RESEARCH LETTER

Effectiveness of a new science communication course – A preliminary report

NG Kah Loon,[1] DENG Xudong,[2] ZHANG Sanqian,[1] Maurice CHNG Yuan Zhang,[1] CHUA Tin Chiu,[1] KOH Li Ling,[3] SIM Xiu Juan,[1] Vahid ARYADOUST,[4] Eric CHAN Chun Yong[1]

[1] Faculty of Science
National University of Singapore
[2] Centre for Communication Skills
Singapore Institute of Technology
[3] International Relations Office
National University of Singapore
[4] Centre for English Language Communication
National University of Singapore

Address for Correspondence: Associate Professor Eric Chan Chun Yong, Department of Pharmacy, Faculty of Science, Block S4, 18 Science Drive 4, Singapore 117543. Email: sciccye@nus.edu.sg

Recommended citation:
Ng, K. L., Deng, X., Zhang, S., Chng, Y. Z. M., Chua, T. C., Koh, L. L., Sim, X. J., Aryadoust, V., & Chan, C. Y. E. (2014). Effectiveness of new science communication course – A preliminary report. *Asian Journal of the Scholarship of Teaching and Learning*, *4*(4), 196-205.
https://doi.org/10.24112/ajsotl.43316

Effectiveness of a new science communication course – A preliminary report

ABSTRACT

As the ability to write and communicate scientific ideas and theories is a desired competency among Science graduates, the Faculty of Science and the Centre for English Language Communication at the National University of Singapore co-developed a new compulsory communication module for all Science freshmen. With a high student enrolment, the potential impact of this new module on the development of our students is significant. The objective of our preliminary study is therefore to evaluate the effectiveness of the new module with regards to its learning outcomes. Carefully designed pre- and post-course surveys are administered to rate the different learning outcomes, content of the module and extent of improvement in terms of the students' confidence towards writing and communication. Our results suggest that the module has been effective in improving the competency and confidence in communication among our freshmen and further sheds light on the preference of reading materials among Science freshmen. Further research includes trend analysis, text mining analysis of self-reflective letters and longer-term surveys to evaluate the effectiveness of the module. In conclusion, our preliminary findings are positive and reaffirm the importance of a compulsory communication module for the Science undergraduates.

INTRODUCTION

In the 21st century, the competency of Science graduates impacts many aspects of our society, including our qua lity of life, our living environment and the world economy (Glynn & Muth, 1994). For instance, graduates from the Food Science & Technology Programme are trained in many aspects of food safety and analysis that in turn helps ensure the high quality of food imports into the country. As another example, our Environmental Studies graduates are competent in addressing various societal and scientific challenges with regards to critical environmental issues. In addition to technical competency, the ability to write and communicate scientific ideas and theories is another key competency to be developed among our graduates. Many top universities like Harvard (Harvard College Writing Programme, n.d.) and Yale (Writing at Yale, 2014) have long recognized the importance of compulsory communication courses in their core curriculum. In 2011, the Provost of the National University of Singapore (NUS), Professor Tan Eng Chye, shared his vision and belief that language and communication modules should be made compulsory within the undergraduate curriculum (Tan, 2011).

Since 2007, the Faculty of Science (FoS) in collaboration with the Centre for English Language Communication (CELC) has been offering a plethora of communication modules to different groups of Science students. *SP1202 Communicating with the Academy* is an elective module designed with the aim of developing critical thinking, reading and writing skills based on a selected set of undergraduate scientific texts. Similarly, Pharmacy majors read *SP1203 Foundation in Effective Communication* as part of their graduation requirement while the Bachelor of Environmental Studies (BES) students read *ENV1202 Communication for Environmental Studies*. While these modules play a critical role in enhancing the communication skills of Science undergraduates, only a small percentage of Science undergraduates (approximately 15%) are reading these modules. This may be attributed to the wide variety of modules which Science students are allowed to choose from, noting that the communication modules are not compulsory. While planning their time table during module registration phase, students may also face clashes between these modules and their core modules, forcing them to choose among the two.

Considering the importance of competency in terms of communication skills, there is a strong impetus to develop a compulsory communication module for all Science freshmen. To address this need, the FoS and CELC co-developed a new module, *ES1541 Exploring Science Communication through Popular Science* in 2013. The module is offered to all Science freshmen from Semester 1 of Academic Year 2013/14 and is a graduation requirement for all FoS students (except Pharmacy and BES students, as well as University Town residential college students who have read or will be reading Ideas and Exposition Modules or Writing and Critical Thinking modules which serve similar purposes as *ES1541*). The four key learning outcomes of *ES1541* are shown below.

1. To develop a habit of reading, especially in science-related topics.

2. To enhance the ability to critically question published scientific information.

3. To enhance the ability to articulate opinions and perspectives.

4. To develop a student's coherence in writing and oral communication.

Important communication skills for science undergraduates include the ability to read and comprehend science-related publications critically, and express and argue for their opinions in writing as well as in oral communication. *ES1541* aims to develop such abilities of science undergraduates through reading, classroom discussion, summary writing, essay writing and oral presentation activities. This module is a 48-hour course taught over 12 weeks with 2 two-hour sectional teachings per week. Students are graded based on 100% continuous assessment with components briefly described below.

1. Summary writing (20%) – a weekly assignment where each student summarizes a chapter from one of the five popular science publications.

2. Essay writing (30%) – a more in-depth response to one major theme of the book or an academic book review.

3. Peer review reports (10%) – peer reviewing essay assignments of other students.

4. Oral presentation (10%) – oral presentation of the essay writing assignment.

5. Reflective letter writing (5%) – a reflective letter explaining how the module and the assignments have (or have not) helped in developing the student as a reader, writer and communicator.

6. Class discussion, presentation, and participation (25%) – a weekly activity in which students discuss and present an assigned book chapter and other related articles.

RESEARCH OBJECTIVES

With an estimated enrolment of 1000 every academic year, the potential impact of this new module on our students is significant. The objective of our preliminary study is therefore to evaluate the effectiveness of the new module with regards to its learning outcomes. In addition, we also aim to elucidate if differential learning responses exist among students who acquired different pre-university learning experiences. These learning experiences may refer to, but are not limited to, students who achieve different grades in the GCE A-Level General Paper examination, students who opt to read different majors in FoS (e.g. Mathematics versus Biology) or students who are from different Junior Colleges or High Schools. Through evaluating the effectiveness of the module and understanding how background factors may affect the learning outcomes, the findings gleaned from our preliminary study may be leveraged to optimize the pedagogical methodologies so as to further improve the learning experience of our undergraduates and subsequently, their competency in communication.

METHODOLOGY

To evaluate the effectiveness of the new communication module with regards to its learning outcomes, we conduct a series of systematic surveys categorized temporally during the pre-course and post-course periods.

A pre-course survey is conducted during the first week of the module. The survey focuses on capturing the background of each student with respect to his or her reading, writing and communication skills and habits. Students are asked many questions related to scientific communication, including how they feel towards formal writing, how they rate their writing and oral communication skills, and how confident they are towards

writing. This set of survey responses is used to generate a profile of Science freshmen in terms of reading, writing and communication behaviours as well as to form the baseline for a valid assessment of learning outcomes at the end of the semester.

In Week 13, students respond to a post-course survey. This survey asks students to rate the different learning outcomes and content of the module. For instance, students are asked to rate the extent of improvement in terms of their writing ability and oral communication skills after reading the module. The questions of the post-course survey are designed such that answers from pre- and post-course surveys can be matched to draw meaningful conclusions on the learning outcomes. For example, in both pre- and post-course surveys, students are asked to rate how confident they are towards formal writing. By combining individual student's pre- and post-course responses, we can evaluate the efficacy of the module with regards to the extent of improvement in terms of our students' confidence towards writing and communication.

Both the pre- and post-course surveys are administered through the Integrated Virtual Learning Environment (IVLE) on the pretext of gathering feedback on the module. Students' responses are matched using their student matriculation number. To ensure a high response rate, a small weightage of grade is allocated to the completion of each survey.

In order to examine the link between students' background and learning outcomes of the module, administrative data on their educational and demographic background is extracted for analysis. Further relevant details such as dominant language spoken at home and with friends are collected as part of the survey questions.

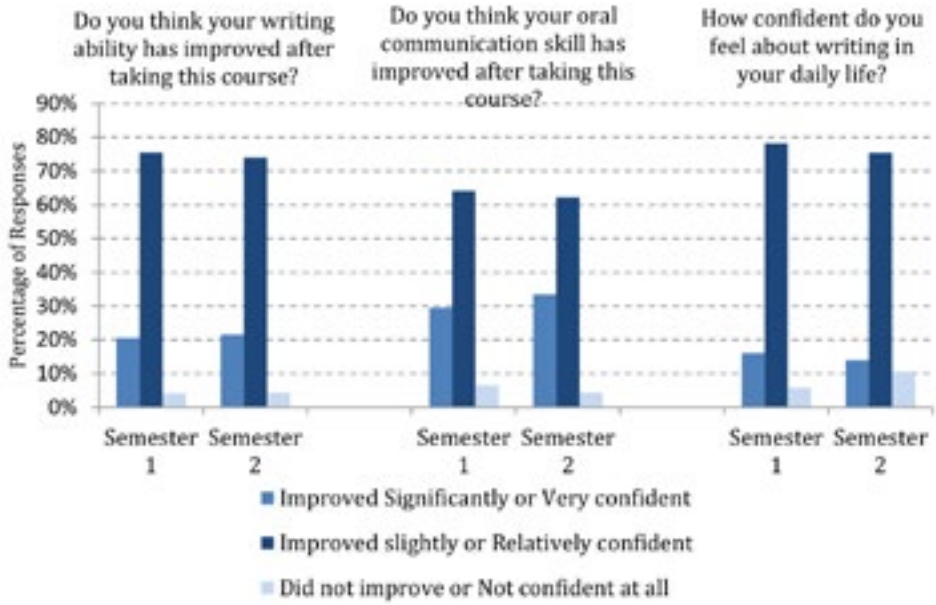
As part of the module assessment, students are required to write a reflective letter explaining how the module and the assignments have helped them develop as a reader, writer and communicator, discussing their strengths and weaknesses and some challenges faced in completing the assignments. These letters are compiled and processed using the software, *IBM SPSS Text Analytics for Surveys 4*, to group specific feelings associated to subjects such as the module itself, the individual books and the respective class assessments.

PRELIMINARY RESULTS

In the Academic Year 2013/2014, *ES1541* was subscribed by 757 Science freshmen (427 and 330 in Semester 1 and 2 respectively). Response rates for pre-course survey are more than 99% in both semesters while those for the post-course survey are 94% and 98% in Semester 1 and 2 respectively. For the reflective letter, the figures are 90% and 93% respectively. Here, we present some preliminary results based on the pre- and post-course surveys for the two semesters and the qualitative analysis of the reflective letters.

In the post-course survey, students were asked the question "Do you think your writing ability/oral communication skill has improved after taking this module?" and they can choose to answer "Yes, it has improved significantly", "Yes, it has improved slightly" and "No, it has not improved at all". The first two sets of bar graphs in Figure 1 shows the students' responses to these two questions across the two semesters. Overall, 21% of students feel that their writing ability has improved significantly while 75% of students feel that their writing ability has improved slightly. Only 4% indicated that their writing ability has not improved at all. For oral communication skills, the percentages are 31%, 63% and 6% respectively. Distribution of responses is highly similar across the two semesters.

Figure 1. Response to Selected Questions in Post-Course Survey

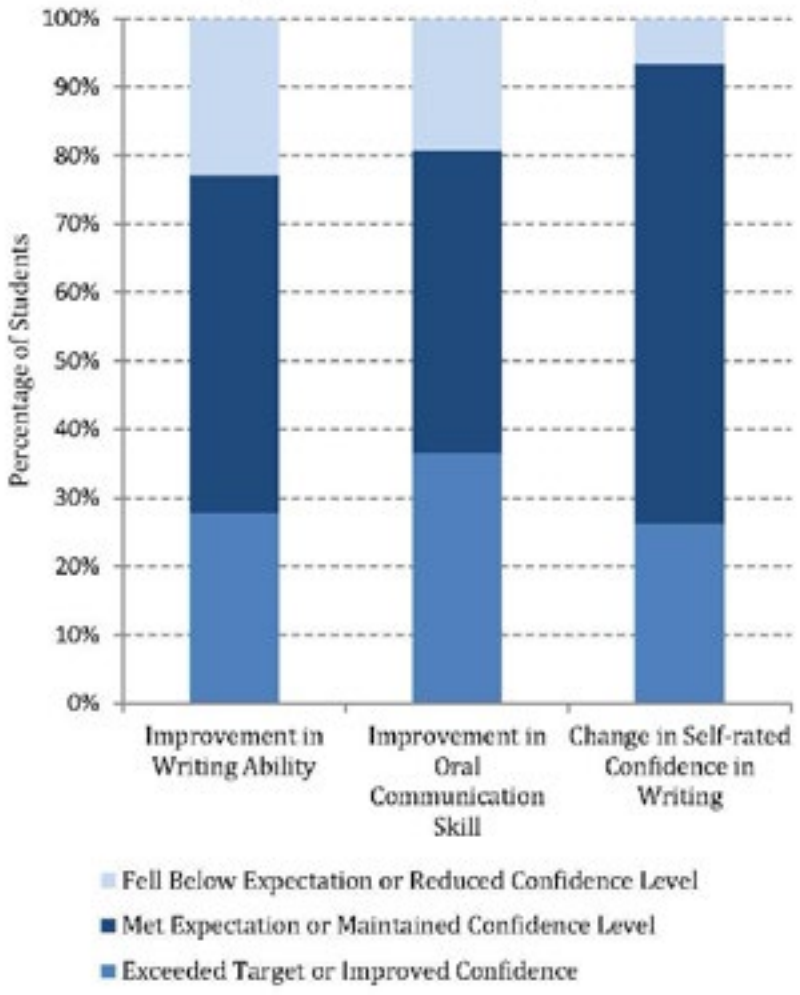


As highlighted before, students' post-course responses can be mapped against the relevant pre-course baseline responses to render the post-course evaluation more meaningful. In Week 1, the students were asked to rate their writing ability and oral communication skills. The students could choose to indicate their level as "Needs significant improvement", "Needs some improvement", "Needs a little improvement" or "Needs no improvement". Due to extremely low responses to the choice "Needs no improvement", the responses to "Needs no improvement" are combined with "Needs a little improvement" for the collective analysis.

With students' baseline self-rated writing ability and oral communication skills, we can match the students' self-rated improvement to their self-perceived need for improvement. "Yes it has improved significantly" is matched to "Needs significant improvement", "Yes it has improved slightly" is matched to "Needs some improvement" and "No it has not improved at all" is matched to "Needs a little/no improvement". Based on this mapping, we constructed a new outcome where we categorize the students into

exceeding target (where students' perceived improvement in skill is more than what they felt they needed), on target (where students' perceived improvement in skill is comparable to the level they felt they needed) and below target (where students failed to improve as much as they felt they needed). With this new construction, it was found that 28% of students exceeded their target in improving writing ability and 49% of students were on target. The majority of the students who failed to reach their targets are students who felt that they needed significant improvement but only improved slightly after the module. In terms of oral communication skills, 37% of students exceeded their target and 44% were able to achieve their target. There is no major difference in distribution of responses across the two semesters. Figure 2 shows the pooled results for both Semester 1 and 2 of Academic Year 2013/14.

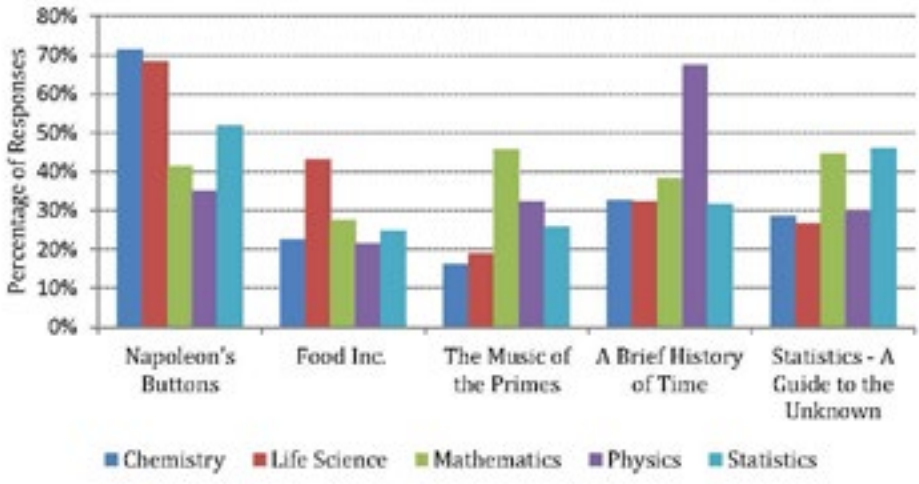
Figure 2. Matching students' self-rated improvement to their self-perceived need for improvement



In both pre- and post-course surveys, students were asked to rate how confident they feel about writing in daily life with three choices: "very confident", "relatively confident" and "not confident at all" (see last set of bar graph in Figure 1). Overall, from pre- to post-course surveys, there is 148% increase in the number of students feeling very confident about writing (an increase from 44 to 109 students) while the percentage of students feeling not confident at all fell by 58% (a decrease from 136 to 57 students). Matching individual student's self-rated confidence pre- and post-course, we find that 26% of students improved in self-rated confidence towards writing while 67% of students maintain their self-rated confidence (Figure 2).

In the post-course survey, students were also asked which compulsory popular science books they enjoyed and would want to continue reading beyond the selected chapters discussed within the module (Figure 3). As a recap, the five books were chosen to correspond to the five major disciplines. We observe a distinct pattern in the preference

Figure 3. Percentage of students who indicated that they enjoyed the book and would continue to read beyond selected chapters by department



of popular science readings among Science freshmen. The type of book that the students responded most positively to correlates with the academic discipline of the popular science text. For example, Physics students tend to prefer the Physics book (A Brief History of Time) whereas Mathematics students tend to prefer the Mathematics book (The Music of the Primes). We also find that some of these preferences extend across majors but the inter-major preference extension may not be reciprocated. In particular, we note that Life Science students seem to enjoy the Chemistry book (Napoleon's Buttons), with the overall preference level of the book coming close to that of Chemistry students. However, this was not reciprocated by Chemistry students as we observe a low overall preference level among Chemistry students for the Life Science book (Food Inc.). Similar to that of Life Science and Chemistry students, we note a parallel pattern

among Mathematics and Statistics students with regards to their respective books. At this point, we have to acknowledge that although the books are chosen based on the different disciplines, it is difficult to normalize their levels of difficulty. Thus, one has to keep in mind that certain books may be easier to read and comprehend even if its discipline does not match that of the student.

Using the text analytics software, we are able to pick up students' feelings associated to *ES1541*. We conditioned the software to filter feelings associated with the module itself, instead of any general feeling for a specific class assessment, and found that 82% (563 of 690) of the respondents have a pleasant feeling towards *ES1541* in general.

DISCUSSION AND FUTURE WORK

Our preliminary results suggest that the module has been effective in improving the competency in communication among our freshmen. Our preliminary data appears to suggest that students tend to prefer materials that relate to their academic interest. The current data will be further analysed as we attempt to examine whether there exist differential learning outcomes among different groups of students. As mentioned earlier in our research objectives, we would like to consider the following research questions:

1. Do differential learning outcomes exist among students from different majors?

2. Do differential learning outcomes exist among students with different level of English proficiency from pre-university preparation?

As part of the research, we shall also reach out to students who have completed the module after one year to examine its longer term impacts on the learning of other subjects. Such longitudinal study is pertinent to appreciate the underlying contribution of a faculty-wide communication module.

In conclusion, our preliminary findings are positive and reaffirm the importance of a compulsory communication module for the Science undergraduates.

Acknowledgement

This research is supported by the Centre for Development of Teaching and Learning - Teaching Enhancement Grant (CDTL-TEG) provided to Eric Chun Yong Chan. The recruitment of two student research associates, Sanqian Zhang and Maurice Yuan Zhang Chng, is kindly funded by the TEG. The authors would like to thank all the CELC tutors who contributed significantly to the excellent teaching of the module.

REFERENCES

Glynn S.M., & Muth K.D. (1994). Reading and writing to learn science: Achieving scientific literacy. *Journal of Research in Science Teaching.* 1994;31(9):1057-73.

Harvard Faculty of Arts and Sciences. (n.d). *Harvard College Writing Program* [webpage]. Retrieved May 18, 2014, from http://writingprogram.fas.harvard.edu.

Tan E.C. (2011, October 18). *The NUS Provost Contemplates: Writing and Communications* [Blogpost]. Retrieved May 18, 2014 from http://blog.nus.edu.sg/provost/2011/10/18/writing-and-communications.

Yale College Writing Centre. (2014). *Writing at Yale* [webpage]. Retrieved May 18, 2014 from http://writing.yalecollege.yale.edu/writing-yale.