

The Roles Of The Intensive Writing Training Course For Postgraduate Stem Students: A Case Study Of An Online-Based Writing Course

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ABSTRACT

Many STEM postgraduate students lack academic writing proficiency due to their previous training and university education. Although some universities offer compulsory writing courses, many students do not meet professional expectations in completing scientific reports and publications. Based on constructivist learning theory, the current study aims to understand the effectiveness of an online-based and semester-long intensive writing training course at a university in the United States. The study was guided by the following research question: Based on the formative and project-based writing assessments, did the learners increase their writing effectiveness in scientific and academic writing? How? From the semester-long intensive writing training with 30 postgraduate STEM students, the participants indicated that the current intensive writing training provided them with the targeted skills as junior-level scientists and postgraduate students. University leaders and department heads may take this study as the blueprint to establish similar intensive writing training for their STEM postgraduate students.

Keywords: language acquisition; language learning; online learning; STEM education; technology education; university student; writing

INTRODUCTION

Background and Literature

Academic writing is an important aspect of the work of postgraduate students in completing their assignments, examinations, dissertations and academic publications. Although postgraduate students are expected to have good writing skills from their undergraduate education, many still struggle to write academic-oriented manuscripts at the postgraduate level, regardless of their native language and language proficiency (Dos Santos, 2021b).

In the United States, almost all postgraduate students need to complete a series of taught courses before the dissertation stage. In general, most American master's degree programmes require at least ten taught courses (equivalent to 30-semester credits) before students can start their master's dissertation. In contrast, doctoral degree programmes can require at least 15 taught courses (equivalent to 45-semester credits). Regardless of the coursework and dissertation stages, intensive writing and

discussion sessions are required for academic communication and exchange.

A previous study indicated that although university faculty members, instructors, and thesis supervisors expect postgraduate students with a doctoral degree to be prepared for academic writing, many students are unable to write professionally (Caffarella & Barnett, 2000). In academic programmes focused on liberal arts and creative writing training, only 64% of recent graduates met the expectation of structural orders, supportive content, and critical thinking (Hoyt et al., 2010). Hence, there is a significant requirement for postgraduate students and future academic researchers to upgrade their writing skills, particularly in academic writing (Dos Santos, 2021a).

In science, technology, engineering, and mathematics (STEM subjects), the writing of academic reports, theses, and journal manuscripts are essential in expressing innovative research and practice findings (Dos Santos, 2021a). However, many postgraduate students in the STEM arena do not have a strong foundation in verbal reasoning (reading, writing, and language skills) or have intensive

training in qualitative writing. A recent study advocated that a language rubric could be useful for postgraduate students with lower language proficiency by following guidelines for development (Rakedzon & Baram-Tsabari, 2017b). It is also worth noting that academic and non-academic writing styles can be challenging for all STEM professionals, including university lecturers, researchers, and postgraduate students.

Some universities offer compulsory academic writing courses for STEM undergraduate and postgraduate students. However, the instructors' writing styles and backgrounds may be challenging for STEM students (Rakedzon & Baram-Tsabari, 2017a). Another recent study (Lewis et al., 2021) advocated that a project-based teaching and learning approach may be appropriate as STEM courses and programmes tend to involve vocation-based and project-based learning. A combination of face-to-face interaction and technologically-assisted teaching and learning tools (Alim et al., 2021) could enable students to gain the required achievements and outcomes based on designed plans, in this case, a formative and project-based intensive writing training course (Dos Santos, 2019).

As noted by a previous study (Liu, 2015), many science students and international students may face difficulties in English language writing. Although many international students passed the university entrance examinations and English language test, many STEM students tend to be interested in logical training and mathematics. Therefore, additional training in writing and language development may be useful. Another study (Zhang, 2015) also indicated that universities should establish technologically-assisted language learning programmes and courses to increase the students' interests and motivations. Particularly for STEM students who do not intend to write training and courses, the comprehensive and multi-media-based language training development is needed to increase the motivations of learning (Gao & Gao, 2015).

PURPOSE OF THE STUDY

Many STEM postgraduate students lack academic writing proficiency due to their previous training and university education (Dos Santos, 2021c). Although some universities offer compulsory writing courses, many

students do not meet professional expectations in completing scientific reports and publications. Based on constructivist learning theory (Bruner, 1986), the current study aims to understand the effectiveness of a semester-long intensive writing training course at a university in the United States. The following research question guided the study:

Based on the formative and project-based writing assessments, did the learners increase their writing effectiveness in scientific and academic writing? How?

SIGNIFICANCE OF THE STUDY

STEM postgraduate education and programmes train junior level researchers to become professional scientists and university lecturers. A way of gaining a reputation and sharing scientific results with academic communities is through publications and reports; however, many STEM programme leaders and scientists struggle to provide effective training in this area (Dos Santos 2021b; 2021c). The results of this study and the instructional direction of the writing centres may provide a blueprint for STEM department heads and scientists to upgrade their writing courses and writing centres for their junior-level researchers and postgraduate students.

THEORETICAL CONSTRUCTIVIST THEORY

FRAMEWORK: LEARNING

Constructivist learning theory (Bruner, 1986) advocated that individuals can establish new knowledge based on the combination of previous experience and current materials. Cognitive learning development occurs when individuals gain, merge, combine, handle, understand, and exercise their new knowledge, which could activate their known experiences and skills. Four factors could be categorised:

The teaching strategy should focus on the connections of previous experiences, current materials, and potentially gain skills;

The teaching strategy should focus on the motivations of learning and skill management, which allowed the learners to gain new knowledge from their previous experiences;

The teaching strategy should be designed to meet the expectation and current level of the learners;

The teaching and learning materials should help the learners to move beyond the current stage to the next level.

METHODOLOGY

The Intensive Writing Training for STEM Postgraduate Students: Online Course

A formative assessment with a project-based evaluation was used to understand the overall development of academic writing and the effectiveness of the writing centre, particularly in intensive writing training for STEM postgraduate students. The intensive writing training was an optional course, to which STEM postgraduate students could sign up in addition to their regular schedule as a non-credit course. However, once the learners enrol, the academic letter grade (pass or fail) will be marked on their academic transcripts. It should be noted that unlike the English-as-a-Second Language (ESL) or first-year composition courses, this course did not intend to teach grammatical structure or vocabulary but advanced-level writing. Both native English learners and second language learners were welcome. Please note the university department developed the intensive writing training. The course instructor taught the course and collected the surveys. The researcher studied and analysed the survey and published the results.

During the semester, students learned how to develop the Introduction-Methods-Results-Discussion (IMRAD) structure based on a series of project-based writing reports, assignments, and peer-review activities in line with their academic programmes. Please refer to Appendix A for the training schedule and content of the course.

Participants and Recruitments

The current intensive writing training course enrolled 30 students in three different sessions; ten students were assigned to the three-hour course in the semester. An experienced lecturer (Associate Professor) with a STEM background and experience in scientific publications delivered the course and collected the survey data for the researcher (i.e. the author of this study). Based on the enrolment plan, four students from biology, four from chemistry, four from botany, four from neuro-science, four

from public health, two from engineering, two from medicine, two from physics, two from mathematics, and two from computer-related programs were enrolled on the course.

DATA COLLECTION

As outlined in the schedule and curriculum, students focused on the IMRAD training and submitted their assignments as formative assessments. Three grading tools were employed - peer evaluation, instructor evaluation, and self-evaluation. Double-blinded grading and assessments were employed in peer and instructor evaluations to prepare the journal-related review procedure. Once the peers and instructor had completed the review reports, the students were required to read the comments and edit their writing based on the suggestions from other parties, with each student reviewing at least two manuscripts from other classmates. After the students had completed the editing, they provided a self-evaluation of their own updated writing. It should be noted that there were no rubrics for the grading, and only lecture notes and handouts were used in the evaluation procedures.

By the end of the intensive writing training, the students had prepared a ready-to-publish manuscript as their overall performance output from this course. Although the students were not required to submit the manuscript to a journal due to the data collection progress, experimental procedure, and institutional review board regulation, the completed manuscript was submitted as the formative assessment or portfolio. Moreover, two qualitative surveys (short question-answer) were submitted during the mid-term and final examination weeks as a satisfaction criterion of the course (i.e. 60 valid surveys were collected).

DATA ANALYSIS

The researcher employed the data analysis tools based on the recommendations of the grounded theory approach (Strauss & Corbin, 1990). The researchers employed two techniques, including the open-coding technique and the axial-coding technique, to categorise the massive sharing from the participants. First, the open-coding technique was used to categorise meaningful sharing into different themes as the first-level groups. In order to conduct further

data analysis, the axial-coding technique was employed for the second-level groups. As a result, three themes and two sub-themes were yielded.

Human Subject Protection

Privacy of all parties is the most important element in this study. As a result, the signed consent forms, sharing, stories, contact information, university information, computer, and related information were all locked in a password-protected cabinet. Only the researcher could read the information. Once the study was completed, the researcher deleted and destroyed all materials to protect privacy. The study received support from the Woosong University Academic Research Funding 2022.

Findings and Discussion

After completing the semester-long intensive writing training, collecting the formative

assessments, peer-reviewed reports, and surveys, both the students and instructors felt that the training had improved writing effectiveness in scientific academic writing.

Gradual Development in Writing

The development of scientific writing was the goal of this intensive writing training. Over the weeks, students needed to plan, think, write, and submit their portfolios for assignment and peer review. The following is an example of a public health student aiming to understand the relationship between gender roles and social stigma in mid-age male patients with mental stress and depression. During the first four weeks, the students had limited ideas on starting the introduction chapters, particularly the purpose statement and significant statement. The student submitted a draft as the assignment for module 1. Table 1 illustrates part of the writing.

Table 1: The first draft of the purpose statement from the introduction chapter

Purpose statement
Many middle-aged men do not want to seek help from mental health centres because of the social stigma and the viewpoints of other people. But public health workers and psychologists should help them. Otherwise, the social problems will continue.

Once the peer and instructor had reviewed and commented on the writing, the students edited and polished their writing based on the comments. When the editing was completed,

the students provided a self-evaluation as they entered the grade into the computer system. Table 2 gives comments from a peer and the instructor.

Table 2: Constructive comments from a peer and the instructor

Peer #1	Instructor
1) The writer needs to write down the connection between social stigma and men in stress and depression.	1) The purpose statement should outline the purpose of this study. For example, how does social stigma impact the decision?
2) The writer should think about why social stigma is the problem for men with a mental disorder. Please be specific.	2) How does social stigma change men's decisions? 3) Why social stigma is the key to changing the mid-age men's motivation?
	Let us think about it and think about two research questions. Good start! (Pass)

The student rewrote and polished the assignment based on the comments and suggestions from the peer(s) and instructor's

report. The student reconstructed, uploaded, and provided a grade for this assignment. Table 3 outlines the development.

Table 3: Edited writing with the self-evaluation and comment

Edited paragraph	Self-given grade
According to Smith (2008), mental health issues could cause negative consequences if the individuals do not seek help and counselling properly. However, because of the social stigma and viewpoints from American society and people, male patients do not intend to seek help from the counselling centres. The current study investigated the relationship between social stigma and gender position among a group of mid-aged men from New York City (N = 100).	Pass or A- The paragraph answered the comments from all people.

Moreover, the quality of the peer-reviewed reports and comments increased significantly over the formative assessments and developments. At the beginning of the semester, over 90% of the students wrote only five or fewer sentences per peer-reviewed report.

However, based on the submissions from module 6, the peer-reviewed reports highlighted details, constructive comments, and meaningful recommendations. Table 4 outlines part of a peer-reviewed report.

Table 4: Peer-reviewed report (partially listed) after the semester-long intensive writing training

Peer-reviewed report from module 6 (partially listed)
<p>...In the second section, it is reported (lines 93-95) that the percentage of chemical disposal in Florida is less than 8%. However, the number could not show the whole story in the state. What could the author tell about neighbouring states' rates, such as Georgia or Louisiana? For example, if the percentage in Florida is important to this research, what about more successful rates from other states? The comparison will increase and tell the percentage that they consider feasible to attain?...</p> <p>...Another interesting problem would be about similar research projects with some similar projects and problems in other countries; for example, Mexico and Cuba. The author provided a couple of examples, yet it would be enlightening if they could elaborate on more related investigations or on the questions addressed in other contexts to elicit relevant information. For instance, the author said that about other influencing factors, such as geographic locations and education background (lines 76, 89, 112, 145, 245, 334, etc.)...</p>

In line with constructivist learning theory (Bruner, 1986), the students connected their previous knowledge with the current lessons and lecture notes and the peer-reviewed comments from their classmates and instructor to build on new ground in scientific writing. Reflecting on a previous study (Norton & Toohey, 2011), the current intensive writing training effectively built up language proficiency and knowledge sets based on previous experience and current materials. As none of the students had experience peer-reviewing and submitting academic-oriented review reports, the current intensive writing training provided opportunities to construct new experiences and skills (Gao & Gao, 2015).

Qualitative Survey Comments and Feedback from Students

Based on 60 valid qualitative surveys, all the students expressed their positive experiences. Although the course did not carry any academic credits, all believed the course successfully built on their STEM and academic knowledge through their writing skills. Two themes were built based on the surveys: 1) employing previous and current knowledge through writing, and 2) preparation for scientific, research, and teaching career pathways.

Employing Previous and Current Knowledge through Writing

All 30 students considered the current intensive writing training to have significantly increased

their understanding of writing STEM-oriented academic manuscripts and papers with effective instruction. More importantly, the instruction from the experienced STEM lecturer had increased their understanding of how to target their writing for scientific reports and publications. Many expressed their interests in STEM-oriented training. One said:

...the training for the scientific report is very useful because we have to publish two Science Citation Indexed papers before graduation...but I don't know how to start...this course is an excellent tool to tell us the style and requirements...(Survey #6)

Besides the STEM-oriented academic writing training, over 50 surveys expressed key statements on the differences between traditional writing training and the current writing for STEM postgraduate students. Many indicated that employing experienced scientists to teach scientific writing was the most effective approach as lecturers in English language teaching and humanities might not fully understand the style and discussions of statistical reports using quantitative data. Based on this, the researcher captured a comment:

...I understand many professors in the Faculty of Science and Engineering do not understand how to teach writing...because writing is not their expertise...but we need to have scientists to teach us how to write reports with all quantitative data and statistics...I like this course because we have the right professor for the right course...(Survey #22)

Reflecting on a previous study (Norton & Toohey, 2011), the students felt that the current intensive writing training enabled them to build on their previous knowledge with the current material to establish new ground. More importantly, in line with constructivist learning theory (Bruner, 1986), the new ground and knowledge could be further applied to other subject matter and practice, such as discussing quantitative data and statistics.

Preparation for Scientific, Research, and Teaching Career Pathways

Postgraduate students with a master or doctorate can go on to work in academia, laboratories, science organisations, and government, all of which require excellent writing skills to report their experiments. Some surveys indicated that the intensive writing

training provided students with the opportunity to write academic journals appropriately. These students also felt that they could teach undergraduate students and mentees how to complete their assignments, reports, laboratory reports, undergraduate graduation projects, and even master's theses. In other words, the current intensive writing training allowed the students to transfer the knowledge to the next generation. A comment was captured:

...I have already combined my undergraduate ideas and problems with my current PhD knowledge and this intensive writing training...I can see the problems of the undergraduate and master's students...I can now use this writing skill to solve and tell the undergraduate students and master's students how to handle the data with excellent report...(Survey #46)

Besides the desire for career pathways in teaching and academic research, many students focused on career developments in industry, particularly in scientific laboratories, organisations and government agencies. Although careers in the industry generally do not have a heavy academic writing workload, excellent writing skills are still essential in project work (Liu, 2015). Many expressed that the current intensive writing training filled the gaps in scientific writing after their undergraduate graduation. A comment was captured:

...my undergraduate degree did not require any capstone projects...no heavy workload in writing because I studied a bachelor's degree in science...the only two writing courses were from my freshman year [first year]...I did not take any writing courses for more than a decade...I don't want to work as a professor but I want to learn how to write the laboratory reports...which people can understand my writing...(Survey #28)

In conclusion, in line with constructivist learning theory (Bruner, 1986), the intensive writing training provided opportunities for the students to understand classroom instructions as junior-level researchers and academic professionals. As many decide to join academia after graduation, STEM-oriented training beyond their theoretical and scientific laboratory experience will be essential (Liu, 2015).

LIMITATIONS AND FUTURE RESEARCH DEVELOPMENTS

The current study only collected data from postgraduate students. However, undergraduate students and non-credit students may face writing difficulties as many need to complete their final-year projects and internship reports. Although many colleges and universities offer general writing training to students from all courses and programmes, the targeted (i.e. particularly training for science students) individuals and groups may be missed. Therefore, writing programme coordinators may take this study as the opportunity to reform and establish some of their writing training and programmes for the undergraduate, postgraduate, evening, and non-credit students university-wide.

Due to the COVID-19 pandemic, many courses and instructions have been moved to online platforms. The intensive writing training could be instructed via online platforms as distance-learning courses. Therefore, future research studies and applications may employ the current curriculum and instruction for any potential online courses and programmes to meet the needs of non-traditional, returning, adult, and evening students.

CONTRIBUTIONS AND CONCLUSION

University leaders may take this study as the opportunity to establish some intensive writing

training programmes for all students, including undergraduate students, postgraduate students, international students, and targeted students from different academic programmes and departments. Particularly, based on the current curriculum design, students need to conduct the double-blind peer-review procedure as preparation for their academic voyage. Therefore, although not all learners will join academia after university, professional-oriented training will upgrade the skills and preparations for university graduates.

Writing centre leaders may coordinate with the university leaders, department heads, and administrators for intensive writing training, particularly with professional training, such as double-blind peer-review procedures. Although this study focused on the issues for STEM postgraduate students, the results indicated the challenges of writing skills for all students in the universities, regardless of their levels and academic programmes. In other words, writing centre leaders may expand and establish subject-oriented intensive writing training, such as training for fine arts students, doctoral degree students' academic training etc., in order to meet the needs of different students in the university.

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APPENDIX A

Appendix A: The schedule of the intensive training course for STEM postgraduate students

Week	Module	Training details	Assignments	Due date
1-2	1	Introduction of scientific writing Understand publication	Indicates a topic for the scientific report	By the end of Friday (week 2nd)
3-4		Introduction Purpose and statement Theoretical framework	Completed the introduction chapter	By the end of Friday (week 4th)
5-6	2	Literature review	Completed the literature review (At least 20 articles)	By the end of Friday (week 6th)
7-8	3	Methodology	Completed the methodology chapter (Qualitative or qualitative or mixed or experimental design)	By the end of Friday (week 8th)

9-10	4	Findings	Completed the findings chapter (Potentially outlined the findings and results from the study)	By the end of Friday (week 10th)
11-12	5	Discussion	Completed the discussion chapter (Compare the current finding and previous literature reviews)	By the end of Friday (week 12th)
13-14		Conclusion and further statements	Completed the conclusion chapter (Indicated the contribution of this study)	By the end of Friday (week 14th)
15-16	6	Peer-reviewing procedure	Reviewed and commented on at least three classmates' full manuscripts	By the end of Friday (week 15th)

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