Promoting Good Scientific Communication Habits by Leveraging the Community of Practice within a Single Research Group

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Notes

Note the first three authors contributed equally to this manuscript. Also note that this study received ethics approval from the ethics board of our institution to gather data from our participants from voluntary, anonymous, online surveys. We would also like to acknowledge Jacques De Guise, lab director of LIO, for his unhesitating support of this program within his lab.

Abstract

Large university research groups are communities of practice within which graduate students are expected to learn and research new ideas, but also write and publish scientific articles on these ideas. Lab members have varied experiences, and have mastered different skills related to scientific communication, thus mentoring among lab members is often seen as a good system to transfer knowledge on scientific communication. However, a lack of organization and an uneven distribution of interactions typically limit this transfer of knowledge to students. We aimed to leverage the framework of an existing community of practice within a lab to formalize activities targeted at promoting group active learning related specifically to scientific communication.

Beginning in the spring of 2017, we integrated various activities aimed at helping students with scientific writing and publishing, into a research group consisting of more than 10 professors and over 30 graduate students and research staff. These activities included communal Writing sessions, Peer support writing groups, and Journal clubs among others. Even with voluntary participation, many lab members participated in the activities, with large group activities attracting on average about 35% of the students in the lab. We also discovered that many of them were willing to get involved in the organization and creation of activities. Anonymous surveys indicated respondents found the activities were a good use of their time and addressed a need in their lab. These findings indicate that support for scientific writing and publishing can be provided in a regular and organized way within research groups using a model based on mutual help and peer assistance. University services that already offer support for scientific writing and communication can integrate their existing activities within the community of practice of a research group by involving lab members and working on a basis that involves knowledge exchange.

1 Introduction

1.1 Overview

Graduate students are expected to learn and research new ideas, as well as participate in the larger scientific community by writing and publishing scientific articles using scientific communication and critical thinking skills. These skills have been shown to be better acquired in a learning community environment as compared to formal teaching [1]. A research lab can be considered as a community of practice (a type of learning community) for general research skills, as Wenger defines one to contain the following: Mutual engagement, Joint enterprise, and Shared Repertoire [2], [3]. Lab members are engaged in a common practical research activity (Mutual engagement) to gain knowledge of and make a contribution within the domain (Joint enterprise) while sharing resources such as lab equipment, software, etc., but also domain knowledge and experience (Shared repertoire). However, a lab might not have a structured environment in place for the transfer of scientific communication skills per se. We aimed at formalizing good active learning habits for scientific communication using the existing community of practice in an engineering research lab. In this paper, we present the implementation of activities aimed at developing the scientific communication skills of members in a laboratory with close industrial ties.

1.2 The Need for Scientific Communication Skills

Expertise in scientific communication constitutes one of the most highly regarded skills by both the private sector and academia [4], [5]. Graduate engineering students consider good communication skills to be very important for succeeding in the industrial sector, even more so than business management principles [6]. Nonetheless, many studies focusing both on the private sector [7] as well as academia [8] show that students coming out of engineering schools lack these skills. Many engineering faculty members do not consider the teaching of communication skills to undergraduates as part of their duties, and many others simply do not have the time, expertise, or interest to do so [9]. As mentioned above, a community of practice is ideal for teaching communication skills, and labs already act as such learning communities for other research skill-sets. First, we can look at the existing mentoring and knowledge transfer systems for scientific communication already in place in research laboratories.

1.3 Lab practices for mentoring in scientific communication

Beyond the lab supervisor, mentoring and feedback may come from other members of a lab. These members have varied backgrounds, experiences, and skill-sets with regard to scientific communication. Mentoring and interactions among lab members, although often encouraged, can be disorganized, unevenly distributed among members, and compartmentalized. This compartmentalization limits the knowledge transfer among labmates; skills and experience might not be shared with those who most need to acquire them. For example, international or English as a second language (ESL) students tend to have more challenges when it comes to writing a scientific article, and they might need additional support [10], [11]. The lack of a structured method for knowledge transfer among lab members on scientific communication skills, despite

the existence of a community of practice for other skill-sets, motivated us to promote activities that filled this gap.

2 Project objectives

2.1 Our campus-wide learning community program

Our project takes place at École de technologie supérieure, a cooperative engineering school located in Montreal, which mainly comprises French-speaking students and offers most of its programs in this language. This school also has strong industrial ties, with the majority of its graduate students working on practical projects in collaboration with industrial partners. We have previously implemented a campus-wide active learning environment for scientific writing, publishing, peer-review, and other scientific communication skills, within our engineering school. The particulars are presented in another article at this conference [12], but briefly, many of these voluntary activities are focused on bringing students together so they can work in groups, give feedback, and learn from one another. This initiative is based on learning communities and communities of practice (as mentioned earlier) which have many educational benefits, including getting students actively engaged in their learning [1]–[3], [13], [14].

2.2 Integrating our program in a lab

In the spring of 2017, our team explored the possibility of offering some of these activities on-site, in research labs, with the aim of creating a scientific communication community of practice (SC-CoP). Our interest for integrating these activities into research labs came about for many reasons. First, scheduling for activities would be easier since most students follow the same deadlines related to their research (conference submissions, industrial project deliverables, etc.) and generally have the same time slots available. As a result, facilitating access to these kinds of activities within a research group would prompt students to participate in the SC-CoP more consistently, would encourage them to get involved in its organization, and would allow them to learn by completing relevant practical work while also working with peers who share similar research goals. To test the feasibility and the impact of creating such a program, we began a pilot project in one research lab.

3 Implementation of the program

3.1 Description of the Selected Lab

In the spring of 2017, we approached a large research group at our school, the Imaging and Orthopaedics Research Laboratory [15]. It is composed of 12 professors, 11 part-time or full-time research assistants, 12 postdoctoral fellows, 20 Ph.D. candidates and 53 Masters students spread across three different worksites. We focused specifically on one of their off-campus work

sites, which is located inside a multidisciplinary hospital research center, hosting the largest of their three research subgroups. Researchers and students affiliated with this specific branch (approximately 30) are encouraged to work with clinicians and industrial partners in the scope of their research projects. Thus, the laboratory had already developed a well-run organizational structure, and a strong collaborative culture. Dedicated research assistants help students who might have to deal with quality assurance, ethics, or data management aspects during their research projects. However, no service or organization existed to assist students in their scientific writing duties, which occupy a great deal of the students' daily tasks. According to the lab's director, good writing habits or lack thereof might explain a student's ability to successfully complete their degree. Hence, the absence of such a service was already identified as one of the weaknesses of the laboratory's organization, and the supervisors readily demonstrated a willingness to integrate activities that might promote good writing habits. As is typical for research labs at our school, most members of this research lab are non-native English speakers.

We surveyed students on their career objectives, allowing them to pick more than one choice, with the aim of understanding their needs and goals in relation to scientific communication. Table 1 presents the answers to this question.

Career Objectives	Nbr of responses
Industry (non-research)	10
Teaching (professor, course lecturer, etc.)	3
Research in academia (professor, postdoc, research support, etc.)	6
Research in industry	10

Table 1. Career objectives of respondents (n=14).
More than one choice allowed per respondent.

Most responding lab members aspire to work in industry either in research or non-research positions, while few aim at becoming professors. This inclination may be a reflection of the strong collaboration and co-op environment present in both our school and in this lab, which works closely with industrial partners on research problems with concrete applications.

3.2 Setting up the SC-CoP

This pilot project was our first collaboration with an entire research group, and we decided to use an organic management style for its execution: we did not impose a hard schedule but rather collaborated with the lab members to find a balanced means of supporting students without overloading them with too many activities. Their feedback and input were regularly used to adjust our offer to better fit their needs as the project evolved. This approach was judged more appropriate for our goal of leveraging a community of practice that engaged students.

The lab director selected a Master's student (who is also a co-author of this article, and to whom we will refer to as lab ambassador) to be responsible for the activities inside the lab and to work with our team. The role of this student was key to the success of this project in that he helped plan the schedule, developed activities with us, gathered feedback, and kept both our team and the lab members in touch. Because of this particular student's interest and leadership, he ended up taking a larger role than originally expected and was integral in developing a structured method for implementing SC-CoPs that can be more easily replicated in other labs.

Our first step was to draft an activity schedule that reflected students' and lab members' actual needs. We created a short survey which consisted of 12 questions asking participants to indicate on a Likert scale the level to which tasks related to scientific communication pose a problem to them (e.g. writing in English, getting feedback, writing efficiently, reviewing texts, etc.). This first survey, completed by 12 lab members out of approximately 30, showed that respondents had difficulties with writing efficiently (meeting writing goals, avoiding distractions, etc.), getting feedback on their writing, adopting an appropriate English style in their text, having the opportunity to review others' work, and keeping up with their readings. The activities we implemented were developed with both these results and a project-based learning strategy in mind. This strategy focused on making progress on student research projects by using peer-review and paper writing sessions to teach graduate students essential communication skills, while reducing their individual workload [16]. Our approach also aimed at breaking the isolation that lab members might face while performing such tasks. The schedule implemented consisted of the multiple activities presented below.

3.2.1 SC-CoP Activity: Workshops

30-minute workshops were set up weekly. They consisted of short presentations on various scientific writing and publishing related topics (e.g. topics on oral presentations, writing concisely, bibliometric indicators, etc.) that were prepared and given by either the facilitator or by external invited speakers who had expertise in the topic (e.g. bibliometric indicators were presented by an expert from the library). Often, students came up with workshop topic suggestions which helped us customize our offer.

3.2.2 SC-CoP Activity: Writing blitzes

A two and a half hour writing blitz was set up weekly. This activity invited lab members to set concrete and realistic goals on their current writing tasks that could be completed during the activity (e.g., write five points related to a weekly quality report). We then used the Pomodoro technique [17] to structure the activity into multiple 25-minute blocks during which participants focused on their writing, while eliminating common distractions (e.g., cell phones, Internet browsing). Students often used the breaks in between to discuss their projects with each other. In the first week, 15 participants attended the blitz and many of them requested that we increase the duration to a three-hour rather than a two-hour activity. The writing blitz is simple to set up and can help lessen the "back loaded" problem which Craig [10] defines as a delay before writing about a research project as it progresses, creating a lot of pressure on the writing process. Since this activity incites students to integrate their writing tasks into their routine, it accustoms them to the idea of tackling the writing process from the very start of their project.

3.2.3 SC-CoP Activity: Journal Clubs

At the beginning of fall 2017, we developed a new Journal Club activity to help students keep up to date with their scientific readings and methodically analyze scientific articles. These two-hour long meetings took place once a month, bringing lab members together to dissect scientific articles with the help of a scientific communication expert. The activity avoided long presentations and rather focused on analysing scientific papers that were relevant to the lab's research projects. Prior to the activity, participants had to read one or two scientific articles. During the activity, they discussed and compared articles using different analysis tools such as templates, analytical grids, etc.

3.2.4 SC-CoP Activity: Writing support groups

The Writing Support Group involved a small group of students and lab personnel meeting on a regular basis and exchanging their written work with each other for feedback, under the guidance of a facilitator. The usefulness of such peer-review groups in improving writing skills through mentoring and the sharing of experiential knowledge is fairly well documented [6], [11], [18]–[20]. The writing samples that were reviewed by peers in these groups were always tied in some way (directly or indirectly) to the professional research work of participants. For example, group members gave advice and feedback on scientific articles, applications for fellowships, rebuttal letters in response to reviewer comments on scientific article submissions, etc.

3.3 Current schedule

As of April 2018, workshops are being held once a month on various topics. Writing blitzes of three hours are still held weekly and are now entirely led by lab members. Participation varies

from week to week, depending on students' respective schedules and deadlines. For most sessions, 5-8 people will show up for the activity. Journal Clubs are usually held once a month and students continue to come up with different themes for the articles to read. The Writing Support Groups are held on an *ad hoc*, by need basis (e.g. often before a particular submission deadline). At the time of writing, these activities have been taking place regularly for the past 11 months. Most impressively, they are now being planned, organized, and led by the student ambassador and other lab members. Our team still conducts workshops, but the other activities are run by the students. These observations show that implementing a SC-CoP in a lab context can be self-sustaining.

4 Outcomes

In this section, we analyze the outcomes of our projects on students' writing habits, while focusing on the potential benefits that became manifest from this experience. We created a second voluntary survey to monitor any change in the difficulties students encounter that are related to scientific communication. This survey repeated questions from the first survey that we conducted (see section 3.2 Setting up the SC-CoP), but also added questions about the lab members' perception of our activities. Reusing the questions from the first survey allowed us to compare some of the results and get a general idea about the lab members' impressions on the same communication tasks before and after the project began.

The results showed some differences in lab members' perceptions of difficulties related to scientific communication and allowed us to get a feel for the changing needs of the lab (See appendix 1). In general, tasks that were ranked less difficult in the second survey were related to the existence of an active SC-CoP where lab members help each other (getting feedback, pinpointing elements to improve written work, opportunity to review scientific articles).

Notably, the survey asked questions on the perceived usefulness of the activities (on a Likert scale from 1 to 5, where 1 represents strongly disagree and 5 represents strongly agree).

	How many times have you participated in our activities within the framework of your lab?			
	1	2-5	5+	Overall average
1 - In general, participating in our activities is a good use of your time.	3.50	4.67	4.86	4.58
2 - Our activities address a need in your lab.	4.00	4.33	4.57	4.42

3 - You learned new scientific communication practices by participating in our activities.	3.00	3.67	3.86	3.67
4 - Support and feedback from your colleagues during our activities are useful in helping you better write, revise, and present.	2.50	3.67	3.71	3.50
5 - Our activities let you get to better know your colleagues and/or to break a sense of isolation.	3.00	2.67	3.86	3.42

Table 2. Average perception of the activities by lab members as measured by the agreement to some statements on a scale of 1 to 5, where 1 represents strongly disagree and 5 represents strongly agree (n = 12).

The results indicate that most participants agreed with the statements. When looking at the trend from left to right, the more they participated, the more they found the activities useful. They particularly agreed with two points: (1) participating in activities was a good use of their time and (2) activities addressed a need in the lab. Aspects perceived to be weaker, but still positive (marked higher than neutral), are related to (5) getting to better know one's colleagues and to (4) getting feedback from colleagues. The lower scores (last two rows in Table 2) could mean that this lab already had a strong culture of collaboration and that there was very little isolation to begin with, and that participants rely more heavily on the feedback given by our staff than that from their colleagues.

The last question of the survey asked students, "What prompted you to participate in our activities?". A few elements are repeated in the comments (see appendix 2) : (1) the group dynamic for activities motivates students to write, (2) the activities give a structure to their tasks, (3) they feel a sense of collaboration. These themes relate to the goals of the project which were to structure interactions and knowledge transfer about scientific communication among students in a laboratory setting by creating a community of practice that formalizes good active learning habits.

5 Conclusion

This project aimed at integrating scientific communication activities within an existing community of practice (SC-CoP) in the context of a research lab. After 11 months, activities are still held weekly and are now organized mostly by graduate students from the lab, with little input from our staff. Results from our surveys suggest that students appreciate these activities and find that the activities address the needs they have related to scientific communication.

These findings demonstrate that formalizing knowledge transfer in an experiential environment using a community of practice is possible by integrating regular, structured activities.

This project is still ongoing and will continue to evolve with the feedback and initiative of lab members. We plan to increase the frequency of as well as better structure some activities such as the Writing support groups, as a way to engender habits related to giving and receiving feedback on each other's work.

There are certain limitations to the extrapolation and replication of this structure in other research labs. First of all, the lab in which we implemented these activities already enjoyed a strong research and collaboration culture, along with good, structured working habits. Secondly, we were very lucky in the selection of the lab ambassador for the activities and realize that choosing an ambassador with less motivation and leadership could make it more difficult to both organize the same activities and also to get feedback from participants.

These limitations are not unsurmountable. At the moment of writing this article, the SC-CoP model is already being implemented in a second lab, also with strong industrial collaborations in place. To make sure the project runs smoothly, we have established some requirements on the lab such as the selection of a motivated ambassador. It remains to be seen whether this second lab has a culture similar to the first one. In any case, the gains that can be achieved by implementing a successful SC-CoP in a lab with a weak research and collaboration culture, unlike the case presented here, are far greater.

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7 Appendix 1

The table below presents the difficulties related to scientific communication that changed the most between the beginning and the end of the project. The level of perceived difficulty associated with a task is represented on a Likert scale of 1 to 5, where 1 is considered as a very easy task and 5 is considered as a very hard task.

Difficulty	Beginning (June 2017)	Current (January 2018)
Writing efficiently: getting started in writing a scientific text, meeting writing goals, avoiding distractions, etc.	3.17	3.38
Managing time: meeting deadlines, writing regularly, etc.	2.83	3.15
Getting feedback: getting tips and comments from colleagues to help better your scientific text, receiving timely feedback (i.e. quickly and when you need it), etc.	3.50	3.08
Communicating ideas clearly: writing texts with a clear narrative that is easily understood by the target readers, etc.	2.83	2.69
Writing in English	3.25	3.38
Pinpointing the elements to improve in a text: reviewing a colleague's writing, giving pertinent comments and suggestions, etc.	2.75	2.54
Having the opportunity to review scientific writing: having the chance to read the texts of colleagues in order to comment and practice reviewing scientific writing	3.42	2.92
Being up to date on important scientific readings in one's research domain.	3.42	3.85
Giving clear oral presentations to communicate scientific research	2.75	2.85
Getting feedback on oral presentations: giving practice talks in front of colleagues and getting feedback and tips to improve the presentation	2.75	3.23
Discussing all the problems mentioned above in this poll with colleagues: ease in talking about problems related to scientific writing, opportunity to discuss these problems, etc.	3.00	2.92

Table 2. Difficulty of tasks related to scientific communication as perceived by participants on a scale from 1 to 5 where 1 represents not a problem and 5 represents a big problem.

8 Appendix 2

Below is a list of comments left by students when asked, “What prompted you to participate in our activities?” at the end of the second voluntary survey:

“the fact that you came presented your service directly in the lab”

“learn the knowledge of scientific writing because English is not my mother tongue”

“The collaborative model helps me structure my writing periods.” [Free translation from French]

“By curiosity at first. Then, the collective motivation these activities create. I am more productive in those moments and I feel less alone in this type of activity.” [Free translation from French]

“Having a new and structured writing environment. The fact that the facilitators are pleasant.” [Free translation from French]

“The motivation of the group to focus on a reading or writing”

The possibility of working in a structured manner and to benefit from the group dynamic. The professionalism, enthusiasm and sympathy of the facilitators (Staff and ambassador named)” [Free translation from French]

“It motivates/forces me to write.” [Free translation from French]