From Anecdote to Evidence: One Program's Efforts to Define STEM Collaborators' Perceptions of Successful Writing Instruction

Ian R. Weaver
University of North Carolina Wilmington
Colleen A. Reilly
University of North Carolina Wilmington

Abstract. What do STEM faculty perceive as evidence of success in terms of the writing courses that they design for their students, and how can instructors use the evidence they provide to market our courses and program to other departments on campus? To begin answering these questions, we collaborated with STEM faculty in a preliminary stage of participatory assessment research to learn what they understand as evidence of our undergraduate science-writing course's learning benefits. We conducted a focus group that revealed preliminary evidence about colleagues' definitions of success related to our course, including the improvement in metrics that concerned STEM faculty; improved writing skills important for their students; and progress on intangibles related to writing, such as maturity and flexibility, that were previously invisible to us. These insights provided us with the language and criteria to design a framework to advance our collaboration and construct additional assessment research that can result in more evidence of what makes writing instruction successful for students in the sciences.

Keywords: Participatory Assessment, Program Assessment, Writing Instruction, STEM Collaborations

Contact author: weaveri@uncw.edu / reillyc@uncw.edu

STEM faculty who collaborate with technical and professional communication (TPC) faculty anecdotally highlight the success of our undergraduate and graduate science-writing courses, expressing gratitude for how the courses have dramatically improved students' writing. But what do these STEM faculty perceive as evidence of this success and how can TPC faculty use this evidence to market our courses and program to other departments on campus?

This program showcase article discusses our preliminary efforts at gathering evidence from our STEM colleagues about what makes our courses successful and using that evidence to build an assessment framework to collect even more concrete information. To begin answering these questions, we collaborated with STEM faculty in a preliminary stage of participatory assessment research to learn what they understand as evidence of our undergraduate course's learning benefits. Although our project seeks to make visible the current contributions of our courses, we align with Kyle Vealey and Charlotte Hyde's (2015) stance that assessment can be a rhetorical act that not only solves current problems but also provides vision for future growth and development. Specifically, we plan to use the language and evidence that we found to improve our courses and to market those courses to additional campus constituencies.

To conduct this first phase of our research, we held a focus group with four STEM faculty associated with our science-writing course. Our focus group revealed a range of preliminary evidence providing us with concrete insights about how our colleagues defined success in terms of our writing course, including the improvement in metrics that concerned STEM faculty; improved writing skills; and progress on intangibles related to writing, such as maturity and flexibility, that were previously invisible to us. Based on these insights, we began to build a framework to advance our collaboration and construct more extensive assessment research. In this article, we provide an overview of scholarship about curricular success and participatory assessment; describe our course and the STEM faculty's course along with our history of collaboration; detail our analysis and findings; and explore the preliminary evidence we found. We conclude by demonstrating how TPC programs can use preliminary data to plan future curricular collaborations and participatory assessment research.

Scholarship Focused on Defining Curricular Success

Determining what constitutes success at the level of the academic program or course generally involves systematic assessment, which is

research, as Heidi McKee (2016) contended, although it is not always acknowledged as such. The scholarship around curricular research and assessment in TPC highlights the complex and multi-layered approaches needed for this type of work, requiring input from a variety of sources within the course and program and externally from the program or course's ecosystem (Carnegie, 2007). Building on Joanna Schreiber and Lisa Melonçon's (2019) work that emphasizes the need for continuous improvement in curricular design, Chris Eisenhart and Karen Gulbrandsen (2020) highlighted the importance of "using multiple, data-driven methods to place common curricular practice within larger contexts as a way to address institutional needs and goals" (p. 68). In this section, we provide context for our work through an overview of previous approaches to investigating curricular success.

Data-driven research constitutes an approach to curricular analysis at the program and course levels in TPC. Faculty scholars report collecting institutional data and publicly available government and other information to direct curricular decisions. Some scholars report using data about workforce trends and demographic statistics (Carnegie & Crane, 2018; Coffey et al., 2020), whereas others examine academic and trade publications to find "the conceptual and practical skills that academics and practitioners have identified as important" (Eisenhart & Gulbrandsen, 2020, p. 70). Within an institution, information about enrollment numbers in courses and programs (Eisenhart & Gulbrandsen) and student employment placement data (Coffey et al., 2020) constitute benchmarks that campus leaders can grasp. A number of studies outlined the importance of longitudinal enrollment data in courses and programs to support their efficacy (McKee, 2016) and "as a metric for programmatic success" (Eisenhart & Gulbrandsen, 2020, p. 71). Eisenhart and Gulbrandsen also have promoted examining longitudinal degree completion data to demonstrate the ethical nature of a program's recruiting and student support practices.

Direct assessment to analyze student work in light of course/program student learning outcomes (SLOs) purportedly works well for undergraduate program analysis (Coffey et al., 2020; Eisenhart & Gulbrandsen, 2020). To perform direct assessment meaningfully, faculty need both internal guidelines and external standards. For example, Nancy Coppola et al. (2016) referenced the evaluative standards proposed by the Joint Committee on Standards for Educational Evaluation, which proposes "five key attributes of evaluation quality: utility, feasibility, propriety, accuracy, and accountability" (p. 7). The values articulated within our field also

provide standards to inform program and course assessment. For example,

> The Technical Communication Body of Knowledge (TCBOK) (2016) through its early development in 2007 (Coppola, 2010) to its redevelopment in 2012 (Hart & Baehr, 2013) has attempted to bring together our disciplinary core competencies as a codified collection of knowledge assets for the profession to be used in contextualized instruction and assessment of the writing construct. (Coppola et al., 2016, p. 8)

Likewise in their revision of a specific course, Kathleen Coffey et al. (2020) wanted to account for "evolving values and research trajectories within the broader field of TPC" (p. 145), which include redefinitions of content, "circulation and networked writing, and user experience" (p. 145). To identify these core values in action, Chris Lam, Mark A. Hannah, and Erin Friess (2016) analyzed Twitter data from #techcomm for a specified time to determine the central concerns of a range of stakeholders as reflected in social media.

Participatory curriculum development and assessment constitute important methods for defining success for TPC programs and courses. Michael Salvo and Jingfang Ren (2007) defined participatory design as "built on a process of designing with users and stakeholders rather than designing for them" (p. 424). They caution that participation must extend beyond providing advice to completing research and design in conjunction with users and other stakeholders as actors. To place stakeholders as central to the process, Salvo and Ren have viewed curriculum as a technology that can be investigated and redesigned for better usability on behalf of specific populations.

Participatory assessment and program/course design are layered processes that rely on overlapping sources of information to locate and contextualize the degree of success achieved by the curricula in question. For example, in their Design for Assessment Model, Coppola et al. (2016) garnered evidence from numerous sources including curricular structures and the opinions of students, current and former. Previously viewed by institutions as "noise," student feedback becomes a central source of evidence in participatory assessment (Salvo & Ren, 2007, p. 425); the input of students should be integrated into evidence from curricular review and from surveys/interviews of instructors and administrators (p. 426). McKee (2016) also used surveys of current students to evaluate their reconfigured program, asking what attracted them to the major, what major they would have chosen if this one had been unavailable, and what they would like to see in the

curriculum moving forward (see also Coffey et al., 2020).

This last question connects with Salvo and Ren's (2007) assertion that "the model we propose views program assessment as identity building, a process of identifying and articulating not only who we are but also who we want to become" (p. 426). Teena Carnegie and Kate Crane (2018) also emphasized the importance of using a multi-layered and iterative assessment process with participatory elements to design a forward-looking curriculum; they review published research and data and conduct interviews with their graduates (p. 28) to inform their efforts.

In addition to gathering participatory assessment data from students, scholars have targeted other stakeholders within their institutions as sources of information. Coffey et al. (2020) identified key stakeholders in a constituent major and interviewed them to participate in enhancing the curriculum. Their truly participatory approach is reflected by "providing faculty and administrators in related programs…access to the set of materials [they] created for PW instructors teaching the course, so they could evaluate how the revised course could continue to function in their own programs" (p. 156).

In the next section, we detail how we collaborated with STEM colleagues to create a junior-level course, "Writing in the Scientific Disciplines," for students in environmental science; we then outline the first phase of our proposed assessment practice to research and articulate what is successful about our current course for the students enrolled therein. Drawing on Eisenhart and Gulbrandsen's (2020) approach, we consider assessment as a multi-stage and layered process. Our process is in the preliminary phase of developing a framework, including locating relevant terminology, to analyze the success of this course in concrete terms and to discover what it contributes to science students' skills and to our STEM partners' curriculum.

Evidence Gathering Methods for Our Pilot Research

As a first step in our participatory assessment research, we sought to locate the terminology and criteria describing the successful outcomes of our science-writing course from the perspectives of our STEM colleagues. Using our shared terminology, we determined that we can build a robust research framework to collect direct and participatory assessment information to further enhance the course and market it to other departments. To begin unpacking what success means to our colleagues, we completed two types of analyses:

1. a review of documents relevant to our course "Writing in the Scientific Disciplines" (subsequently called our science-writing course) and the course for which ours prepares their students, "Seminar in Environmental Sciences" (subsequently called the Environmental Science (EVS) capstone course);
2. a focus group discussion with key stakeholders from EVS and the library who are responsible for the design of our collaboration and the delivery of the EVS capstone course.

Below we provide a brief history of the collaborative development of our science-writing course, our document analysis, and the justification and process for conducting our focus group meeting.

Brief History of the Development of Our Science-Writing Course

In Spring 2015, we were approached by the Department Chair of Environmental Studies (now EVS) and asked to reserve a section of our science-writing course (a precursor to our current course) for their students. As enrollments revealed, beginning in approximately 2010, students from EVS had comprised from one quarter to one half of the 20 students enrolled in our science-writing course each semester. Because the course was also an optional requirement for majors in our professional writing track, we decided to develop a separate course for EVS students. We worked with TPC faculty to craft a series of assignments and syllabi, which we then discussed with the chair and incoming chair from EVS. From the start, our course design was contextual, as defined by Kirk St.Amant (2018), as we endeavored to address the needs of the EVS program and their students in our initial course proposal. Our science-writing course was added to the undergraduate catalogue in 2015 and was also approved as an optional course in our major, a requirement for EVS students, and a prerequisite for the EVS capstone course.

Each year, we have added sections of our science-writing course as EVS has grown in size. Most recently, we scheduled four sections of the course for Fall 2022, and all seats are currently full. We continue to meet with EVS faculty each year to negotiate the content of our science-writing course, gain support for new hires in TPC to teach science-writing (see also Arduser, 2018), and plan additional curricular collaborations.

Document Analysis Process

In investigating the origins of our science-writing course, we located

the course proposal that we submitted to create the course and the data that we collected about enrollments in the course's precursor class over seven years. We also examined the sample syllabus for the course and compared it with recent syllabi, noting the evolution of the SLOs. Finally, after the focus group meeting, we collected a syllabus, assignment descriptions, and some rubrics for the EVS capstone course and found that reviewing these documents provided us with additional concrete information about what we are preparing the students in our science-writing course to do. For example, we discovered that the senior project as described in the EVS documents is more flexible from a genre perspective and developed through a more iterative process than we were expecting.

Justification and Process for Our Focus Group

To collect preliminary information about how faculty from EVS defined success in terms of our science-writing course and how well it prepares their students for the EVS capstone course, we organized and recruited colleagues for a focus group, which was designed to last about one hour. We submitted the design of the focus group, our recruiting email, prepared questions, and a consent form to our campus IRB and received an exempt status for this portion of our research. Despite our exempt status, we made all IRB recommended changes to the study design. We elected to conduct a focus group to spark "memory, experiences, and ideas" from participants (Tracy, 2013, p. 167). This format also allowed us to observe how our participants responded to certain concepts as a group and how each individual's comments would encourage more concrete observations and recollections from others.

For participants (see Table 1), we recruited the past department chair, who began the collaboration with us; the current chair; the incoming chair (currently the assistant chair); an assistant professor who teaches the EVS capstone course; and two lecturers who also teach the EVS capstone course. We recruited the participants through email and offered boxed lunches during the session through support from our Center for Teaching Excellence. Because he is retiring, the previous chair declined our invitation as did the assistant professor and one of the lecturers. The senior lecturer, who did attend, requested that we invite the EVS liaison librarian, who supports the EVS capstone course by holding consulting meetings with students and assisting with their research.

Table 1. Focus group participants

Role	Description
Current Chair	Full professor who created the EVS program and has forged and sustained our collaboration. (He communicates with us at least once a semester.)
Incoming Chair	Associate professor who has taught the graduate capstone course and teaches other upper-level undergraduate courses.
Senior Lecturer	Senior lecturer who has taught the undergraduate capstone course since the beginning of our collaboration with EVS.
Liason Librarian	Academic research and engagement librarian who works with the EVS capstone instructors and meets with students individually to address research fluency and assist in topic development.

We prepared nine questions in advance of the forum (see Figure 1), and we secured permission to record our conversation for record-keeping and accuracy purposes. We met in a designated faculty space within the library. After our lively 1.5-hour discussion, we transcribed the conversation, reviewed it, and identified central themes which we will detail in the Analysis and Findings section.

Figure 1. Questions prepared for the open forum

1. What are the goals of the EVS major?
2. What does the successful graduate look like? What are you looking for?
3. How does the EVS capstone course fit into helping you achieve the major's goals?
4. What assignments (documents) do you use to know whether you're preparing students to think and do? How do you assess these assignments, documents?
5. What did you hope that your students would gain from taking our science writing course?
6. What seems to have improved related to their writing and communication? What have you observed?
7. Have you seen this improvement in the assignment you mentioned before? How so?

Figure 1. Questions prepared for the open forum (cont.)

8. What do you hope to keep seeing?
9. What would you like more of or to have changed?

Analysis and Findings

After our focus group session, we determined how to process the documents and rich discussion that we recorded. Although our focus group began with prepared questions (listed in Figure 1), we transitioned to an organic and less structured discussion. All participants contributed evenly to our discussion and seemed willing to speak freely. As the department chair indicated at the end of our discussion, the curricular collaboration that EVS has with TPC colleagues is unique in their experience because TPC faculty repeatedly ask for meetings with and feedback from EVS about how well our courses are serving their students. This recognition of the foundation for trust and collaboration that we cultivated over time certainly allowed the focus group to yield useful insights.

Because we view this portion of our research as preliminary, we couch our findings below similarly. Our goal was to locate the language that unpacks what our EVS colleagues mean when they call our course and collaboration a success so that we can then construct an empirical evaluative framework to use in directly assessing our course and soliciting feedback from students and other stakeholders. Our analysis of the documents and focus-group feedback below advanced our understanding about how our colleagues view what our science-writing course accomplishes for their students and did so in some expected and other surprising ways.

Document Analysis

Our document analysis focused on the course action form that created the science-writing course, the sample syllabus attached to that form, a recent science-writing course syllabus, and the syllabus and capstone assignment description and rubrics for the EVS capstone course. Our course action form indicates that the purpose of the course is to explore "writing in academic contexts" and "the multiple practical strategies scientists use to communicate in professional settings." This focus was determined after several discussions with the EVS department chairs, current and former, who provided insights about their students' needs. However, as we found from our focus group, we did not have a complete understanding of how the course could contribute to EVS curriculum.

The science-writing course sample syllabus attached to the course action form contained five general SLOs:

- To recognize a scientific discipline or group of disciplines as a specialized community of discourse;
- To critically consider the products of science and science's role in the complex problems of human societies;
- To read, interpret, and produce writing in academic genres;
- To develop rationales for effective accommodation of academic science for various expert stakeholders; and
- To use various tools and modes to produce texts for academic audiences.

As these SLOs reflect, the course was originally centered on academic writing. We saw a need to focus on scientific discourse as a unique communicative approach for creating and disseminating ideas; however, we did not directly mention design beyond hinting at the use of "tools and modes." Because we had not yet taught the course before establishing the SLOs, we were unsure about what was needed beyond what our EVS colleagues told us. The assignments parallel these SLOs, asking students to produce only academic genres such as a literature review, research paper, and research poster.

In subsequent semesters, we gained more knowledge about our students and their needs and developed a more expansive list of SLOs that expanded the focus beyond academic writing:

- Summarize and compare the findings and arguments expressed in scientific scholarship.
- Explore issues of subjectivity in relation to scientific discourse.
- Write effectively about scientific issues and topics for a variety of audiences and types of publications.
- Develop an effective writing process involving invention, drafting, responding to feedback, and revision.
- Learn and employ primary and secondary research strategies to locate scientific findings, debates, and data to support writing assignments.
- Write persuasively yet fairly about complex and controversial scientific issues and ideas, drawing on the conventions of science-writing modeled in course readings and discussed in class.
- Design texts for a variety of audiences and contexts.
- Demonstrate the ability to create clear, persuasive, and appealing graphic elements and visual designs informed by basic design principles.

As these revised SLOs reflect, we incorporated more theoretical concerns, including subjectivity in scientific discourse and negotiating

controversies as well as instruction in visual rhetoric and design. We also added a project asking students to use their scientific expertise to write for external audiences.

We collected documents from the EVS capstone course after the focus group because we thought the participants would be more willing to share materials after learning about our work. The senior lecturer sent us her syllabus, schedule, capstone project assignment description, and rubrics. The SLOs for the EVS course parallel ours in ways but are less detailed and specific:

- Demonstrate the ability to critique ideas and opinions on advanced topics in environmental studies;
- Have the ability to present information, both written and oral, on an advanced topic in environmental studies using modern techniques and technology; and
- Have a polished resume and cover letter prepared for immediate use on the job market.

The first SLO surprised us, as it seems to relate more to rhetorical analysis than concrete writing tasks related to EVS. Like our initial syllabus for the science-writing course, the EVS SLOs generally reference "modern techniques and technology" for writing and design. Finally, the requirement to create employment documents was also enlightening.

The capstone assignment description and rubrics were also interesting as they emphasized the focus on writing process and genre flexibility, which we learned about during the focus group. The students receive comments on a number of drafts of their capstone projects; earn credit for meeting with the teaching assistants (TAs) and the librarian; and submit early planning documents, including a proposal brainstorming form and a research pitch. Furthermore, students have flexibility regarding the genres that they can produce, which directly contradicts our previous understanding that we were primarily preparing the students to develop academic research genres. Finally, the rubrics are less descriptive and more focused on quantification than we were expecting. For example, the rubric for the project draft identifies required elements and tasks that are graded on a yes or no basis. The quantification and tight parameters for assignment grading may reflect the fact that TAs are primarily responsible for grading early submissions.

These are matters that we need to explore in future phases of our research.

Focus Group

Our focus group discussion lasted 1.5 hours, during which we had a lively conversation with our participants that was spurred by some of our prepared questions but that evolved organically. We followed standard practice for analyzing the qualitative data gleaned from the focus group, including recording and transcribing the data and analyzing for themes (Breen, 2006, p. 466). We each reviewed the recording and met to discuss what we learned, and the first author created a transcription for our reference. Based on the recording, the transcript, and our subsequent conversations, we developed three themes in which we could place the significant feedback about how our course was characterized as successful from the perspectives of our participants. These themes included the following: improved metrics, improved writing skills, and progress on intangibles.

We also analyzed the transcribed discussion for the frequency, extensiveness, and intensity of the remarks made by our participants. Our 1.5-hour conversation was too short to make frequency a helpful measure; we found that extensiveness and intensity were more revealing. That is, some topics were discussed by multiple participants (extensively), and some topics were mentioned with more "intensity, passion, or depth of feeling" (intensity) than others (Krueger, 1998, p. 36).

Finally, each participant repeatedly emphasized the benefits of our science-writing course on their students' writing, using a range of evidence to support their assertions. This information was offered in response to direct requests from us for clarifications and specific examples. In the subsections below, we discuss each theme, its extent and intensity, example quotations, and the evidence offered or implied to support the observations. We also include Tables 2, 3, and 4 to visually illustrate how our focus group assisted us in beginning to understand our STEM colleagues' perceptions of what counts as evidence of success regarding our course.

Improved Metrics. Improved metrics (see Table 2) was the first type of evidence cited by participants; it was intensely stated but the least extensively discussed. Participants began answering our questions by citing an increase in grades on the central assignments in the EVS capstone course and in the class overall. Two of four participants cited grades as evidence, both discussing this topic ardently and emphasizing how dramatically their students' grades have improved. They mentioned that the majority of students previously received failing grades on the first drafts of their projects and now receive grades

closer to B-. Though they did not have specific grade-distribution data on hand, they offered to send us this data.

Table 2. Improved metrics theme

Topic (# of participants	Sample Quotations	Implied or Stated Evidence
Grades (2)	"Literally almost everybody in the class now gets As because their writing is that dramatically improved." On early draft assignments, "the average grade was between 37–42%" and is now sitting "right around 80%."	Grades on assignments, overall semester grades
Completion of Capstone Course (1)	Fewer withdrawals, Ds, and Fs in the course	Drop rates, grades
Grading (1)	"TAs used to spend 4.5 hours on average commenting on [early draft] submission... and that has dropped down to 2 hours because the increase in the students' ability to write is through the roof."	Time spent grading, substantive comments versus focus on mechanics/sentences

Other improved metrics included the amount of time that instructors and their TAs, who are graduate students in EVS, spend grading and commenting on students' drafts. The senior lecturer highlighted the drastic differences she observed in TAs' grading time since our science-writing course became prerequisite for the EVS capstone course; she reported that the TAs previously spent on average 4.5 hours commenting on initial drafts of students' capstone projects and now spend about 2 hours. In addition, both the senior lecturer and the assistant

chair mentioned an increase in the number of students who successfully complete the course and a decrease in the number of failing grades (Ds and Fs). Though the improved metrics topics were associated with the most tangible types of evidence, these were the least discussed. As the following two subsections indicate, our participants were more interested in their students' progress on writing skills and intangibles.

Improved Writing Skills. Participants discussed four general topics relating specifically to their students' improved writing skills (see Table 3). Though discussed less extensively than the other two categories in this theme, science-writing virtues and research competency were highlighted with a matter-of-fact tone. In response to a direct follow-up question, science-writing virtues, including clarity and cohesion, were mentioned as specific aspects of improvement in their students' writing.

Research competency was a topic emphasized primarily by the librarian. The librarian noted that, after students began taking our science-writing course, they spoke differently about and demonstrated advanced research techniques. The librarian reported that, when students were asked where they will search for information, they no longer said "in the library database" but were more likely to mention specific databases, such as Web of Science or BIOSIS Previews. The senior lecturer noted similar changes related to research proficiency among students, and both the senior lecturer and librarian remarked that the students' abilities enabled the instructors and TAs to discuss higher order research concerns earlier in the course, such as why students choose to cite one scholar over another and examine who is included in and omitted from students' reference lists.

The writing skills topics that participants discussed more, as noted in Table 3, include writing maturity and genre fluidity and creativity. These topics were less concrete than science-writing virtues and research competency. Each of our participants mentioned multiple instances in which they were surprised by students' higher-level handling of their writing processes, and they saw students taking the initiative to engage in substantive drafting and revision. The senior lecturer used phrasing like, "I used to have to teach this but now…." The assistant chair mentioned that her students have started to acknowledge scholarship more often, including in-text citations even in less formal genres like discussion posts. In discussing these points, the participants mentioned wanting more research to determine if students who performed at these higher levels of writing maturity in other classes beyond their EVS capstone course had taken our science-

Table 3. Improved writing skills theme

Topic (# of Participants)	Sample Quotations	Implied or Stated Evidence
Science writing virtues, clarity, cohesion (2)	"Ultimately, just the clarity of their writing is better, the continuity is there; they're submitting entire papers and not just [incomplete] drafts... It's all there, not just bits and pieces."	Writing artifacts like seminar papers and presentations
Research competency (2)	"I've seen correlation between those who take the science writing course and being able to then articulate specific tools they'll use through the library to focus on their research questions." "So just in terms in how they think about sourcing and searching for their information is an improvement...."	Students' justifications for searching techniques and sourcing choices in conversation and presentation, citation accuracy and range of voices in sources noted in papers
Writing maturity (4)	"They've finally gone through enough writing experience...[that] they're understanding the difference between, outlining, brainstorming, outlining, drafting, final submission." In discussion board responses, "I don't ask for citations or things like that but they're putting citations at the bottom, they're in-text citing...They're [writing] cohesive[ly] on the discussion board!"	Less class time spent justifying drafting in a structured writing process, high-level writing practices applied to less-formal assignments
Genre fluidity and creativity (4)	We had "one student who wanted to write a patent for a medical device; she got the patent.... We've had students write management burn plans for nature conservatories that have been implemented.... We've had environmental videos. More and more websites are being done. A lot of them are using them for their side hustle business."	Outcomes from students' work, such as submitted reports, patents, presentations at conferences, and community engagement work

writing course, which is precisely where we hope to take our research.

Genre fluidity and creativity referred to students' ability to extrapolate their skills in writing scientific research and to apply them to other genres. The senior lecturer explained that outward facing genres are not taught directly in the EVS capstone course but that students determine which genres to use for their final capstone texts and direct themselves through research and writing in those genres. Using a flexible approach to genre was discussed in reference to students' exigence for their self-chosen senior capstone projects. The participants did not use the word "genre" and instead talked about students' ability to be creative and fluid in terms of the types of texts they composed connected to their career success in EVS fields. Some of the genres mentioned included business plans, environmental management and burn plans, patent applications, and site assessment reports.

Progress on Intangibles. Our last theme is progress on intangibles (outlined in Table 4). The categories of remarks within this theme comprised the most unexpected feedback about what success means to our participants. Two of the less extensive intangible topics talked about were emotional resiliency and teacher experience. Two participants noted that students seemed less stressed with the capstone course's writing expectations since taking our science-writing course. Students entering the capstone course appeared to anticipate a certain amount of discomfort associated with taking a writing-intensive course. When they received feedback on their writing, students seemed to process that feedback more productively and less defensively. They also more effectively used the tiered writing structure of the course, which was evidenced by students submitting complete assignments even during the drafting phases of the project. Previously, drafts, for instance, may have consisted only of lists or incomplete thoughts. Through their experience in our science-writing course, they have learned that more complete drafts result in more productive feedback.

Another intangible observation is the quality of experience that TAs and instructors reported when teaching the EVS capstone course. As the students' writing has improved, the class has become more enjoyable to teach. Higher grades mean that teachers and TAs spend less time justifying grades and defending their feedback. Because students had more writing experience and utilized more effective writing processes, teachers could prioritize helping students pursue their interests and passions, finding ways for them to complete a wider range of

genres in their capstone projects.

Table 4. Intangible observations theme

Topic (# of Participants)	Sample Quotations	Implied or Stated Evidence
Teacher experience (2)	The improved writing abilities leading to more students getting As "makes it much more enjoyable experience for our TAs" and "enjoyable for faculty of record."	Fewer student complaints and better work
Emotionally Resilient (2)	"I've seen a marked improvement in less stress! The fact that the students have gone through this style course with you all in your science writing course coming into our capstone course, they come into it with that expectation of stress...."	Improved attitudes of students
Adaptability (3)	"I haven't had a student complain about feedback they've received in ages."	Fewer complaints, better use of feedback
Confidence (3)	I would like to "actually try and measure in some way, do students who take the science writing course feel more confident about their approach to capstone... vs. students who haven't taken the science writing course and their doing that for the first time."	Students' positive attitudes and lack of fear
Flexibility (4)	"One of the things I've observed over the years is that in EVS there are a lot of different pathways that students can take to get to the center of the tootsie pop...." "Students who have expressed they've done the science writing course... seem to feel more comfortable to step out of writing the standard scientific research paper and try something new."	Creative response to the course requirements in terms of genre production

Each participant discussed the apparent rise in students' adaptability and confidence in meeting the demands of the course and in applying their writing skills in a range of scenarios. Participants communicated that they thought students were more successful and capable writers than they used to be, and they associated student success with confidence. Students were also better able and willing to process instructor feedback productively. Confidence seems to lead to adaptability and aids students to approach writing tasks with more interest and less fear. Our participants suggested a specific method for measuring this increased confidence: conduct a pre- and post-survey before and after students take our science-writing course and after they take the EVS capstone.

The last intangible observation made by participants is how our science-writing course seems to make students more flexible. Each participant mentioned that EVS students need to know how to communicate effectively with other scientists, experts in other fields, and the public. Although they did not use the words rhetoric or rhetorical situation, they mentioned how students seemed comfortable adjusting their writing tasks to meet the demands of new contexts and audiences. Our participants emphasized the impossibility of preparing students for all possible contexts and genres, and they stated with exclamation (high intensity) how students were able to adapt and be flexible instead of producing only familiar academic genres. They returned to this topic throughout the entire discussion and referenced it in relation to the skills that students need for success in future organizational contexts in EVS. One participant even asked us if we taught students how to argue so that they could be prepared to spontaneously defend their perspectives to skeptical publics.

Discussion of Our Results and Future Directions for Research

We designed this first stage of our multi-layered and multi-stage participatory assessment research to discover the language and criteria that our STEM colleagues in EVS use to frame preliminary evidence for what constitutes success in terms of our science-writing course. We were able to use our focus-group discussion to locate specific themes unpacking the ways that our course successfully prepares EVS students to become better writers and researchers prior to entering their capstone course. Discovering a shared or "neutral language" for discussing writing was crucial to our participatory approach (Spinuzzi, 2005). As Clay Spinuzzi noted, in participatory research and design, neutral language can help bridge "the worlds of [designer] and users by finding a common… mode of interaction" (p. 166). Incorporating our STEM

partners' language and perspectives into our assessment research gives them an active role in shaping the future development of our assessment framework. In the subsections below, we explore the expected and unexpected results from our research, the importance of these results for revising our course and marketing it to other STEM programs, our next steps in participatory assessment, and the limitations of our work.

Expected and Unexpected Feedback

When we planned our focus-group research, we anticipated that our conversation would center on how our science-writing course provided EVS students with improved writing skills. We expected, for example, to discuss topics relating to basic writing literacies (Cargile Cook, 2002), including proficiencies that have long been heralded as science-writing virtues, such as "accuracy, conciseness, addressing audiences appropriately" (Ballard, 2018, p. 62). Like Thomas Ballard, we found that STEM faculty considered these types of skills as evidence of effective writing, and we learned that our STEM partners have seen their students improve in these practical skills (seen in other TPC programs, per Kynell, 1999).

Also expected were our colleagues' discussions about students' ability to research. Our findings align with the central place that research competency has held in technical communication for at least the last two decades (e.g., Hart-Davidson, 2001; Stanford et al., 2017). Our course devotes close to one third of the semester to literature-review writing and the other two thirds to writing and presenting research. The improvement in research skills, therefore, was confirmatory to us.

Finally, we expected discussions about academic genres to be prevalent, and our expectations were both confirmed and challenged. Our participants never mentioned the need for their students to master a specific genre. Rather, they discussed genre concepts in reference to students' need to be nimble and flexible to succeed as environmental scientists. One participant explained that, for EVS students, "One of the things I've observed over the years is that in EVS there are a lot of pathways that students can take to get to the center of the tootsie pop." In other words, students will not be restricted professionally to writing formal science-research papers; they need to select from a range of genres including reports, plans, patents, podcasts, and websites to reach the audiences they encounter in their work.

The successful outcomes we did not predict came in the remaining

themes and topics: improved metrics and progress on intangibles including writing maturity, adaptability, and confidence. We discovered that our class contributes to helping students in concrete and intangible ways. Though we understand that metrics are an important measure of success, we learned which sources of data meant the most to our partners, including a rise in grades; a decrease in withdrawals, Ds, and Fs; and a decrease in grading time. For example, our STEM partners were so excited about the changes they saw that they cited the improvement in grades from memory, such as the 20% to 30% increase on draft grades and the surprising number of students earning As in the course.

We were also surprised by the citation of progress on intangibles as evidence of success, such as the increase in writing maturity that was both intensely stated and extensively discussed. Writing maturity referred to students' advanced writing processes and the decrease in students' stress. In their writing projects, students articulated complete thoughts, exhibited critical thinking, and endeavored to communicate beyond academic audiences and contexts. Our participants indicated that students no longer wrote in "bits and pieces"; they understood the difference between brainstorming, outlining, drafting, and final submissions and included citations and references, even in informal assignments such as discussion board posts. The senior lecturer said it best: "They've finally gone through enough writing experience" to do this higher-level work. Most importantly, we learned that our course alters students' approaches to writing and their abilities to process feedback more maturely and productively (adaptability). Although we include responding to feedback as a learning outcome for our science-writing course, we were unaware that we were directly addressing a difficulty that EVS capstone instructors previously experienced: the marked decrease in students' complaints about feedback and grades as a result of our course is exciting news.

Within the theme of "progress on intangibles," the participants also highlighted students' seeming confidence in navigating the uncertainty and lack of guidance in producing genres. We expected our participants to congratulate us on teaching their students to write specific genres like literature reviews and research papers, but they actually said they were grateful that their students could write beyond these genres. We thought we offered a course focused on academic science-writing, but our participants indicated that we were teaching their students intangible skills related to analyzing rhetorical situations

and to responding to them flexibly.

Much of the evidence connected to intangibles represented the type of tacit knowledge we needed to learn by inviting our STEM partners to collaborate in identifying what constitutes evidence of successful writing instruction. As many have noted (e.g., Moore & Elliott, 2016; Spinuzzi, 2005), a strength of participatory design lies in helping researchers and designers uncover users' tacit knowledge or "what people know without being able to articulate" (Spinuzzi, 2005, p. 165). Such knowledge, according to Spinuzzi, is "implicit rather than explicit, holistic rather than bounded and systematized" (p. 165). Through our organic focus-group discussion, themes like progress on intangibles (see Table 4), representing such tacit knowledge, were able to emerge.

Finally, we were surprised by what we did not hear. We anticipated more discussion of mechanical correctness and grammatical proficiency. However, our STEM partners did not laud such "how-to, practical… skills" (Scott, 2004) or the widely critiqued hyperpragmatic outcomes (e.g., Hashlamon & Teston, 2022) as the best features of our course. The majority of our conversation focused on rhetorical and research skills and intangibles. In the words of Ballard (2018), "the validation of technical communication as a discipline, and rhetoric specifically, found through this study has been a welcome finding" (p. 62).

Course Redesign and Marketing

Based on this first stage in our research, we will make specific changes in our science-writing course. We will revise our SLOs to highlight the intangible skills that we are providing, such as productive response to feedback and genre fluidity. Additionally, we have tried to incorporate more overt rhetorical instruction in the course, but we can now do so within the language of our STEM partners. Tone Bratteteig et al. (2013) explain that a shared language must be developed by "advocating 'home-made' description" (p. 134). For example, we can highlight specific stages in the writing process such as topic development; focus on contextual analysis necessary for environmental science; and highlight research skills specific to the projects students complete in their EVS capstone course. Finally, the most significant change will be centered on genre fluidity. Our focus on the research paper has always been problematic for some students who are not performing field research. Now that we discovered that students can benefit from exploring other research-based genres such as reports, plans, or white papers, we can integrate those options into the research portion of our course.

Part of our goal for this research was to learn how we can market our science-writing course to other STEM programs on our campus. Drawing on the language of success that we have gained, we can highlight the metrics and intangibles important for other programs in addition to our ability to assist students with writing skills. We can begin discussions with STEM colleagues by asking informed questions about the metrics that are important to each discipline, the difficulties that they experience commenting on students' writing, and the ways that students process their feedback. Approaching the marketing of the course through the lens of our unexpected results will aid us to communicate with other STEM colleagues and better address their needs and those of their students.

Next Steps in Assessment

The next steps in our assessment research will harness the themes we identified (consolidated in Table 5).

Based on feedback from our participants, we will collect data on grades, grading time, and withdrawal and failing rates. The data we collect will be course-level (semester grades) and assignment-level; our participants said that they track and are willing to share such data. As far as writing skills are concerned, we will use our revised SLOs and conduct direct assessment of students' writing from our science-writing course and the EVS capstone course.

To investigate intangibles such as confidence, we will survey students before our science-writing course, after the course, and before the EVS capstone course based on our participants' suggestions. We will also compare feedback on intermediate drafts to final versions of papers from both courses.

And, finally, we will collect capstone papers to analyze for flexibility by noting the range of genres created. Ideally, this analysis would be followed by a survey for students to indicate whether they published or otherwise used their capstone projects outside of their EVS capstone course.

Other TPC programs can build on both our approach to course design and the first phase of our participatory assessment research when developing or rethinking upper-level courses designed to serve students in other programs. Some of our assumptions about what STEM faculty value in writing courses and writing instruction proved invalid. As Ballard (2018) and others have found, values central to TPC also matter to faculty in other disciplines; however, we need to build spaces and structures to capture our shared understandings of what constitutes success in writing instruction. The initial framework (represented in Table 5) that we will use to guide our subsequent assessment

Table 5. Themes, future assessment framework, and sources of evidence

Metrics		**Writing Skills**		**Intangibles**	
Grades	Semester-level grades from past 4–5 years	Science-writing virtues	SLOs, student writing	Confidence	Student surveys before science writing and after EVS capstone
Grading Time	Information from TAs	Research competency	SLOs, student writing	Stress resilience	Student surveys before science writing and after EVS capstone
Rates: withdrawal, D, and failing grades	Data from university	Process maturity	SLOs, student writing	Adaptability	SLOs, comparing drafts to feedback and final drafts
		Genre fluidity and creativity	Capstone paper	Flexibility	Capstone paper, follow-up surveys

research can be adopted and can inspire similar analyses by other TPC programs that have or want to seek collaborative relationships with STEM disciplines.

Limitations of Our Initial Research

Overall, we were excited about the knowledge we gained from the first phase of our participatory assessment research. Nonetheless, we have identified limitations that we will rectify. Our focus group included a small number of EVS faculty and support instructors; we hope to speak with and survey additional faculty and the TAs, who provide student feedback in the EVS capstone course. We also approached our focus-group results in a less formal and systematic way than is optimally described in the literature. We were not seeking metrics of reliability because this was an exploratory study designed to elicit the main themes and language that we could build upon in future phases of research. Finally, we were not able to address the other course (master's level) that we offer to EVS students because of time constraints. We will incorporate this into our future analyses.

Conclusions

Learning what stakeholders consider to be evidence of successful writing instruction will vary from institution to institution. Nevertheless, value exists in seeking to understand stakeholders' points of view, not only what they hope to see from our programs but also what they are seeing. Our focus group helped us understand what our STEM collaborators view as evidence of successful writing instruction, including improved metrics, improved writing skills, and progress on intangibles—such as maturity and flexibility. The emphasis our STEM collaborators gave to specific metrics and intangibles surprised us and gave us the language and criteria necessary to create a framework (represented in Table 5) to advance our collaboration and construct more extensive assessment research. Though the specific assessment research presented here is unique to our case, the participatory approach we have shared will benefit other programs seeking to understand their work and to market courses to other disciplines.

As noted above, we benefited from having worked with our STEM partners for seven years prior to beginning this assessment research. Because we began this program collaboratively, and because we met regularly, we were positioned to receive informal feedback from our colleagues. Rather than impose our preferences and expectations for how to conduct assessment, we strove to understand in concrete terms what our peers were seeing so we could together determine why and how the course was working for their students. Most significantly, we found that our science-writing course provides much more than instruction on writing clearly and citing sources; it changes EVS students' relationships to writing and provides them with intangible skills that we did not anticipate.

In reviewing our work, other programs in TPC can learn about the questions to ask to learn more about their own courses and curricula and see their work through the eyes of their collaborators. The perspectives they find and the evidence they uncover may reveal, as it has for us, that their course provides much more than a service to their students: it provides a whole new perspective on writing and communication and prepares them on many levels to take on the work of their chosen fields.

References

Arduser, Lora. (2018). Specialized technical writing service courses as a program sustainability tool? *Programmatic Perspectives*, 10(1), 12–43.

Ballard, Thomas M. (2018). Cross-disciplinary perspectives on technical communication: STEM faculty as stakeholders in the technical communication service course. *Programmatic Perspectives*, 10(2), 47–70.

Bratteteig, Tone; Bødker, Keld; Dittrich, Yvonne; Mogensen, Preben H.; & Simonsen, Jesper. (2013). Methods: Organising principles and general guidelines for participatory design projects. In Jesper Simonsen & Toni Robertson (Eds.), *Routledge international handbook of participatory design* (pp. 117–144). Routledge.

Breen, Rosanna L. (2006). A practical guide to focus-group research. *Journal of Geography in Higher Education*, 30(3), 463–475. https://doi.org/10.1080/03098260600927575

Cargile Cook, Kelli. (2002). Layered literacies: A theoretical frame for technical communication pedagogy. *Technical Communication Quarterly*, 11(1), 5–29.

Carnegie, Teena A. M. (2007). Integrating context into assessing U.S. technical communication programs. *Technical Communication*, 54(4), 447–458.

Carnegie, Teena A. M.; & Crane, Kate. (2018). Responsive curriculum change: Going beyond occupation demands. *Communication Design Quarterly*, 6(3), 25–31.

Coffey, Kathleen M.; Glotfelter, Angela; & Simmons, Michele. (2020). Dynamically responsive programmatic design: A framework for identifying pressures for change. *Programmatic Perspectives*, 11(2), 138–165.

Coppola, Nancy W. (2010). The technical communication body of knowledge initiative: An academic-practitioner partnership. *Technical Communication*, 57(1), 11–25.

Coppola, Nancy W.; Elliot, Norbert; & Newsham, Faye. (2016). Programmatic research in technical communication: An interpretive framework for writing program assessment. *Programmatic Perspectives*, 8(2), 5–45.

Eisenhart, Chris; & Gulbrandsen, Karen. (2020). Embracing efficiency: Using program design and assessment to face tough times. *Programmatic Perspectives*, 11(1), 68–87.

Hart, Hillary; & Baehr, Craig. (2013). Sustainable practices for developing a body of knowledge. *Technical Communication*, 60(4), 259–266.

Hart-Davidson, William. (2001). On writing, technical communication, and information technology: The core competencies of technical communication. *Technical Communication*, 48(2), 145–155.

Hashlamon, Yanar; & Teston, Christa. (2022). Teaching participative justice in professional writing. *Technical Communication Quarterly*, 31(2), 159–174.

Krueger, Richard A. (1998). *Analyzing & reporting focus group results* (Vols. 1–6). SAGE Publications. https://dx.doi.org/10.4135/9781483328157

Kynell, Teresa. (1999). Technical communication from 1850–1950: Where have we been? *Technical Communication Quarterly*, 8(2), 143–151.

Lam, Chris; Hannah, Mark A.; & Friess, Erin. (2016). Connecting programmatic research with social media: Using data from Twitter to inform programmatic decisions. *Programmatic Perspectives*, 8(2), 47–71.

McKee, Heidi A. (2016). Researching a new professional writing major: Miami University. *Programmatic Perspectives*, 8(2), 142–162.

Moore, Kristen R.; & Elliott, Timothy J. (2016). From participatory design to a listening infrastructure: A case of urban planning and participation. *Journal of Business and Technical Communication*, 30(1), 59–84.

Salvo, Michael J.; & Ren, Jingfang. (2007). Participatory assessment: Negotiating engagement in a technical communication program. *Technical Communication*, 54(4), 424–439.

Schreiber, Joanna; & Melonçon, Lisa. (2019). Creating a continuous improvement model for sustaining programs in technical and professional communication. *Journal of Technical Writing and Communication*, 49(3), 252–278.

Scott, J. Blake. (2004). Rearticulating civic engagement through cultural studies and service-learning. *Technical Communication Quarterly*, 13(3), 289–306.

Spinuzzi, Clay. (2005). The methodology of participatory design. *Technical Communication*, 52(2), 163–174.

St.Amant, Kirk. (2018). Contextualizing the technical communication service course: A research approach to reviewing, re-thinking, and revising the service course. *Programmatic Perspectives*, 10(1), 142–171.

Stanford, Jennifer S.; Rocheleau, Susan E.; Smith, Kevin P. W.; & Mohan, Jaya. (2017). Early undergraduate research experiences lead to similar learning gains for STEM and non-STEM undergraduates. *Studies in Higher Education*, 42 (1), 115–129.

Tracy, Sarah J. (2013). *Qualitative research methods: Collecting evidence, crafting analysis, communicating impact*. John Wiley & Sons.

Vealey, Kyle P.; & Hyde, Charlotte. (2015). Extending participatory assessment to STEM, community, and industry stakeholders: Rhetorical work and ethical considerations. *Programmatic Perspectives*, 7(2), 4–24.

Author Information

Ian R. Weaver is an Assistant Professor of English in the professional writing program at the University of North Carolina Wilmington. He coordinates the post-baccalaureate certificate in science and medical writing, and he teaches undergraduate and graduate courses intechnical and professional writing, grant writing, science writing, research methods, environmental writing, and technologies. His research investigates program building and the rhetoric employed in science and environmental communication as well as the use of participatory methodologies in community building.

Colleen A. Reilly is Professor of English and Faculty Associate for the Center for Teaching Excellence and Center for Faculty Leadership at the University of North Carolina Wilmington. She teaches undergraduate courses in professional and technical writing and graduate courses in science writing, research methods, and genders, sexualities, and technologies. Currently, she co-edits theJournal of Effective Teaching in Higher Education (jethe.org).