time, sometimes in cases where the manuscripts were in revision following a round of review with a scientific or engineering journal. Nevertheless, at the core of the course was a series of lectures that took the students logically through the process of writing a paper in English well. These lectures, with some modification, have remained at the heart of the course over a number of years now.

The feedback obtained from this initial offering was extremely positive, encouraging us to follow up with a course targeted towards less advanced graduate students. We also felt that it would be useful for these earlier stage students to obtain training in best practices for oral presentation of their work, specifically those that might be helpful to them when speaking at a scientific conference. It was also decided that we would permit enrollment to the course for students from disciplines outside of biomedical engineering. The total enrollment for this second offering however remained low because we required each student in the course to have two opportunities to make an oral presentation, the second after receiving one-on-one feedback on their first presentation from the course instructor.

From these early small class experiences, it became clear that our course was filling a vital need for the training of SJTU graduate students. We were requested therefore to scale up the enrollment to accommodate a much larger number of students. Thus, in July 2018, we offered our course to 195 SJTU graduate students coming from a wide number of academic disciplines: agriculture, biomedical engineering, chemical engineering, environmental science and engineering, life science and biotechnology, medicine, pharmacy, and systems biomedicine. These changes, particularly the massive increase in enrollment, made the course a daunting undertaking for us and required restructuring of the teaching model radically. For the 2019 course, the enrollment had grown to 241 students and the enrollment for the 2020 course was 284 students. Furthermore, because of the Covid-19 pandemic the 2020 course had to be delivered exclusively online using Zoom, presenting us with a new challenge. Hence, we have a broad range of experiences that permits us to have confidence that the lessons we have learnt in administering the course are applicable to a range of circumstances. The balance of this report describes our experience with the large enrollment versions of the course starting in 2018. We believe that this is where our experience would be most valuable for those contemplating offering similar graduate training. Although we targeted our course to engineering and science students, we believe that our instructional practices should be adaptable to any discipline (e.g., business, law, medicine) where the English language is the professional default international means of communication. The primary

difference would be to mold the content to reflect the modes of communication particular to each discipline. The instructional design of coupling a sequence of core lectures with parallel small class tutorials that move through the syllabus in harmony should work well for most cases.

## 2 Course Description

### 2.1 Overall plan

We structured the course around eight 90-minute lecture sessions spread over four weeks delivered to all students and supplemented with twice weekly tutorial sessions delivered to 10-15 students. SJTU has two campuses – Minhang and Xuhui. Two offerings of the lectures were given at the Minhang campus and one at the Xuhui campus. There was no difference in the lectures given to each group though we had planned to split the Minhang groups based on English language proficiency in 2020 and adjust the lectures to match the differing proficiencies of the groups. This did not happen because the Covid-19 pandemic forced us to deliver all lectures in 2020 remotely via Zoom. The pandemic also affected the duration of the summer term at SJTU when our course was given, shortening it from four to three weeks. For this exceptional circumstance all course enrollees attended the same lectures and we scaled back the number of lectures from eight to six. We continue to believe that the educational experience might be improved by adjusting the lecture content to better match the proficiency of the students enrolled but we have no direct evidence that this is so. Also, as will be noted later, assessment of the course suggests that there may be limited scope for improvement.

Each lecture and tutorial session comprised two parts, with a short break between them, to alleviate the decline in student concentration that occurs naturally over time. The lectures always included a concluding quiz to test student comprehension of material covered in the lecture just delivered or that covered in an earlier lecture or tutorial session. This was done even when the lectures were presented online in 2020. The quizzes permitted us to assess student learning of material covered in the lectures or in the tutorials, to monitor class attendance, and to provide a reason to adjust course content, if necessary. With few exceptions, the latter did not prove to be the case, because the feedback we obtained from student performance on the quizzes indicated that we were meeting our learning objectives.

### 2.2 Lectures and tutorial content

**Lecture One** began with a short consideration of motivation for taking the course, and a summary of the proficiencies we sought to improve. The bulk of the lecture was devoted, however, to an analysis of the components of a scientific paper, to introducing students to a scientific journal's expectations for published work, and, most importantly, to a consideration of how one should approach the writing process. Specifically, we provided students with a road map of the order to follow in writing a paper's different sections and why this order should be followed. The order will generally be slightly different for a methods scientific paper and a results-driven paper, because the paper will be centered around the methods section for the former case and the results section for the latter. During the remainder of the lecture, we provided brief descriptions of what should be covered in the different sections of the paper and why. The meaning of plagiarism was also mentioned.

The quiz given at the end of this first lecture sought to assess each student's proficiency at writing in English at the outset of the course and to probe student comprehension of the lecture just delivered. Specifically, we tested the students' understanding of how to organize a scientific paper, following coverage of this topic in the lecture.

For the first tutorial session, which preceded the first lecture, the tutor outlined for students what would be covered in the course and sought to assess each student's experience and current proficiency in

technical writing. Students were asked to briefly describe their background in research, their experience in scientific writing in Chinese and in English and what writing skills they wished to obtain through the course. Tutors summarized the course content and explained what assignments the students would be required to complete. To serve as an example for analysis of technical writing in later tutorials, the students were given a published paper, written in English, from a scientific journal (Paper A) along with the “Instruction to Authors” for that journal. As students in tutorials were grouped with other students from the same research discipline and their tutor was also from that discipline, the selection of this paper matched well the interests of the students in their tutorial group. To personalize writing instruction for each student, the tutor also collected the abstract of each student’s B.S. or M.S. degree thesis (both English and Chinese versions). These abstracts provided material for tutors to use to illustrate weaknesses in student writing and sections of text that the students could analyze, modify and improve, in the process indicating progress in attainment of proficiency. Finally, since a student’s final deliverable for the course was to be presentation of a poster, students were given an outline of how to prepare a poster for defense at a scientific meeting.

**Lecture Two** concentrated on writing style, specifically that appropriate for scientific journal articles. We based some of this lecture’s content on the ideas contained in Gopen and Swan (1970). Engineering and science students have developed a clear understanding of the best ways to present data. They follow accepted norms and, by doing so, communication is eased. The same reliance on form of presentation to enhance communication applies to the written word, but this is generally poorly understood among scientists and engineers. By demonstrating to the class that form of presentation is something they do already for data, perhaps unconsciously, it was possible to motivate why a style of writing might be important also. Use was made of examples of badly constructed sentences and paragraphs. Students could see immediately upon reading these passages of text that they were difficult to understand. The passages were then analyzed and reworked, so that the class could see why they had been confusing and how they might have been constructed better. The passages of text were chosen to illustrate some specific points. We sought to show that long sentences are difficult to write well and thus best avoided by novices. In passing, this issue allowed us to demonstrate for the class how common word processors like *MS-Word* have built in tools like *Word Count* which can be used for textual analysis. Badly constructed long sentences were helpful in illustrating how wide separation between subject and verb can cause the reader to lose track of the writer’s intent. One particularly long sentence that mixed two ideas, permitted us to illustrate how a semi-colon could be used to break the two ideas and order them for importance. Other subjects addressed included paying attention to the topic of a sentence and paragraph, separating the discussion of topics, the position of stress in a sentence, writing in active and passive voice, and the selection of verbs that signal to the reader the action taking place. The latter allowed us to highlight the importance of building vocabulary and provided an opportunity to show the students the value of *Thesaurus* and how it can be accessed within *MS-Word*. We pointed out that, though writing concisely is generally the favored approach, there will be occasions where additional text can be necessary. When this is appropriate and when not is often determined by the expected audience, so good professional writing requires knowledge of the reader. There is no need to explain terms, concepts or other things that we can reasonably expect a reader of our article to know. In addition, we showed how paragraphing can be used to mark transition from one topic to a new one, and how this creates linkage between paragraphs. During this lecture we also introduced the students to *The Elements of Style* by William Strunk Jr. and E.B. White, a classic text for concise and clear writing in English.

The quiz given at the end of this second lecture sought to assess student understanding and retention of the material presented in lecture one. The questions tested student awareness of what content should be placed in different sections of a scientific paper and how to stage such content in a logical manner within the constraints sometimes placed by a scientific journal.

In the second tutorial session Paper A from the first tutorial was used to analyze the overall structure of a scientific research paper and the students were asked to consider how closely the authors had

followed the “Instructions to Authors” provided for the journal. The theses’ abstracts, that had been collected in tutorial one, were exchanged among the students, who were instructed to analyze the one they receive, and to comment on its content and clarity.

**Lecture Three** was devoted to use of graphics and tables in scientific papers. We advised students on when to use figures and when to use tables to illustrate data and what needs to be considered in their construction. For figures we described how to determine the number of panels per figure, how to organize (order) the panels, and how many plots per panel can be included. This necessitated, of course, a discussion of how one decides to segregate content between figures. One needs to look upon each figure as a minor story in its own right with the different panels serving as chapters. When multiple plots occur in one panel, each plot must serve its role; e.g., the effect of a different chemical concentration, how the effect varies by strain of an animal, etc. We showed the students where the use of pictures, line graphs, bar charts, drawings, scatter plots, 3-D plots, pseudo-color plots, linkage maps and pie charts are appropriate and where they are not. The former was done by pointing to examples in published work. For misuse of forms of presentation, we created our own examples to show the students how mistakes might occur and to contrast the benefits of different modes of presentation. We discussed the choice of line thickness, tick marks, axes labels and use of color. We emphasized the importance in following a journal’s instructions for figure and table format and the need for a prospective author to research recent articles in the journal to see how figures and tables appear there. Discussion of what constitutes a good figure caption followed with some specific examples used as demonstrations. We told the students that for the best captions, a reader can understand what is in the figure without reference to another section of the paper and this should be one’s goal. The caption should include a short but informative figure title, clear but brief explanations of what each panel, plot, drawing, etc. contains, and, where statistically different measures are highlighted, an explanation of significance. Because the students obtain instruction in experimental design and statistics in other courses, our discussion of statistics was very limited, although we noted that for the best studies, data analysis and statistical tests are built into the experimental design. On the presentation side, our concern is in presenting the data in such a way that an expert would understand why one performed the statistical test that one did. If the data can be assumed to be distributed normally, means and standard deviations (or standard errors) might be used. When using nonparametric statistical tests, a box plot with medians and lower and upper quartiles would be appropriate. This lecture was also used to explain to the students what needs to be included in the Methods section of a scientific paper and what should not be put there.

In early offerings of the course, we used the quiz that followed this lecture to test student vocabulary. Subsequently, the task of testing vocabulary was shifted to a later lecture and to the accompanying tutorial session. While we recognized that it is important to impress upon students the part played by vocabulary in writing well, we felt that this was a higher-level writing skill, whose importance was easier for the students to appreciate when they understood the fundamental aspects of scientific paper writing, like the components of the paper and how to build the story told therein. Thus, in later offerings, this third quiz was used as an exercise in writing the abstract of a scientific paper. The students were provided an abstract that had been poorly constructed and asked to identify its flaws. They were also asked to rewrite a paragraph of that abstract, making it both more concise and clearer. Our aim was to use an authentic short piece of text that should be self-contained as a test bed. It contained long, difficult to understand, sentences. For this exercise we were interested in clarity of expression. We took up the issue of what the abstract of a scientific paper should contain in the next lecture.

The third tutorial focused on vocabulary, scientific terminology, sentence writing and grammar. The tutors made use of *The Elements of Style* by Strunk and White to illustrate key aspects of clear writing. Students were asked to write a paragraph based on a sequence of a few sentences, paying attention to the stress and topic positions of a sentence, something that had been covered in lecture two. There was also discussion and analysis of paragraphs from Paper A (see above) and students’ theses abstracts.

In **Lecture Four** we covered the mechanics of writing for a scientific journal in detail. We advocated writing concisely and demonstrated how pruning unneeded words generally resulted in better text. We emphasized good sentence construction, contrasting good and bad examples. We showed that there was often a best word to use and pointed out that increasing vocabulary through reading widely helps to make one a clearer and better writer. We showed the students how there are a number of tools built into common word processors that can be used as an aid when writing. To round out this lesson we focused on writing a paper's Abstract. Journals often require a specific layout for the Abstract but they all include essentially the same components, largely in the same order. The Abstract is a summary of the paper. It should include what question(s) was(ere) addressed, how this was done, what was found, what does it mean and why should anyone care about the work. All of this must generally be contained in a comparatively small number of words, so it is a very good place to address the topics covered earlier in the lecture. Use was made of published examples.

The quiz that followed this lecture probed the students' understanding of the material covered in lecture three. We asked them questions about the design of figures and the use of statistics. To conclude the quiz, we set the students the task of writing a figure caption for a figure that we provided. The figure was selected to be one that any scientifically educated person would understand, ensuring that a lack of detailed technical understanding would not be an impediment to the task.

In the fourth tutorial attention was paid to the construction of tables, figures, captions and the use of statistics. Paper A was once again used as the source for examples to analyze and to discuss. Following this exercise, the students were instructed in some detail how to construct a poster for a scientific meeting, emphasizing how the flow of information through the poster should tell a story. The tutor explained how tables and figures should be constructed and sequenced to create an intuitive layout, noting the need to consider the perspective of the intended audience. The need to write concisely was emphasized. As a follow-on homework exercise, each student was required to design a 60 x 90 cm poster based on her or his B.S. or M.S. thesis work.

**Lecture Five** contained two distinct sections. In the first, we compared the contents of the Introduction and the Discussion sections of a scientific paper. For the Introduction section, the author is expected to outline the problem to be investigated, why the study is novel, why it is important, and how it builds on a body of existing work and knowledge. When a hypothesis is being tested that should be stated too. By contrast, the Discussion section covers how one's findings fit within the body of knowledge, how results reported in the paper add something new and important, and where gaps in understanding remain that will need to be filled by future work.

The second half of lecture five was devoted to the process of submitting a manuscript to a scientific journal and how to interact with its Editor. We considered the reasons for selecting a particular journal and how publishing in high impact journals can advance one's career. Within this context we discussed a journal's citation index [short term *versus* long term], considering where work like one's has been published previously, whether and why one's laboratory favors one journal over another, and where one's work will have the most impact. Having considered the factors that influence journal selection, we next provided guidance on handling the submission process. We emphasized the need to appraise oneself of a journal's required format, and how to construct a good submission cover letter. At the time of submission, it is appropriate in many cases to provide suggestions for potential reviewers of one's manuscript as this helps an editor or associate editor with their task of identifying persons qualified to pass judgment on your work. We also explained how the reviews one receives of one's manuscript should be handled. Authors need to respond in a timely fashion and are often given a deadline to do so. One should respond to every point a reviewer or the editor raises. Each response must be written in a polite tone and it is customary to thank reviewers for their service. In most cases, reviewing of articles is performed without compensation, so gratitude on the part of authors is to be expected, even when a reviewer's criticism may seem misplaced by the authors. Almost all reviewers seek to improve a manuscript, while ensuring that the results and conclusions presented are valid.

There was some variance in our team about the need to explain the review process in the detail that we did. While the senior faculty members felt that it was important, a number of the junior faculty members argued that this is something that students do not need to know until later in their careers. In most cases, the laboratory's principal investigator manages the manuscript submission process. Although this is true, it can be argued that trainees should be prepared for all parts of their professional life. Advanced Ph.D. students are sometimes involved in manuscript reviewing with their mentors as a training exercise with the consent of editors. Like with all tasks, one becomes better with practice so, when time permits, learning about the manuscript review process is time well spent. This part of the course was sacrificed however in 2020 when the Covid-19 pandemic forced us to shorten the course.

Lecture Five concluded with a discussion of citations and plagiarism. There are two main ways of citing work in science and engineering: one is by naming the authors and year of publication and the other is by a number. The latter is more common for engineering journals. Students were shown examples of both systems. Programs such as *Endnote* are used commonly for handling referencing and this is an area in which students were generally well versed. Most students also appeared to be familiar with the concept of plagiarism and had a good understanding of it. Because of students having a generally good understanding of the mechanics of citation, we emphasized the need to give credit to the authors of original source material and not review articles, except when a review article provides a novel interpretation of data and it is that novel interpretation that is the focal point. There is some propensity for authors with little experience to cite secondary sources like review articles more frequently than they should.

For the quiz that followed lecture five, we offered the students a test of vocabulary. The students were given passages of text from which we had removed words. A student's task was to fill the gap produced with the better of two words offered. Some of the choices were technical in nature, while others were not. Hence, we tested both student vocabulary for their discipline and for English more generally.

The fifth tutorial began with the students having to report on the main points covered in lecture four. Specifically, the tutors were interested in probing student understanding of what forms a good Abstract for a scientific paper. With this fresh in the student minds, the tutors asked the students to analyze and critique the abstracts of their B.S. or M.S. theses. They were left with the task of revising and improving their own abstract as a homework exercise. There was also an in-class discussion of early drafts of student posters, to be followed up with poster revision, also as a homework assignment.

Our goal for **Lecture Six** was to get the students to view a scientific paper as a single entity. We told them to consider the reader and to not complicate the paper's narrative unnecessarily. When one's logic is involved, a good writer needs to consider how best to guide the reader through its steps. We emphasized careful planning of the paper. One needs to be clear in one's own head what the story is that one wishes to tell and then stage the presentation of material in the paper in a way that leads one through its parts logically. One needs to think about what one wants to say in each section of the paper, then in each paragraph for each section and, finally, in each sentence of each paragraph. Sections and paragraphs should follow a logical path, building a story as one progresses through the paper. There was some discussion of grammar and the students were made aware of some of the many online resources for testing and improving one's grammar. There was also discussion of style. It was pointed out that the active voice can be more engaging than the passive form and that the active form is more acceptable in scientific writing today than it was in the past. Students were encouraged to begin by writing English with short sentences and only later to consider writing longer sentences. They were warned to avoid sounding grandiose, to avoid repetitive use of the same word, and to avoid the insertion of unnecessary words. Emphasis was again placed on the aim of writing concise and clear text. It was also made clear that good writing often requires an author to choose the right word and that this is only possible once one has built one's vocabulary. Students were told that one builds vocabulary by reading and encountering new words, although recall of words can be helped by use of a *Thesaurus*. The trap of repetition from the use of abbreviations (e.g., HIV virus) was pointed out. Students were told to check that when their

figures are produced in the journal that all its aspects will be easily visible. They were asked to use standard measures of visual acuity as a guide; a reader should not need a magnifying glass to view one's figure. We also discussed differences between Chinese and English writing traditions. Writing in long sentences in Chinese is unusual, while in English the passive voice is more common than it is in Chinese. In English, words are often omitted to avoid repetition and to make the sentence shorter and simpler. In Chinese, by contrast, words are less often omitted and instead may be repeated. It was felt that in highlighting these differences students would be better able to write text more easily in English, sounding less like a translation from Chinese.

For the quiz that followed this lecture, students were given a set of sentences, ordered randomly, which together tell a story. They were charged with rearranging the order so that they were in a logical sequence.

The sixth tutorial focused on in-class writing practice and further analysis of text. Drafts of student posters were viewed and critiqued. For homework, the students were charged with revising their posters in response to the feedback received and to prepare their posters for printing.

**Lecture Seven** was devoted to instructing students in best practices for oral presentation at a scientific meeting. We advised students that *MS-Powerpoint* is the only platform that is more or less used universally at scientific conferences, but that they should not assume that all versions of *MS-Powerpoint* are the same. We impressed upon them the need to test their presentation with the software provided by the meeting organizers well in advance of giving their talk and to adjust their slides to produce the presentation intended as necessary. In fact, a major focus of the lecture was how it is essential to be well prepared for one's presentation. Talks at scientific meetings present a rare opportunity for young scientists or engineers to establish their professional reputation and should be taken very seriously. Most of us are not naturally good at public speaking but all of us can do well at this task with adequate preparation. It is essential to have one's talk down cold and that requires practice, more practice, and still more practice. This will become tedious and tiresome so it can help to record oneself delivering one's talk. One can play this recording back to oneself many times, imprinting it in one's brain without overtaxing one's vocal cords. It can also be helpful to create a video recording that can be used to identify and eliminate distracting movements of the body. During one's talk it is important to make eye contact with the members of the audience, both to engage them in your presentation and to check that they appear to be following what you are saying. One should avoid reading the text on one's slides, but rather let the audience do that. Obviously, this implies that if there is so much text that the audience would not find this to be possible in the time the slide is presented, while also listening to you, that all of the text should not be there.

A good talk begins with an introduction that seeks to motivate the audience to listen to what you have to say in your talk. One should let the audience know what is in it for them. It is a good practice to start a talk slowly to acclimate the audience to one's voice and accent, especially for non-native English speakers or those with unusual accents. One can increase one's pace as one moves through the talk after familiarizing the audience to one's accent. One should seek to distinguish the forest from the trees; i.e., give the BIG PICTURE before the details. It also helps to make use of signal words (e.g., the problem, the solution, critical discovery).

Careful preparation and frequent practice of one's talk will help one to overcome the understandable nervousness that comes from presenting one's work before the leaders in one's field, as happens at an international scientific conference. It is important for a speaker to appear comfortable since this adds credibility to what one presents. Comfort signals to the audience that one believes in one's story. To project an image of comfort it helps to balance oneself on two feet and to try not to rock back and forth. One can help to project confidence by looking for a friendly face in the audience, and by making eye contact with several people. It is also a good practice to smile at the start of one's talk and give a friendly greeting. A novice speaker should remember that most of the audience will be pleased if one does well. Laser pointers bring with them a number of challenges for a nervous speaker. They magnify



hand instability when projected to the screen. When extremely nervous, there is the risk of inadvertently pointing the laser at members of the audience or the session moderator. Some laser pointers have complicated ON-OFF mechanisms, so a wise or experienced speaker will familiarize oneself with the laser pointer provided before one's talk or will bring their own. Preparedness extends to making oneself aware of the size of the room for one's talk. The volume of the microphone needs to be set so that those at the back of the room can hear one comfortably. One should make the size of detail on one's slides large enough to be seen or read anywhere in the room. Slides that are constructed well permit the speaker to use verbal cues to direct the audience's attention to features on your slides with expressions like top left panel, middle row of data, etc. Thus, a well-organized slide may need little use of a pointer.

For talks that have been tested, it is often possible to have additional slides ready to illustrate points brought up in question time. This demonstrates that the speaker is well prepared. Answers provided to questions should be directed to the whole audience, not just the questioner. Sometimes it may be necessary to restate the question, so the audience knows what was asked. It is also fine to ask the questioner for clarification if a question seems confusing before giving one's answer.

At this time in its development audio-visual content should be employed only if it is absolutely necessary; i.e., if one could not make one's point as well without the audio or movie clip. The risk that one's clip will not show or not show as intended is quite high, and, if it fails to do so, one will lose valuable time, have to explain what the clip would have shown, and you will look a shade incompetent. If one were able to explain what the clip would show in its absence well that would negate the necessity of showing it at all.

We concluded this lecture by showing the students the instructions provided by meeting organizers for preparing a talk for their scientific meeting. We chose an example where the instructions were detailed and comprehensive, validating the advice we had provided in the lecture.

The quiz that followed this lecture tested students recall of some of the key points raised earlier in the course. One question probed student understanding of the contents of the different sections of a scientific paper. Another tested student understanding of the process of submitting a manuscript to a scientific journal.

**Lecture Eight**, being the last of the lecture series, started with a summary of the course. In the early editions of the course, the second part of the lecture was spent considering an imaginary research project leading to a paper to be submitted to a high impact journal. It was intended to be both educational and amusing. For the quiz that followed the lecture, students were charged with writing a compelling abstract for the imaginary study. In recent years, the final lecture simply summarized what had been covered in the course and we adjourned to a poster session in which the students presented their posters to the course principals, its tutors and fellow students. This was a very engaging and enjoyable session, where the students received valuable feedback on the presentation of their work.

The course was concluded with a celebration in which students judged to have produced and defended the best posters were recognized.

In 2020 when the course was delivered online via Zoom, we had to adjust the poster presentation event. The best poster from each tutorial session, as judged by the session's tutor and fellow students, was selected to be presented as that tutorial group's entry to an online poster session via Zoom in a class-wide event. The presentation of posters at online scientific meetings has become common during the time of restricted travel during the Covid-19 pandemic, so the event we staged remained an authentic experience for the class. We observed that some students were adept at presenting their posters in a way akin to the way a poster might be presented in person at a scientific conference. These students zoomed in on different panels within their poster, guiding the audience through the different panels sequentially, just as happens when one is being presented a poster at a meeting. The best poster presentations demonstrated the students' ability at telling a scientific story and their acquired mastery of scientific writing in English. It is possible that virtual presentation at scientific meetings will remain common in

the future as participants from developing countries seek to defray the high cost of attendance in person. Hence, we feel that alerting students to optimal ways of presenting posters online should be incorporated in the development of professional skills.

### 3 Student Population

The graduate student population at SJTU, while predominantly Chinese, includes a significant number of international representatives. Thus, students enrolled in the course included a few Europeans, some from African countries, some from the Middle East and some from the Indian sub-continent. None were native English speakers, although all had some competency in spoken English. The proportions of female and male participants were almost equal.

### 4 Student Needs

To match course content to the needs of students enrolled in a course such as ours, a good understanding of existing competence is essential. Ph.D. students entering SJTU are required to have passed the CET-6 (College English Test Band 6). This ensured that Ph.D. students entered our course well-trained in many aspects of the English language. Specifically, while they could understand spoken and written English satisfactorily, they generally lacked experience in presenting themselves or their work in the language. Importantly, we could also assume that most enrolled students had already read quite extensively from the literature of their research field, and, in the process, attained a substantial vocabulary specific to their research area.

To help guide us in meeting the needs of the student body we asked the class enrollees to complete a self-assessment questionnaire about their English language proficiency and their background in scientific writing. The questions probed three areas: (1) basic skills in English, (2) writing style, and (3) specific skills particular to writing a scientific journal article. The results are summarized in the following three tables, where competence refers to the percentage of students expressing confidence in their ability.

Table 1

#### *Basic Language Skills*

Basic Language Skill	Competence
Spelling	71%
Use of definite and indefinite articles	57%
Paragraphing	54%
Use of prepositions	44%
Grammar	43%
Verb tense	39%

Table 2

#### *Students' Perceived Competence in Writing Style*

Writing Style	Competence
Organization of sentences within a paragraph	46%
Smooth transitions from sentence to sentence	39%
Concise well-structured sentences	22%
Wide vocabulary	15%

Table 3

*Tasks Specific to Scientific Papers*

Task	Competence
Citations/bibliography	65%
Presenting evidence to support assertions/ideas	50%
Avoiding plagiarism	48%
Title selection	34%
Presenting evidence in support of conclusions	29%
Writing a compelling introduction	18%
Logical progression of a storyline	16%

The outcomes were largely as we had anticipated and provided support for the emphasis placed upon different components of instruction in our course. Although there was room for improvement for some students in all areas, it was clear that higher level writing skills needed most attention and it is upon these that the course content was focused. Moreover, it is specifically within the area of professional writing where we, as instructors, can add most value. Basic language skills can be taught by many. Vocabulary expands through reading. But, writing scientific articles well is a skill learnt either through the practice of doing so many times, or by learning from those who have. The objective of our course was to shorten the time to proficiency.

From the third table, it can be seen that more than half the students considered themselves well versed in the mechanics of referencing other work in scientific papers. A quite high percentage felt that they knew well the rules to apply when dividing text into paragraphs and 50% felt they knew how much evidence would be needed to support a particular assertion or conclusion. Somewhat surprisingly to us, since this has historically been an obstacle for Chinese authors of scientific papers, more than fifty percent of the students considered themselves able to correctly use definite and indefinite articles. Based on our observation during the course, we would endorse this student self-assessment as they do make few errors in this regard. Perhaps the past decade has seen improvement in the teaching of basic English language skills in China that has created a difference between students of today and those trained a decade earlier. The least challenging skill for all students was spelling. More than 70% of the students considered themselves proficient in this category.

Throughout the course we continued to ask students where they felt additional help in scientific writing was necessary. It was encouraging to learn that all of the areas they highlighted for extra instruction had already been included in our course plan and, as a result, we were able to alert the students of each item on the “wish list” when the course had advanced to the point that it was covered.

## 5 Cultural Differences

For maximum effectiveness, teaching should be tuned to match the culture of the student body. For an institution like SJTU which prides itself on expanding international student and faculty numbers navigating different cultures can be a significant challenge. It is reasonable to propose that one might expect to adhere to Chinese cultural practices in China. After all, international students and faculty members have elected to train or practice their professions at a Chinese university and one advantage of doing this is the opportunity to familiarize oneself with Chinese culture. Nevertheless, the learning environment for a student from another culture could be compromised if one pays insufficient attention to that student’s cultural, including religious, practices. This is a challenge faced by all institutions who seek to build a diverse student body and one that will grow in prominence throughout the 21st century. Our student body included representatives from diverse cultures, and we attempted to provide a

somewhat individualized experience for our non-Chinese enrollees. These students were collected into tutorial groups containing only students coming from overseas. While there was cultural diversity in these groups still, all shared the experience of training in a foreign land. This helped in a small way to alleviate the challenge of minority status.

## 6 Team Teaching

We adopted a team-teaching approach for this course. For students to master scientific writing and oral presentation in English requires them to have multiple opportunities to present and have their proficiencies critiqued. In this way it is possible to gauge improvement and validate the instructional approach. We felt that it was also beneficial to anchor the course with a sequence of lectures attended by all students. These lectures served as a focal point for the tutorial sessions and ensured that the students understood the principles common to all scientific communication. With the tutorials we were able to accommodate some specialized instruction as regards to discipline or the cultural backgrounds of students. At many institutions, particularly in the United States, it is commonly found that in some courses science or engineering professors are teamed with an English writing/speaking instructor. In this arrangement, the science/engineering professor is responsible for the technical content and the writing/speaking instructor responsible for communication. While this might be the optimal approach to take for an undergraduate course, we feel that the model we have followed of employing only engineering/science professors is appropriate for training at the graduate level. All team members had experience in writing and publishing scientific papers in English and in presenting their work at scientific conferences. They were therefore well set to understand the professional needs of the students taking the class.

## 7 Course Assessment

A number of assessments of the course have been made over the years and the results of these assessments have been universally positive. In 2020 the course won the SJTU Teaching Achievement Award. In 2019 the SJTU Graduate School charged SJTU's Center for Education and Human Development with conducting an independent assessment of the course. The participation rate among the students enrolled in the course was 87.9%. The following table summarizes student opinion about the course.

Table 4

### *Students' Feedback*

Category	Effectiveness Score
Teaching Preparation	92.6%
Course Content	92.3%
Teaching Methods	90.8%
Student Teacher Interactions	93.5%
Assessment Methods	92.1%

Most students also felt that their proficiencies in written and oral communication in professional English usage had been improved substantially. The following table summarizes improvement for specific areas.

Table 5

*Students' Perceived Improvement*

Proficiency	Improved/Very Much Improved
Vocabulary and expression related to scientific English	63%
Sentence patterns and knowledge of grammar related to scientific English	75%
Knowledge related to academic journals, e.g., journal ranking, review process, etc	68%
Knowledge of and preparation for participation in international conferences	67%
Reading ability in scientific English	64%
Writing ability in scientific English	77%
Comprehension of scientific English	55%
Ability to communicate about science and technology in English	61%
Skills related to journal publication, e.g., submission, reply to reviewers, etc	69%
Oral presentation skills in English for international conferences	62%
Academic English communication ability	65%

We consider these results to be very encouraging. Since the students started the course with different levels of proficiency in areas of scientific communication in English, these generally high percentages indicate that almost all students feel that they gained much from the course. This observation is consistent with the high marks the course scored in other assessments, and, as noted earlier, implies that the scope for future improvement is limited. Even so, the independent assessment report provided two observations that indicate areas in which some improvement remains possible. It noted the variance in entering student proficiency in English communication and the challenge posed by inclusion of international students unfamiliar with Chinese educational norms. These were challenges that we had observed ourselves and had hoped to address in 2020 before the Covid-19 pandemic forced us to move to online instruction. We have continued to shepherd international students into separate tutorial groups and hope in so doing to understand from their tutors the special challenges they face.

## 8 Future Plans

Now that the course has reached a mature state and that a number of faculty members have experience in presenting its content, the decision was made to have future offerings of the course open to students during a regular term of the academic year. This adjustment creates more flexibility in scheduling for students and we regard it as a natural progression. It will permit the lectures and tutorials to be spread over a longer period and given in a less intensive manner. Whether or not this will enhance the learning experience remains to be seen but the data will be interesting. It will shed some light on the debate over whether intensive “boot-camp” style courses, for which our experience so far, with a course given in the summer term, might be considered an example, or longer term but less intense traditional course formats, like that now to be tried, results in greater student learning.

## 9 Useful Sources

We were not the first to consider the need to instruct science and engineering students in communication. It may be useful therefore to alert the reader to some other recent sources. One can find guidance provided by the journal *Nature* at the following website: <https://www.nature.com/scitable/ebooks/english-communication-for-scientists-14053993/contents/>. The Institute of Physics (IoP) has published a book for the professional training of junior faculty members (Illingworth & Allen, 2016), which includes useful guidance on scientific writing and conference presentations among other things. SJTU was given permission by IoP to produce a Chinese language version of this text and the translation was performed by faculty members from our course. Chris Woolston and Joana Osório conducted a series of interviews in 2019 for the CAREERS section of *Nature* probing the professional challenges faced in science by non-native English speakers. Mensh and Kording (2017) have also offered their thoughts on what makes a good scientific paper.

## Acknowledgements

Penny Hirsch is recognized for some of the ideas relating to scientific oral presentations. We would like to also recognize the team of tutors who have contributed to the course over the years. They were Yao Chen (2018-2020), Lin-Tai Da (2020), Kun-Yan He (2018), Li-Yu Huang (2019), Qiu Huang (2018-2020), Li-Li Jing (2018-2020), Jun Lei (2018), Dan Li (2019-2020), Lin-Sen Li (2020), Guan-Ning Lin (2018-2020), Chen-Guang Liu (2018), Yu Liu (2019-2020), Qing Lu (2019), Wei-Ying Lu (2019-2020), Jie Luo (2019-2020), Yu-Ge Niu (2018), Li-Hua Song (2018), Tsung-Yuan Tsay (2018-2020), Ilya Alexandrovich Vinnikov (2019-2020), Han Xiao (2018), Hua Xiao (2018-2019), Yi Xiao (2020), Min-Juan Xu (2018-2020), Li-Tao Yang (2018-2019), Hui Yu (2020), Jun Yuan (2018), Jin Yue (2019-2020), Li-Chi Zhang (2020), Qing Zhang (2019), Jian-Jiang Zhong (2019-2020), Yue Zhou (2018-2020), Bo Zhu (2019-2020) and Ming-Yan Zhu (2019-2020).

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