

Developing a contextualized and scaffolded pedagogy for the writing of scientific abstracts in English: Abstract Package and Conceptual Template

Hana Gustafsson¹, Allyson Hoffman, Kari May Fischer

Abstract

In this paper we aim to contribute to pedagogical practice in the teaching of scientific abstract writing in English. We present a tailored pedagogy we have developed for our local scientific communication courses which have a diverse student profile in terms of research disciplines, research stages, and writing challenges. To meet our students' needs, we have built our pedagogy around four pillars: awareness of the genre based on the course textbook, a flexible schematic map for the top-down planning of the abstract (Conceptual Template), a combined abstract-related genre based on real-life submission scenarios (Abstract Package), and a scaffolded writing path which includes instruction, writing practice, formative feedback, and writing milestones. Thus far, we have successfully implemented our pedagogy with master's students and partially also with doctoral students. We hope that our approach is transferable to other contexts and can be widely adopted both by teachers of scientific communication and by researchers.

1. Introduction

As the scientific research community is using English for most of its publishing outputs, 98% of all scientific publications are in that language, including in countries where English is spoken as a foreign language (Ramírez-Castañeda, 2020; Gordin, 2015). With scientific publications increasingly written in the English language, it is crucial that novice researchers and students working towards a research degree are provided with opportunities to obtain the relevant knowledge of publishing conventions, as well as skills within scientific writing, so that they can flourish in professional research spaces.

At the Norwegian University of Science and Technology (NTNU) in Norway, final-year students working on their project-based master's theses can elect to take our semester-length course in scientific communication². Most students in the course come from engineering disciplines³, with the *5-Year Integrated Master in Electronic System Design*, and the *5-Year Integrated Master in Product Development and Production* as the most represented study programs. In addition, the course also attracts a variety of students from the faculties of Science, Natural Science, Architecture and Design, and Economics, among others. Given that five-year integrated master's degrees are a typical academic pathway in Norwegian higher education, these

¹ corresponding author; hana.gustafsson@ntnu.no

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<https://www.ntnu.edu/studies/courses/SPR%C3%85K3501#tab=omEmnet>

³ Of the 154 students total in our Fall 2021 course, 112 (73%) came from either the Faculty of Information Technology and Electrical Engineering, or from the Faculty of Engineering.

students will likely have written a bachelor's thesis before entering the master's writing process. Despite this previous writing experience, many students are not well-versed in the writing conventions required for a research-based master's thesis. Besides, while some of our students receive writing guidelines from their home departments and project supervisors, the depth and breadth of the guidelines varies. For example, some supervisors provide detailed report or thesis templates for students to fill in with their own content; others refer students to the generic IMRaD structure of scientific research papers. However, most students in our Fall 2021 class did not receive any writing guidelines: only 23 of our 154 students at the beginning of the semester informed us they had been provided with some writing guidelines from their departments or supervisors. Together, these characteristics make for a diverse student body, not only in disciplinary profiles (see Course Profile in Appendix) but also in research stages, knowledge levels, and writing challenges.

To cater for the needs of this varied student community in our scientific communication course, we are continuously working to develop a tailored pedagogy. Given the breadth of disciplines represented in the course, we aim to provide students with principles of scientific research writing that are transferable across disciplinary writing conventions and can be easily adapted to different research writing requirements. We also provide opportunities for structured and guided practice, which is reflected in the course design. For the main course topics, we first offer class assignments as the first stage of the students' writing development path. Although non-obligatory, most students do complete these class assignments as a way of identifying and clarifying their ideas. Students then transfer this foundational work to the related obligatory assignments. For each assignment students receive personalized feedback tailored to their current writing needs. The nature and amount of our feedback is guided by the dynamic model of the writing process formulated by Sarah Haas (Ferrareto and Gustafsson, 2021, pp. 13-14; Haas, 2009) based on student focus groups. Finally, students use one of the obligatory assignments, the Abstract Package, as a basis for the final exam. The abstract Package is one of the key components in our contextualized and scaffolded pedagogy for the writing of abstracts.

We have selected the scientific abstract genre as one of the focal topics of our course, for several reasons. In the short term, the abstract will likely be one of the most read pieces of the student's project report, as it is filed together with the master's thesis in the university database (NTNU Open) and can be viewed by anyone using the database. Later, when our students complete their master's degree, they will be likely required to submit an abstract at least once during their research- or professional career. Moreover, abstracts are a high-stakes gateway to both disseminating and consuming research-generated information. The structure, formulation, and language of an abstract can determine whether a paper is accepted to a conference or a journal, and how much attention it receives online (Jin et al., 2021). It is therefore crucial that our students recognize the importance of the abstract and have the knowledge and skills to produce quality abstracts themselves.

In this paper we aim to contribute to pedagogical practice by sharing our tailored pedagogy, our insights into the teaching context which gave rise to it, and the choices we have made as instructors on an established course in scientific communication. While we do mention the key references that have guided our choices, it is not our aim to provide an overview of existing pedagogical approaches to abstract writing. We first discuss some of the challenges our students face, and how we perceive their needs with regard to abstract writing. Then, we present the details of our pedagogy, discuss its strengths and weaknesses, and propose ways of moving forward.

2. Writing an abstract: our students' challenges

With regard to abstract writing, our students face several challenges related not only to the writing of the abstract text itself but also to their understanding of the research process and their role as researchers. As a rule, most of our students struggle to identify the starting point: How does one start on the writing of an abstract? When in the research process is it suitable to write an abstract? Our students primarily understand the abstract as a summary of work that is finished and complete, whether it is a project report (a final document) or the project itself (including results and conclusions). As a result, they tend to be puzzled about the practice of abstract writing when the content is not all in place; for example, when they do not yet have project results or a final version of their project report. They also find it difficult to know what information to include or exclude, given the limited space of the abstract on the one hand and the amount of information in their project reports on the other. Finally, even if the individual elements are well formulated, students often struggle to link them together into the coherent narrative of the scientific abstract, as a logically organized and informative text that accurately represents their research.

Most crucially, we have noticed that many of our students do not clearly formulate and highlight the contribution of their project to the research field and may not even be aware that they are making an important contribution. This problem can manifest in the abstract text in one or more ways. For example, the principal research activity of a student's project may be stated briefly towards the end of the abstract, or it may not be explicitly stated and must be inferred from the individual information elements in the abstract, or it blends with the background information. Here, the use of the passive voice throughout the whole abstract contributes to this confusion; that is, the reader has difficulty seeing what research has been done so far, and what the student did as part of the project. This observation leads us to believe that, in addition to scaffolded writing practice, our students may also need a thinking-writing tool that facilitates both deep insight and clear formulation of what they have done as part of their projects, as well as what it means for the research field.

To address these needs, we provide our students with a schematic map for abstract planning and writing, abstract-related genres based on real-life submission scenarios, and a safe space to practice the writing of abstracts. Similar to practice in other genres of writing, such as the persuasive essay and the critical analysis, our scaffolded approach both lowers the stakes and demystifies the writing task. It allows students to get comfortable with the genre conventions, make mistakes, and revise with instructor feedback. The following section describes our pedagogy in detail.

3. Addressing our students' challenges: developing a suitable pedagogy

3.1 Our starting point: the course textbook

In the context of our scientific communication course, the natural starting point for the teaching of the scientific abstract was our course textbook *Writing Scientific Research Articles* by Margaret Cargill and Patrick O'Connor (Cargill & O'Connor, 2013). This textbook is foundational for writing-related topics in our scientific communication course as it provides clear instruction on the AIMRaD structure of scientific papers, the function of each section, and writing strategies at global and local organization of the scientific paper. The authors also dedicate a short but informative chapter to the abstract, with a focus on science and technology fields.

First, the authors stress the importance and function of the abstract: as a convenience and first point of contact for the busy reader (the abstract tends to be the first, possibly the only part of the paper we read), its accessibility (the abstract may be the only freely available part of the paper), and its role as part of abstracting services in searchable databases. Our students can relate to this since finding and reviewing relevant literature is part of their projects. They also recognize the significance of abstracts when they analyze their own literary practices: they themselves begin by reading an abstract before reading the full research article.

The authors then describe the scientific abstract as typically consisting of the following information elements (Cargill and O'Connor, 2013; Weissberg & Buker, 1990): *some background information (B)*, *the principal activity or purpose of the study and its scope (P)*, *some information about the methods used in the study (M)*, *the most important results of the study (R)*, and *a statement of conclusion or recommendation (C)*, or *P+M, R, C* in a condensed version of the abstract. Finally, the authors recommend analyzing relevant published abstracts for these information elements, which elements are typically included and where in the abstract they are present. This, again, is something our students recognize, as they frequently read abstracts of relevant research articles and are aware of these basic information elements.

As to the writing process, the authors recommend drafting one sentence per information element, then combining the sentences into a first draft of the abstract, followed by word count check and adjustments based on the requirements of the target journal. The authors also strongly recommend paying close attention to submission guidelines, which often contain instructions for how to structure the abstract, or even provide the structure headings (Structured abstracts, referenced for example in PubMed (2018)). Those of our students who tend to write an abstract rather like an article introduction appreciate this writing strategy; others are already aware of this strategy but need help putting it into practice.

In sum, the course textbook forms an important starting point in our pedagogy as it facilitates the students' understanding of the abstract as a genre and outlines a useful writing strategy. Our next step is to further elaborate these foundational points to provide our students with specific and scaffolded writing guidance from the first to the final drafts of their abstracts.

3.2 The Conceptual Template: top-down planning of the abstract

To help our students operationalize the information elements in an abstract, as well as the strategy for abstract writing presented in the course textbook (Cargill & O'Connor, 2013) we have developed a schematic mental map which we call the *Conceptual Template*. The Conceptual Template is based around the conventional IMRaD structure of the scientific research article (Introduction, Method, Results, and Discussion), both in terms of structure and function of each section. In principle, we understand the abstract as a mini-IMRAD genre, where each information element mirrors the corresponding section in the research article. This perspective is in line with accounts of rhetorical moves in abstracts and research articles (Swales and Feak, 2009; Swales, 2004; Hyland, 2004).

The Conceptual Template offers the typical information elements of an abstract in their logical order and provides a verbal cue for each element (the verbal cues are listed and explained in Figure 1). The verbal cues are casually formulated, with generic placeholders and personal style, which can and should be adjusted later in the writing process. The first-person formulation of the cues is also meant to give the students agency, as researchers and as writers, guiding them to formulate exactly what they did—as opposed to what has been done so far in the research field (typically covered in the Background). This way we hope to direct the students' attention to their

own content, so that they *create a research space* (Swales, 2004) for the questions and methods in their projects, formulate the complete research story of their projects (not only the method and findings), and become aware of their contribution to the research field. Finally, the verbal cues help students select the most crucial information they need for the abstract and exclude information that is relevant but can be nonetheless omitted in the abstract. This way, the cues serve to further specify the guidance provided by the course textbook: Cargill and O'Connor (2013) stress that each information element in the abstract presents only *some or the most important information*, thus abstracting away from the details presented in the full-length paper.

In sum, the Conceptual Template is a generic schema that can be completed according to the conventions of a given research field, while accommodating the specifics of a student's research project. For example, the starting point in the template (marked by the cue *This project VERBs THING*) can be modified to include not only specific aims, scope, and activities, but also the preferred or required writing style (*This project / This study / This paper / We*). Students working on applied projects can choose to adjust the cues for discussion (*This means that*) and conclusions (*Future research should*) to discuss the relevance of their research for the industry and other non-academic stakeholders. Similarly, students working on scientific projects within fundamental research (in our case, this is typically in chemistry and biology) can choose to provide more detailed background and previous research, while leaving out comments on the practical relevance of their project. The Conceptual Template thus provides the students with a schema for the complete story of their research, with placeholders for each part of the research story, which can be elaborated as their research progresses.

This paper VERBs THING (Aim / What the project does)

This first part of the template presents the aims of the paper, or states what the paper does. The cue helps students realize that each paper or project “does something with something”, regardless of the discipline or type of research. To illustrate the versatility of the cue we provide specific examples such as *this project tests a theory / develops a model / problematizes a key concept*.

for the purposes of (Why / motivation)

This cue directs students' attention to the “why”, in the sense of motivation for their paper, relevance to the research field, or practical application. We encourage students to be aware (often they are not) of why they are carrying out their projects, and how their findings might be applied, whether they are aiming to solve a real-world problem, or to advance scientific understanding.

THING is / is important for (Background)

This cue introduces the background section, highlights its function, and directs students' attention to background information that is essential to include in the abstract. We clarify that the cue is a placeholder for any content they may need to include in the background section, such as previous studies or real-life applications and problems, depending on their field and type of research.

However (Gap)

This simple but powerful verbal cue guides students to formulate the *gap*: the need for further research in a specific area, a practical problem, or question that needs to be addressed. This cue marks perhaps the most important point in the formulation of the relevance of the student's project to the research field. It also helps students grasp the function of the background section.

To address this, I VERBed THING (Method)

This cue has several crucial functions: it describes the method, it explicitly links the description of the method to the need for the study (the gap) as formulated in the previous information element, and it links back to the first item in the template—the aim statement. This cue performs an important textual coherence function in that it re-activates a more textually distant item.

I found (Results)

This verbal cue indicates the findings. The personal, casual formulation guides the students to reflect on their active role as researchers, on their own observations, and on the outcomes of what they themselves did in their projects.

This means that (Discussion)

This verbal cue leads students to reflect on the significance and implications of their findings and clarifies the function of the discussion section. Although the cue may seem trivial, this phrasing succeeds in directing the students' attention to the interpretation of the results or findings.

Future research should (Conclusions and recommendations)

This verbal cue guides students to reflect on the relevance of their project for future research in the field, thereby focusing their attention on their own contribution to the research field.

Figure 1. The Conceptual Template: a top-down planning tool for abstract writing

3.3 The Abstract Package: extending the abstract genre

Bearing in mind the practical relevance of the abstract, we have also looked to plausible real-life submission scenarios which could help us further define important aspects of the abstract and provide relevant writing guidance for our students. We have taken into consideration two important aspects which can be challenging for novice writer-researchers. Firstly, abstract submissions tend to have strict word count requirements, particularly in submissions through online platforms which allow only the maximum required number of words or characters. Secondly, other textual genres are often required together with the abstract, such as the title and keywords, and a 50-word summary for the conference program (see for example the AILA 2021 World Congress CfP, Sign Language Linguistics Society, 2019). Finally, the awareness of these submission requirements and the skills needed to produce these textual genres are mostly gained through repeated experience of abstract submission, something that our students as yet lack.

These aspects of real-life submission scenarios and our students' need for practice led us to formulate a combined genre for the purposes of our course: the *Abstract Package*. The package consists of four components: the *title*, *keywords*, *300-word abstract*, and a *50-word summary for a conference program*. For the purposes of our course, the 50-word conference program summary is referred to as *the scientific one-liner*. We have introduced this term to direct students' attention to two important aspects of the conference program summary: its structure (one or two sentences) and its function (to provide a quick overview of the conference paper).

In the context of our scientific communication course, the Abstract Package is one of the four obligatory assignments the students must complete in order to proceed to the final exam. Although the full length of the Abstract Package is approximately 400 words, it is by no means a simple writing task. Each of the sub-genres in the Abstract Package requires a different level of abstraction from the full details of the research project as well as awareness of the contribution to

the relevant research field. To guide students through the writing of this assignment, and to help them produce high-quality abstracts, we have designed a scaffolded writing path.

3.4 A scaffolded writing path: guiding students through the writing process

Our scaffolded writing path includes instruction, writing practice, as well as formative feedback, and runs throughout the entire course (fall semester, week 35 to week 47). Individual stages of the path provide the students with a starting point for the drafting of the abstract, the opportunity to develop multiple drafts and to adjust their abstract so that it accurately reflects the current stage of their research project. The path also includes clearly defined writing milestones, some of which are part of the formal course assessment (see Figure 2).

In the first stage we present the Abstract Package, its structure, function, and natural context, as part of a lecture on Genres of Science Communication. This is the second lecture in the course (week 36), so the Abstract Package is presented early on. We pay special attention to the scientific one-liner as a sub-genre of the Abstract Package, explaining its function in a real-world submission scenario. We also state the specific requirements for the submission of a one-liner in this course (it should be one sentence conveying the whole story of the project, not only the problem, the research question, or the method). To provide a starting point for the writing of the one-liner, we also suggest a few sentence templates⁴ that students can fill in with their own content. The most generic template we suggest for the one-liner is as follows: *Using METHOD, this project VERBs THING for the purposes of APPLICATION IN INDUSTRY*. We then explain that this generic template provides a structure for the one-liner sentence, as well as placeholders for research-specific content. We stress that the sentence template can be modified and extended up to the maximum 50-word limit for the one-liner.

In the same lecture (Lecture 2 in week 36) we also present the Conceptual Template and encourage students to fill it in with their own content, thus starting on the first draft of their abstract. This task is formulated as a class assignment (Assignment 2; see Figure 2). Although this assignment is not obligatory, most of our students do complete it, regardless of whether they attended the lecture where the assignment was set, and regardless of the stage of their research project. Most students understand the placeholder function of the template cues and fill in those parts of the template that correspond with the current stage of their research project (typically, they will leave out parts of the template that refer to results and conclusions).

The lecture is then followed by a workshop where students draft their Abstract Package and receive personalized feedback from the instructors. Although the exact design can vary depending on whether it is run digitally (a webinar) or in-person, this practice session always includes individual writing time, the submission of a draft, and feedback-based interaction with the course instructors. The nature and focus of feedback can vary depending on each student's writing experience, research stage, general English proficiency, or level of engagement with the relevant course material. In the webinar format the interaction tends to be in the writing mode, either through a real-time chat function or in the draft document itself (as comments and tracked changes). This mode provides a lasting record of the feedback-based interaction, which is valuable for both students and instructors, as it can be referred to later in the course.

⁴ The sentence templates are typically based on previous student work in this course and edited by us to ensure correct grammar and sentence structure.

Following the workshop, the students are required to submit the draft of their Abstract Package as one of the obligatory assignments in the course (Obligatory Assignment 9 / OA9, see Figure 2). The course instructors then assign a point score, depending on how complete the assignment is (4 points is the full score, 1 point for each complete part of the Abstract Package), and provide further feedback, if needed. At this stage, the feedback mostly concerns the structure of the scientific one-liner, or a missing part of the Abstract Package. Although it is not a requirement, we encourage students to submit a draft that has been further developed based on the feedback they received during the webinar.

In the last stage of the scaffolded writing path, the students further develop their Abstract Package assignment into a final, polished version. The final version of the Abstract Package is the basis for the final exam, which assesses its completeness (inclusion of all sub-genres) and quality (inclusion of all conventional parts of the abstract, clearly formulated contribution, overall clarity and coherence).

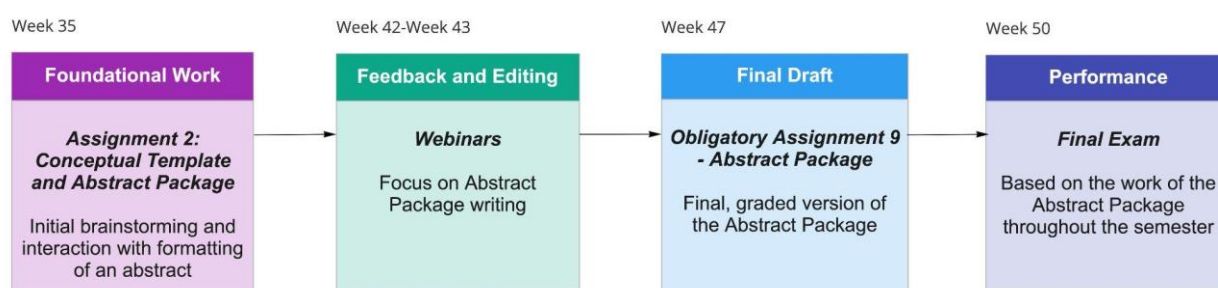


Figure 2. The Scaffolded Writing Path for the Abstract Package

4. Conclusions: Moving forward

Based on the improvement we repeatedly see during each semester in our final year master students, we intend to continue applying and developing our pedagogy in our scientific communication course as well as in other similar courses. Thus far, our pedagogy has generally proven transferable across disciplines and research stages due to its flexibility and easy contextualization. We have already begun implementing aspects of the pedagogy in other scientific writing courses⁵ primarily meant for PhD candidates in different disciplines working on project-based dissertations. Although those courses tend to have a different curricular design, we have successfully integrated the Conceptual Template and the Abstract Package in the course assignments and in the final exam.

The Conceptual Template seems to work well as an abstract writing tool, for several reasons. Firstly, it is a low-threshold entry in the students' writing processes: students can interact and manipulate the template even with limited scientific writing experience. Next, the template is flexible, allowing students to modify it according to their own specific content. The template can

⁵ HFEL8000 Communicating Science: Audiences, Purposes, Conventions (NTNU)

<https://www.ntnu.edu/studies/courses/HFEL8000#tab=omEmnet>

also be adapted as the research proceeds through its stages: at the start, students are encouraged to highlight the motivation, research questions, method, and hypotheses; later, these information elements can be condensed when findings and conclusions are added to the template. The template also has a high level of scalability, as it can be used for a variety of scientific writing genres such as conference papers, research articles, and research reports (across our science communication courses, we have already seen the Conceptual Template successfully applied in all these cases). Finally, the Conceptual Template encourages students to plan their abstract (or even a full article) top-down, outlining the whole research story, which can later be filled in and expanded. We consider this strategy complementary to the writing of the abstract as a summary of fully completed work.

A potential pitfall when teaching the Conceptual Template is that some students seem to have difficulty understanding the related terminology, which in turn negatively impacts their ability to use the template. For example, some students have asked for clarification of the term *placeholder* we use when describing the templated cues in the Conceptual Template, such as *This project VERBs THING*, where VERBs and THING are placeholders. To date, our practice has been to provide a brief explanation of the term, together with some examples (in the sense that students can replace VERB with their own content, such as *investigate, model, test, develop*), but this may not be sufficiently clear for all students. We therefore plan to have more explicit discussions of the terminology within the Conceptual Template, the function of the verbal cues and placeholders, and how the students should be working with them when drafting abstracts. To provide more examples, we also plan to highlight verbs in the published abstracts our students are reading for their specialized courses and projects.

We have also noticed that not all students immediately grasp the flexibility and function of the Conceptual Template, or struggle to adapt it to their own research. In the past we have briefly touched on the model's adaptability during our lectures and advised individual students when they asked about specific projects such as literature reviews and projects that do not yet have results. In the future, we plan to elevate these discussions to the attention of the entire class and spend more time demonstrating to students the flexibility of the model. We plan to save this discussion for after the first assignment so that students can independently explore how the model can work for them and then bring their questions to class. One group of students that may need more guidance are those straddling the social sciences and hard sciences. These students tend to have projects and writing conventions that do not directly align with those of exclusively hard sciences where the IMRaD structure is typically used. Therefore, in the future we plan to further help tailor the Conceptual Template to their specific needs.

Thus far, we have compiled observational and anecdotal evidence indicating that our pedagogy is effective, but we have yet to conduct systematic investigations. We are currently considering several research avenues, both for qualitative and quantitative investigations. For example, student interviews or focus groups can provide insight into the students' experiences of using the Conceptual Template to create first drafts of their abstracts. A longitudinal corpus analysis of the students' assignments could reveal students' progression, or lack thereof, in abstract writing throughout the course. Such an analysis could also show us how the students are using or modifying the Conceptual Template and the language they choose to integrate into the template. Furthermore, we could learn which portions of the Conceptual Template students particularly struggle with. We also plan to incorporate questions about our pedagogy in the course evaluation survey, which is part of educational quality control at our institution. The results of these analyses would serve to empirically validate and shape our pedagogy.

As the next step in the further development of our pedagogy, we are planning to ask students to analyze abstracts from the field(s) relevant for their research projects. This task will guide students to further elaborate the generic Conceptual Template so that it reflects the conventional structure(s) of abstracts in their own fields; for example, if they need to leave out the background, or if they need to start the abstract with the method. Guiding researchers to identify relevant writing conventions and essentially building a writing model based on the analysis of published papers is consistent with the course textbook (Cargill & O'Connor, 2013) as well as other pedagogical approaches to scientific writing (Glasman-Deal, 2020; Bennet, 2019a, 2019b). This task will also build on the work our students are already doing in other courses, that is, extensive reading of the literature relevant for their research projects, which includes numerous examples of published abstracts.

To conclude, we invite other teachers of scientific communication to try out our pedagogy when they teach abstract writing. Although we have made the abstract a core component of our course, the pedagogy can be incorporated in the classroom in any number of ways. For example, teachers may simply introduce the Conceptual Template as one way for students to approach the abstract; or they can adopt the scaffolded writing path if it matches their course design and needs. We hope that our approach can benefit not only students, but also other researchers seeking an effective approach to their abstract writing. Our students have informally shared with us that abstracts they drafted in our course have been successfully used in master theses and conference paper submissions. The idea that our pedagogy could contribute to the success of other researchers writing in English is an exciting prospect for us.

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APPENDIX: SPRÅK3501 *Scientific Communication* course profile (Fall 2021) showing the number of students for each study program represented in the course.

