

## Designing an Online Scientific Writing Course for Graduate Students in Science and Engineering

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# Designing an Online Scientific Writing Course for Graduate Students in Science and Engineering

Mika Tamura and Leena Joseph

## Introduction

Today, English is the legitimate international language of science (Ammon, 2006; Crystal, 2003). A scientist needs to have a satisfactory command of the English language to obtain international recognition in a visible journal and to access relevant publications (Meneghini & Packer, 2007). The dominance of English, however, can be a heavy burden for scientists from non-English-speaking countries who have not mastered English enough to write a clear and concise text (Meneghini & Packer, 2007). Therefore, these scientists will take a longer time to write research articles in English than their colleagues whose mother tongue is English, and they will therefore have less time to conduct their own research (Crystal, 2003). However, they have no other alternative but to keep publishing in English to remain visible in their community, or else their work will be ignored by the international community (Crystal, 2003; Meheghini & Packer, 2007; Tychinin & Kamnev, 2005). The hegemony of English in scientific fields is no exception in Japan. Under such circumstances, fostering young researchers capable of writing scientific research papers in English is imperative at the graduate level of education in Japan.

This study provides an overview of an online scientific writing training course, which was designed for graduate students and young researchers of a graduate school in science and engineering in Japan, and explores the factors that impeded or facilitated the implementation of the course in the EFL/ESL context. Much attention has been focused on the factors that lead to students' persistence or high motivation. Although the focus was on students, information from the instructors and curriculum developer was also obtained for data triangulation in order to increase validity. By referring to the feedback comments from the

students, instructors, and curriculum developer, the study discusses the effectiveness and inefficacies of the online writing course from a variety of perspectives, thereby supporting the validity of the study.

## Background

### *Scientific English*

Scientific research writing is a type of academic writing derived from scientific publication in which original research results are described based on the experimental, theoretical, and/or observational knowledge in any scientific field (Day & Sakadusuki, 2011).

Scientific writing involves a simple, formal, clear, and concise approach toward writing (Peat et al, 2003; Day & Sakadusuki, 2011). Scientific language is more direct and does not include artistic expressions. According to Close (1965), scientists focus more on the accuracy of theme and the findings rather than on the style of presentation. In addition, the pursuit of universal generalization in scientific texts enables the author to signal credibility, reliability, objectivity, and ultimately authority to their readers and the research community (Marin-Arrese, 2002).

In EFL/ESL context, Swales (1990) introduced the study of the rhetorical and linguistic strategies which were adopted in the conventionalized IMRD (Introduction-Method-Results-Discussion) structure of the scientific papers

Gosden (1996) studied the writing practices of Japanese novice researchers in preparing their first scientific papers in English. The study found that they have dual constraints of limited research skills and limited knowledge of the mechanics of scientific writing in English, which leads to poor writing strategies in their research papers. The emphasis on grammar-translation and the use of Japanese throughout their English education in Japan lead the novice researchers to depend on their first language, because of which they may be unable to develop good writing skills in English. Further, they are still unfamiliar

with the notions of external critique and audience awareness because the concept of integrated service language support and the tradition of Language for Specific Purposes (LSP) in the education system are not common in Japan. Okamura (2006) investigated the strategies used by Japanese researchers to cope with their difficulty in mastering scientific English in a non-English speaking environment. The study found that two types of strategies are used. All researchers focused on reading academic texts in their field to learn typical writing patterns. Some paid more attention to the language used by native English speakers. The study also found that the majority ended up working with their limited English due to time constraints, and further suggested that efforts to master the language were more effective in the long run.

### *Online learning and writing training*

With the advancement in information and communication technology (ICT), e-learning or online learning has become prominent in today's higher education system (Song, Singleton, Hill, and Koh, 2004) Song, Singleton, Hill, and Koh (2004) sought to understand graduate students' perceptions of online learning, including helpful components, and observed the challenges based on their online learning experiences. The study indicated that course design, learner motivation, time management, and ease with online technologies are important to most learners for the success of their online learning experience. The challenges faced by learners were technical problems, lack of a sense of community, time constraint, and difficulty in understanding the objectives of online courses. The study provided suggestions to address the challenges of online learning. First, the course design should focus on the goals, objectives, and expectations of the learners together with the technological aspects of the course. Second, since learners are not used to the online learning system, in which information is sent in various formats and at different times, assisting learners to establish time management strategies would be helpful. Finally, helping learners to establish a

feeling of community or connection among learners in the context of online learning is imperative. This requires integration of strategies for community building into the design of the course.

Yang (2010) suggested the importance of reflection, which is the mental process of an individual's internal problem-solving activity, and is seldom observed in classroom instruction. He also discussed the effectiveness of students' reflection and peer review in improving their writing skills through online instruction. Focusing on undergraduate students in an EFL writing class at a Taiwanese university, this study found that reflecting on the differences between self-correction and peer review enabled students to monitor, evaluate, and adjust their writing processes to improve their writing. Although self-correction helped students detect grammatical errors, peer review allowed them to see their own writing through others' eyes, which enabled them to further improve their writing skills.

Jun and Lee (2012) focused on academic writing training using the Moodle course management system, and discussed students' preferences for online/distance learning and their experiences in a three-week online academic writing unit developed by the researchers themselves as part of an ESL academic writing course for international undergraduate students at a research university in the U.S. The study showed that students tend to rate online learning somewhere between good or bad. While they appreciated the convenience of time and place, ease of use, interaction with classmates in forums, and the peer response workshop, they felt that communication with the teacher was lacking, particularly with regard to immediate answers to questions and solutions to problems. It was also revealed that the students found some instructions confusing and considered a couple of tasks before the assignment to be irrelevant. This led to the students' low rating for the online academic writing course when comparing various learning environments: The students mostly preferred a blended learning system, while the onsite and online systems were the second and

third preference, respectively.

## The study

### *Setting*

In this study, the online writing course the ATCYR (Authorship Training Course for Young Researchers) was implemented as part of an English education program for graduate students and young researchers who are involved in a government-funded educational program at a large research-oriented university in western Japan. The 12-week online scientific writing course was designed for graduate students and young researchers who wanted to improve their ability to write research papers in English. This course was conducted through an LMS (learning management system), which is a customized version of Moodle 1.6. Moodle (modular object-oriented dynamic learning environment) is a web based e-learning system, which is a popular tool among educators and educational institutions for online education and training purposes. Typically, the LMS has an instructor to create and deliver reading materials, participate in discussion forums with students, and monitor and assess students' performance. In this course, students were instructed to write a research paper based on their own research. Reading materials were provided to help students write each section of the paper. The course was designed in a way that students had to make two submissions for each assignment. The students submitted parts of their research paper in the form of assignments and the instructor evaluated each assignment. In the first round of evaluation of each section, guidance was offered with regard to language and grammatical errors, while the evaluation of the second submission focused on scientific content and section-specific criteria of the paper. This approach was expected to encourage students to learn from their mistakes and help them to gain fairly good knowledge on how to write a paper.

The majority of the students were Japanese nationals; however, there were also students from other countries, such as China, Korea, Slovakia, Hungary,

Thailand, Indonesia, and Nepal. The students were graduates and post-graduates from various disciplines of chemistry and the life sciences. Their levels of proficiency in English varied from lower intermediate to intermediate and advanced.

### *Data Collection*

Data were obtained from students' responses to the questionnaire (see Appendix 1) and the responses to the feedback sheets from the instructors and curriculum developer. Both the questionnaire and feedback sheets were given at the end of the course so that the results would help improve their performance in the next course. The questionnaire for the students included questions that solicited students' view on the course. All the questions were written in English. However, the Japanese students were allowed to write their responses in their mother tongue so that they could express their opinions freely and accurately. Later, these responses were translated into English by one of the researchers. Since the researcher shared a common language and cultural background, she was able to grasp the nuances in the students' responses. The feedback sheets for the curriculum developer and instructors did not have any questions. Therefore, they described their perspective on the course. This study is a collaborative project between a Japanese course coordinator and the instructor of the ATCYR course, both of whom are the authors of this article.

### **Designing the online scientific writing course**

The first round of the course consisted of two types of online writing training: Basic Course and Advanced Course. Both these 16-week writing courses, each comprising four lessons, started on November 10, 2008. The objective of the Basic Course was to help students build their basic writing skills; hence, the training included creating an outline for a scientific topic, writing an effective paragraph on a scientific topic, and writing an effective five-paragraph essay on a

scientific topic. To meet the students' needs to write on a theme that was related to their area of research, ten topics were prepared for each student based on their actual research theme (they were asked to submit their research theme at the time of application). On the other hand, the Advanced Course focused on training to write research papers. Students were instructed to write a research paper, consisting of a title, abstract, introduction, materials and methods, and results and discussion, based on their own research. The students submitted three assignments in each lesson of both the Basic and Advanced courses. For the first submission, the instructor provided suggestions on how to improve the assignment; the students then made corrections and submitted the second draft. The instructor then evaluated the resubmission and offered further suggestions. The students made final changes to their draft and submitted the final version of the assignment. The Basic Course was taught by an Indian instructor who has a master's degree in English literature from a graduate school in India, and has taught English literature at the undergraduate level. The Advanced Course was taught by an American instructor who has a bachelor's degree in social studies. All Japanese PhD students (seven lower-intermediate English level, one higher-intermediate, one advanced) chose the Basic Course, while three PhD students from other countries (Indonesian, Chinese, Korean) and all young researchers (three research fellows and four assistant professors) took the Advanced Course.

Both the Basic and Advanced courses began with a high assignment submission rate (Tables 1 and 2). After lesson 1, however, the submission rate of assignments in the Basic Course showed a gradual decline, whereas the submission rate in the Advanced Course remained relatively higher.

Table 1

*Assignment submission rate for the Basic Course (2008)*

Basic	Lesson 1	Lesson 2a	Lesson 2b	Lesson 3	Lesson 4
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Course															
Assignment	i	Ii	iii	i	Ii	iii	i	Ii	iii	i	ii	iii	i	ii	iii
Submission %	100	78	22	67	44	11	44	11	11	56	33	11	22	11	0

Table 2

*Assignment submission rate for the Advanced Course (2008)*

Advanced Course	Lesson 1			Lesson 2			Lesson 3			Lesson 4		
Assignment	i	ii	iii	i	Ii	iii	i	ii	iii	i	ii	iii
Submission %	73	91	73	73	73	55	82	73	36	73	55	45

Due to less involvement of the students in the Basic Course, sufficient feedback was not received from them. However, the following comment from a student suggests some possible causes for the low submission rate.

*For me, the first assignment was good because it was appropriate. However, as the course proceeded, the pace of assignment submission increased. As a result, it became difficult for me to follow the course schedule. (PhD student questionnaire for the Basic Course, 2008)*

This student points out that the pace of assignment submission was a challenge. From the schedule, we can infer that the level of difficulty of the assignments increased as the course proceeded. In the Basic Course, the students started with quizzes on grammatical mistakes, followed by creating an outline for a scientific topic, writing a paragraph on a scientific topic, and finally writing a five-paragraph essay. Given that the interval between two lessons was the same, it cannot be denied that this course schedule was a burden for the students. Meanwhile, the pace of the Advanced Course was moderate with a low frequency of submission, as shown in Table 2. The volume and content of each lesson was

also of the same level since the students wrote different sections of the same paper. The following feedback from the instructor of the Basic Course implies that the Basic Course components were not at a level appropriate for the students who took the course.

*I think the lesson plan should be revised to give students more effective training on how to write, and there should be more comprehensive reading material. Also, the assignments could be in the form of quizzes instead of asking students to write whole paragraphs and essays. Further, a thorough needs analysis and learner-level analysis should be done before the lesson plan is finalized. (Instructor, feedback for Basic Course, 2008)*

The curriculum developer of the course echoed a similar view on the components of the Basic Course.

*It (the Basic Course) started out well with a 100% submission rate for assignment 1, which was a grammar quiz. From this, we can perhaps infer that the format of this lesson worked well: the reading material consisted of practical tips on grammar, and the assignment tested their understanding of that. (Curriculum developer, feedback for the Basic Course, 2008)*

His reasoning for the low submission rate in the Basic Course was as follows:

*The submission rate started falling as the paragraph writing assignments began. This could indicate that the students didn't take well to being plunged into free writing. Maybe the students in this course would have liked a greater focus on writing instruction instead of writing practice. It could also be that they found it difficult to come up with content for the paragraphs and essays they had to write. On the other hand, the advanced course students wrote*

*about their own research, so the raw content was readily available.*  
*(Curriculum developer, feedback for Basic Course, 2008)*

The important point here is that the students could choose either of these two courses; however, they decided to take the Basic Course after reading the lesson plan in Japanese, which was distributed prior to the course. This suggested that the Japanese PhD students felt the need to improve their basic writing skills before they obtained writing training on scientific writing. Since the PhD students spend a great deal of time engaged in research activities, they naturally found it difficult to write paragraphs and essays on themes that were not directly linked to their research.

Looking solely at the submission rate, it may be said that the Advanced Course was relatively successful. The feedback from the students and the instructor of the course suggested the need for improvement in the following areas: course component, evaluation, and instructor's background.

### **Course component**

Primary improvement was made in the area of curriculum, more specifically teaching contents and order. After improving the content in the previous round of the course, the new curriculum of ATCYR consisted of five lessons: 1) citations and integrating sources in a research paper, 2) writing the "introduction" section, 3) writing the "materials and methods" section, 4) writing the "results and discussion" section, and 5) writing the title and abstract; full-paper submission and formatting.

A lesson on "citations and integrating sources" was added to the new course. This change was made based on the suggestion from the curriculum developer, who found that students generally make mistakes in citations and references. The instructor also gave clear suggestions for restructuring the course:

*In the future, I would suggest that each assignment include previous ones. For example, when students turn in the second assignment (introduction), it should also include the title & abstract from their first assignment. This will help the instructor to see the paper as a whole, rather than as individual parts. Additionally, it would give the student the chance to see their paper come together as one piece, and if they decide to make a change in one section, they may find it necessary to go back to previous sections and make the same change. This might also help with context, assuring consistent use of abbreviations, etc. (Instructor, feedback for ATCYR 2010)*

In line with the comments of both the instructor and the students, writing of the title and abstract was made the last lesson, and full-paper submission and formatting were also added to this lesson component. Accordingly, the final assignment of each lesson in the last term was replaced with the new format. Consequently, the number of assignments decreased from three to two. Since students have a hectic schedule conducting experiments and attending research meetings and seminars, a four-week grace period was given to them at the end of the course, during which time they could make up for the delay, if any. In addition, the instructor gave suggestions for revamping the course structure and the reading materials. Therefore, additional reading materials that included examples of correct expressions in scientific writing were provided later.

*According to me, the structure of the course is appropriate and the study materials for each lesson are relevant and helpful for the students. However, it would be a good idea to include reading materials on correct expressions in scientific writing, particularly on grammar, stylistics, and word usage in scientific writing. This would enable students to have a proper judgment on the usage of appropriate expressions in their writing. (Instructor, feedback for ATCYR 2011)*

## Evaluation

With the addition of two lessons and provision of the grace period, the duration of the course extended from the initial four months to six months; however, the number of assignments per lesson reduced. The change in the number of assignments was made to allow the students to review their writing based on two different perspectives; this enabled them to enhance their learning process through the course. In the evaluation of the first draft submitted by the students, the instructor highlighted errors and mistakes in grammar and vocabulary. Instead of directly correcting the mistakes, the instructor provided hints by using correction codes or abbreviations of each language function. The students then corrected the mistakes based on these correction codes and submitted the second draft. In the second draft, the instructor analyzed the students' writing in terms of scientific style, based on the section-specific criteria (Table 3).

Table 3

### *Criteria for evaluation*

Section	Criteria for evaluation
Title	Clear, concise, and properly formatted
Introduction	Adequate context and background; proper use of references; clear explanation of how the current study will contribute to existing knowledge
Materials and methods	Smooth flow of sentences and paragraphs in describing experiments; clear tables, figures, and images; proper units and numerals
Results	Logical sequence of results based on the experiments; adequately detailed tables, figures, and images; effective references to tables, figures, and images
Discussion	Clear identification of important and relevant results; comparison of these

	<p>results with previous work; explanation of the implication of the results;  acknowledgement of any unaddressed issues or problems with the results;  directions for future work</p>
Abstract	<p>Information from all the sections of the paper; good beginning and ending;  no wordiness</p>

The instructor of this course emphasized that this two-step submission and evaluation for each section of the paper was effective in developing students' scientific writing skills. The instructor also emphasized the importance of the criteria for the various sections of a scientific paper.

*There was a remarkable improvement in the students' writing, particularly after they incorporated the suggestions in the first drafts. I feel the criteria for each section of the research paper helped the students to focus better on the scientific content and their approach towards the respective sections of their research paper. Moreover, the appreciative comments from the students indicate that they benefited from this course and could improve their scientific writing skills. (Instructor, feedback for ATCYR 2009)*

One student also mentioned that this two-step submission and evaluation according to the criteria for each section helped them to understand the style and format of scientific writing more effectively.

*The evaluations were clear and pointed out parts of sentences that require more clarity. (PhD student, questionnaire for ATCYR 2009)*

With the changes in the organization of the course, instructor, and the number of assignments, an improvement was seen in the students' completion ratio in this five-month training course.

Table 4

*Assignment submission rate for ATCYR 2009*

Lesson	1		2		3		4		5	
Assignment	i	ii	i	ii	i	ii	i	Ii	i	ii
June 2009 (8 PhD students) submission %	100	92	100	100	100	85	77	62	62	62
September 2009 (1 master student, 4 PhD students) submission %	100	80	100	100	100	80	100	80	80	77

To facilitate further improvement of the course, the curriculum developer proposed a short course in which students submit their assignment only twice.

*One disadvantage of this course is that it is quite long: about five months. Maybe we should look into offering a shorter version of the course that's about two months long. ....The nature of the evaluations will remain the same as in the current course, but the number of submissions will be fewer. (Curriculum developer, feedback for ATCYR 2010)*

The short course may be suitable and appropriate for researchers who had adequate experience in publishing research papers. However, the system of two assignment submissions did not seem to be suitable and appropriate for graduate students due to the concise approach of this kind of writing training. Therefore, suggestions to restructure the curriculum into the following three sections were implemented: 1) writing the title and “introduction” section, 2) writing the “materials and methods” and “results and discussion” sections, and 3) writing the abstract and formatting the entire paper. Simultaneously, the length of the course was shortened from five months to four months. The latest ATCYR course is a

four-month course, including a one-month grace period, and consists of three lessons with two assignments for each lesson, as shown in Table 5.

Table 5

*Course Outline for ATCYR 2010*

	Standard ATCYR
Course duration	16 weeks (12-week course + 4-week grace period)
Course start date	October 4
Number of lessons	3
Number of assignments	6 (2 per lesson)
Four-week grace period after the course	

The amount of study and quality of instruction remained the same since the graduate students used the same reading material and their manuscripts were evaluated by the instructor based on the same criteria. Thus, the reduction in the number of lessons did not negatively impact the educational effect of this online scientific writing course. Furthermore, the course with this new schedule had a higher completion ratio (Table 6).

Table 6

*Assignment submission rate for ATCYR 2010 and 2011*

Lesson	1		2		3	
	i	Ii	i	ii	i	ii
June 2010 (8 PhD students) submission %	100	100	100	100	75	88
July 2010 (1 PhD students, 1 research fellow) Submission %	100	100	100	100	100	100
May 2011 (7 PhD students)	100	100	100	100	71	71



Submission %							
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### Instructor

Another major change made in the new course was the appointment of an Indian instructor with a doctoral degree in science instead of the instructors with the background of humanities fields.

On the whole, the students were satisfied with the Advanced Course. The instructor had sufficient experience in writing and editing, and teaching English. However, because he did not have a scientific background, he found it difficult to evaluate scientific papers, which may have led to the above comments from the instructor. One postdoctoral researcher who received instruction from this teacher gave the following feedback:

*It would have been better more comprehensive suggestions or advices were provided. (Research Fellow, questionnaire for ATCYR 2010)*

The instructor had a PhD in the life sciences and has been teaching science and English for the past six years with an organization that provides editing, educational, transcription, and training services to individual and institutional clients worldwide. She has taught both science, because of her academic background, and English, because of her personal interest. She especially likes teaching scientific writing because it deals with both science and English.

The new teacher' instruction was well-received by the students. The following comment from the students clearly indicates that the course was effectively taught by the new teacher.

*The teacher's major was different from our research subject, but her evaluations and corrections were accurate. (PhD student, questionnaire for ATCYR 2011)*

With her fairly good knowledge of chemistry, this instructor did a very good job of evaluating the research papers. Moreover, her interest in scientific publications led to a deeper analysis of students' writings. Further, her experience in writing scientific papers helped her in providing appropriate instructions on the style and format of scientific writing.

### Discussion and Conclusion

In this section, we summarize the factors that contribute to students' motivation and persistence in pursuing an online scientific writing course. First, the study raised the question of whether young researchers, especially graduate students require writing training. The graduate students were initially interested in basic writing training, which consisted of paragraph writing and essay writing. This could be because the students found it necessary to obtain a general foundation in English writing. Because of the mismatch with their English level and research field, however, the online course for basic writing training had a low completion rate. Although the graduate students were given writing topics that were relatively close to their research themes, a direct relation was lacking. Also, writing an essay requires a fairly high level of English proficiency. We assume that these were the two demotivating factors that led to students dropping out from the essay writing course. Even if a graduate student has the skill to write good essays, it does not necessarily mean that he is equipped to write a good scientific manuscript. Taking the students' needs into consideration, we suggest that the online writing course for graduate students should focus on training in writing scientific papers. Okamura (2006) suggests that researchers' efforts to overcome their limited English writing skills and become familiar with/aware of native English speakers' language usage are more effective in the long run and necessary if the researchers seek to be successful in the community. In the two steps of evaluation in the ATCYR course, the students identify the mistakes in

their language use and correct these by themselves based on the first evaluation; in the second evaluation, they can improve their manuscript based on the section-specific criteria. This evaluation style enhances self-reflection by students or the mental process of internal problem solving by an individual. Yang (2010) discusses the pedagogical effects of self-reflection that cannot be fully achieved in classroom instruction. He also suggests that by understanding the differences between self-correction, which helps in the detection of grammatical errors, and peer review, which helps in the objective reviewing of writing, students can monitor, evaluate, and adjust their writing processes to improve their writing. Since the manuscripts include unpublished research results, peer review may not be suitable for the scientific writing course. Thus, detailed analysis by the instructor in the second evaluation serves as an alternative solution. Since the students improve their English language skills as they complete their own research papers, the course also has salutary effects on the four factors that reduce students' motivation to learn writing for publication, as pointed out by Huang (2010): 1) their notion that English plays only a subsidiary role in scientific research, 2) their sense of inferiority in the university writing curricula, and 3) the perceived imbalanced power relations between them and their advisers. Thus, the course is effective and efficient in terms of the students' needs.

Another factor discussed in the study is the importance of the instructor's academic background. The students' feedback suggested that they preferred the evaluations of the instructor with a science background, who would be capable of providing a more accurate analysis and detailed evaluation of the students' writing. Jun and Lee (2012) attributed the students' low rating of the online academic writing course to a lack of communication with the teacher and perceived irrelevance of the instruction. The instructor who taught this course had background knowledge of the students' research areas and enjoyed reading and evaluating the submitted assignments because she herself had a doctorate in chemistry. Therefore, her analysis was more detailed and appropriate than that of

other instructors.

Song, Singleton, Hill, and Koh (2004) suggests that course design, learner motivation, time management, and ease with online technologies are important to most learners for the success of their online learning experience. This study also showed that the duration of the study including the frequency of assignment submission and the number of lessons affect the success of the online writing course. The length of the ATCYR course was shortened from five months to four months by reorganizing the course components. The same reading materials and evaluation based on the same criteria were provided. Therefore, the amount of study and quality of instruction did not change and the reduction in the number of lessons did not affect the quality of this online scientific writing course. The students benefited from the shorter duration because they could complete and publish their paper faster. We believe that the improvements in the course components, duration of the study, and instructor's background increased students' increased motivation and persistence in pursuing the online scientific writing course. The study will contribute to ESP (English for Specific Purposes) and CALL (Computer Assisted Language Learning), and have positive implications for the niche area of English-language pedagogy in higher education.

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