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Improving Students' Comprehension of STEM Writing Conventions

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Recently, faculty and Writing Center staff at Marshall University partnered to improve undergraduate STEM students' ability to clearly and efficiently communicate their knowledge of STEM concepts through discipline-specific writing conventions. We (Anna Rollins, the Writing Center director, and Kristen Lillvis, the English Graduate Programs director) corresponded with STEM faculty and coordinated writing classroom workshops in engineering, math, biology, geology, and computer science classrooms; we also hired and trained three graduate tutors who planned and facilitated each of the classroom writing workshops.[1] The tutors had a minimum of one year experience tutoring in the Writing Center and had completed courses in composition theory and pedagogy; none were undergraduate STEM majors. As part of their teaching, these tutors compiled genre and discipline-specific writing activities and developed a pedagogical handbook for future tutors working with student writers in the STEM fields. What we learned from our workshops will benefit writing centers hoping to offer tutor-led workshops aimed at increasing student comprehension of STEM writing conventions. Below, we offer background on our program of workshops, a model of our tutor preparation and workshop offerings, and reflections on potential future modifications of our program.

BACKGROUND: DEFINING STUDENT NEEDS

In informal conversations with students in the STEM disciplines, we learned that due to the lecture format of many STEM courses, students reported receiving little feedback on their writing. Instructors with large class sizes (a common situation in the STEM fields) who include writing assignments in their courses have noted the impracticality of providing feedback on writing, and these instructors often request assistance from teaching assistants or turn to practices such as Calibrated Peer Review (The Regents of the University of California).[2] Students still expressed frustration

with not receiving feedback on writing from STEM instructors, especially because they were being required to compose in new, discipline-specific genres that required a discussion of complex, newly-learned content. As we reflected upon this frustration expressed by many STEM students, we realized that this would be an ideal opportunity for the Writing Center to intervene in the form of tutor-led classroom workshops.

We sought STEM instructors who were open to incorporating tutor-led, STEM-focused workshops into their classrooms one to three times during the semester. We intended for the tutors to help students understand discipline-specific writing conventions related to a particular assignment or type of assignment that involved writing. We requested a syllabus, assignment sheets, and rubrics from interested faculty. With the understanding that negotiating demands of discipline-specific discourse is crucial, not just for clear communication but also for understanding course content (Martin; Unsworth), we crafted pedagogical materials related to the specific writing conventions of each of these disciplines prior to our classroom visits. Of the fifteen professors in the STEM disciplines we contacted with our proposal, six wanted us to work with seven STEM courses during the semester. We then arranged one or more writing workshops in biology, computer science, civil engineering, geology, and math courses that covered a range of genres being assigned (including team writing assignments) in the courses. The genres included mini-posters, memos, lab reports, vision statements, mapping assignments, and population model reports.

TUTOR PREPARATION AND PEDAGOGY

Having pinpointed student need for STEM writing support, built a framework for our project, and partnered with six STEM faculty across a wide range of disciplines, our next step was to train the tutors who would be working in those classrooms. The three tutors were asked to consider assignments given by STEM faculty through the lens of Michael Carter's four metagenres (or ways of doing that influence the structure of written genres) that characterize compositions in the academy: writing for performance, writing for problem solving, writing for empirical inquiry, and writing for research from sources (394-402). Through the lens of these metagenres, tutors were able to analyze the STEM writing assignments and articulate key discourse features based upon the assignment's overarching purpose. To better understand the use of Carter's metagenres in this context, consider this example of their application to a workshop on mini-posters in an Introduction to Cell Biology course. First, tutors assessed that this genre falls under Carter's description of the metagenre "writing for empirical

inquiry," which consists of "answering questions by drawing conclusions from systematic investigation based on empirical data" (396). The features that characterize this metagenre result in a particular structure: a text with clear subsections often utilizing versions of the terms introduction, materials/methods, results, and discussion. By learning the features of the "writing for empirical inquiry" metagenre, the tutors were able to highlight the connection between the purpose of the genre and its structure. Tutors noted that learning about the way generic features relate to purpose and structure aided the development of more specific lectures and guided questions in class workshops.

Tutors also learned key register features in the grammar of various academic genres and discussed how the genre's grammatical features related to students' current writing assignment in each course. For example, for multiple classes, tutors worked with students who were composing in the genre of procedural writing. We gave tutors information about the grammar that can be expected in procedural writing, such as the use of simple present tense clause structures in directions or imperative clause structures in instructions (Bloor and Bloor 85). This knowledge of the specific grammatical features was helpful for the tutors since they were able to provide specific instruction about word and sentence level expectations for a particular genre's discourse. This information was often implicit knowledge to STEM faculty, but was rarely expressed explicitly in class instructions.

A final key component of tutor preparation was reassurance. While the tutors were well-prepared to present writing workshops focused on the STEM instructors' writing assignments, we still needed to assure them that though they may be less familiar with the content of STEM disciplines, their knowledge of features related to the values of particular discourse communities would benefit students as they learned to negotiate the linguistic demands of a new discipline. During group meetings, we reminded them of situations where they had successfully given feedback to students in STEM disciplines and asked them to share additional examples of their successes. We reinforced the crucial role of the generalist tutor, as articulated by Dory Hammersley and Heath Shepard: the lack of knowledge that a tutor may have about the content in a particular discipline can actually be beneficial to the tutoring session as tutors work from their lack of content knowledge and translate the student's writing in order to navigate the revision process. While our tutors were outsiders to the STEM disciplines, their ability to analyze metagenres was enhanced by the fact that they were not embedded in one discipline. The tutors left these meetings

expressing their preparedness to tutor in unfamiliar disciplines.

FROM PREPARATION TO PRACTICE: THE CLASSROOM WORKSHOPS

Our tutors reviewed the course materials for each of their assigned class workshops and modified the workshop instruction to more clearly teach writing in conjunction with material already being taught in the class. Depending upon each professor's preference, tutors visited one to three times over the course of the semester. Each tutor conducted approximately four one-hour visits. For instance, in the Introduction to Cell Biology course previously discussed, tutors worked with students who were beginning to compose mini-posters based upon a lab they recently conducted. The tutors analyzed an instructor-provided mini-poster model according to both the "writing for empirical inquiry" metagenre and the discourse features expected in the genre of a lab report (past tense for procedures and present tense for discussion and conclusions) (Ryan and Zimmerelli 89). Tutors provided students with this information regarding genre expectations and then crafted self- and peer review questions by taking those expectations into account. For instance, when considering the genre of the mini-poster, which requires clarity and conciseness, questions that focused on global issues of the text were as follows:

- Is there any information that does not pertain to the requirements of the intro section (e.g., information that pertains more to other sections such as describing specifics of the experiment)?
- Does the intro contain accurate background information that correctly references the article? Is that information relevant to the specific organelle in question?

Questions that focused on local issues were as follows:

- Could the background information be simplified? Could words be omitted? Do sentences flow?
- Is the hypothesis clearly presented to readers or displayed as a statement of fact? Is the hypothesis specific to the organelle in question?

Our tutors followed this same process—combining instructor-provided models with metagenre and discourse features analysis—for each of the four class sessions they visited during the semester. For example, tutors giving workshops in the biology classroom also helped students unpack the staging of a lab report. The STEM faculty member provided a model lab report, and tutors

explained what type of information and writing was expected in the introduction, methods, results, and discussion sections. For instance, tutors explained what was expected in the introductory section of a lab report by noting that the first few sentences should provide specific information about the topic of research that led to a hypothesis. Following that background, tutors instructed students that they should explicitly state their hypothesis in a first- person plural active sentence (i.e. "Our hypothesis stated …"). Similarly, in the computer science classroom, tutors worked with students on conciseness as a composition skill. Tutors composed a sample paragraph that discussed content related to the course and that included writing issues related to conciseness that students often struggled with, as noted by the instructor. Tutors spent workshop time working with students to revise the paragraph by focusing on the following instructions: say a lot in a small space, state only what is necessary, and use simple sentence structures. Tutors projected this paragraph on a screen and asked for a volunteer to read the paragraph aloud. Students were then asked to revise this sample paragraph independently. Tutors circulated throughout the room, asking students to share their revisions and working with them to put the instructions into practice. Once all of the students completed their revisions, the tutors asked for volunteers to share their work aloud. After a revision was read, tutors led the whole class in assessing the revision for conciseness, asking students to identify concise passages and to revise (as a whole class) passages that could be simplified. The tutors and students worked together until they agreed that the passages met genre conventions.

EVALUATING THE WORKSHOPS: SURVEY RESULTS AND PROGRAMMATIC IMPROVEMENTS

We gained valuable information from student feedback surveys administered by tutors immediately after each class workshop. On each of the Likert scale surveys, students were asked the following three questions: "How would you rank your writing ability prior to this semester?"; "Did the work we completed in [the] class [workshop] help you better understand the writing assignments given in the course?"; and "Did the work we completed in class help you understand the standards and expectations for writers in your major?" We noted an interesting trend in the responses: an inverse relationship between how students rated themselves as writers and how students assessed the instruction and work we completed in the workshop. For instance, students who self-identified as weak or average writers were more likely to assess our instruction as incredibly helpful. Students who self-identified as strong writers, however, were more likely to assess our instruction as moderately helpful or less than helpful.

There are, of course, several ways to interpret the information from our survey: students who self-assessed as stronger writers could have felt that the information discussed in the workshops was information that they were already familiar with. These students may have already believed they did not need writing instruction due to prior writing success in their composition courses or in high school writing classes. In addition to these possibilities, student feedback may have been influenced by the fact that our tutors were still generalist tutors. Our tutors all had undergraduate degrees in majors outside of STEM disciplines, something that the STEM students were aware of in the workshops. It is possible that, despite our tutors' extensive preparation, knowledge of generic conventions, and ability to teach writing, STEM students assumed their lack of a STEM degree still translated to a lesser ability to tutor STEM writing topics.

After reflecting on our survey feedback, we decided that one key to promoting the Writing Center to advanced writers is to highlight the training tutors have received in writing across the disciplines. As Catherine Savini discusses issues that accompany generalist and discipline-specific tutoring, she notes that writing consultants can help students across the disciplines gain access to new discourses through the following methods: sharing personal experience with a specific genre and discipline, interrogating students about that genre and discipline, and instructing students on how to find and analyze model texts (3). Like nearly all undergraduates, tutors were required to complete general education requirements in the STEM disciplines during their coursework. Additionally, they are required to complete a four-credit Writing Center and Composition Theory course. As we modify this course in accordance with our workshops and survey findings, during the "tutoring across the disciplines" unit we will ask tutors to reflect upon writing they have composed for their general education courses outside of their discipline and to consider how they will speak about their prior composition experiences with students in those disciplines.

While surveys of students yielded mixed results, holding tutor-led workshops in a variety of STEM courses resulted in our center's ability to improve pedagogical resources for tutors working with students across all disciplines. After our STEM classroom workshops, our tutors composed two "best practice" handbooks—one for tutors and one for STEM faculty—based on the work they completed analyzing faculty assignments and providing in-class STEM writing instruction; the handbooks provided specific instruction for individuals working with students writing across the disciplines. Our handbook for tutors included the following

components: evaluating assignment sheets and rubrics, identifying STEM writing conventions, providing feedback, navigating the drafting/revision process, drawing on APA style basics, and giving a discipline-specific class writing workshop. Our handbook for STEM faculty included the following components: creating and explaining assignment sheets, designing a rubric, conducting a writing lesson, planning the drafting process, facilitating peer review, providing feedback, and advocating for the writing center. We have promoted this handbook to STEM faculty at our annual campus teaching conference and also at our campus's Center for Teaching and Learning and Writing Across the Curriculum events.[3] Faculty have expressed appreciation for resources that aid in the development of written course materials and have even inquired about scheduling Writing Center appointments in order to work with tutors as they craft their written classroom materials, though faculty have not followed through with these meetings. To further increase tutor competence in STEM tutoring, in the upcoming academic year we will be awarding digital badges, a strategy for continuing education and professionalization discussed by Tammy Conard-Salvo and John P. Bomkamp. Tutors interested in earning these digital badges will be assigned reading material about genre and tutoring across the disciplines; they will also be instructed to review the STEM writing best practice handbooks authored by our tutors. After reviewing these materials, tutors will be asked to engage in guided, reflective writing about their assigned readings; they will also be given assessments of their comprehension in the form of quizzes. Finally, tutors will be required to complete a particular number of sessions with STEM students in the Writing Center, and they will be asked to compose a reflection about one of these sessions, applying their knowledge of genre and tutoring across the disciplines in their discussion of the session. This final activity, we hope, will make generalist tutors feel more personally experienced in working with STEM writing assignments and will improve their ability to reference that personal experience in future tutoring sessions with STEM students. It is our hope that, by providing this additional training rooted in the cumulative knowledge gained from conducting workshops in STEM courses, we will have more skilled tutors to work with all student writers across our university's campus.

NOTES

1. This research project was funded by Marshall University's Hedrick Program Grant for Teaching Innovation.

2. With Calibrated Peer Review, students prepare for reviewing their peers' work training to be an evaluator, first evaluating sample "calibration" texts to align their responses with the instructor's criteria before responding to anonymized peer

writing. Finally, students respond to and evaluate their own writing (The Regents of the University of California).

3. The handbooks are available online at www.marshall.edu/ctl/faculty-awards-and-grants/hedrick-program-grant-for-teaching-innovation/2016-2017-improving-stem-students-writing.

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