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Museum Exhibits and Science Literacy: Using Technical Writing and Science to Make Connections Among Disciplines and Communities

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Abstract

This article presents a model for increasing science literacy of P-16 students as well as community members by engaging university students in the design and development of university museum exhibits. While the design of this project was in large part motivated by time and budget constraints faced by the faculty members involved, the positive outcomes of the project with respect to student learning and community involvement suggest that this kind of project is highly valuable and worth repeating.

Keywords: Museum exhibits, science literacy, technical writing.

The authors of this article teach at Southwest Minnesota State University (SMSU), a public, comprehensive liberal arts institution in rural Minnesota. The campus attracts a population of roughly of 3,000 undergraduates who come from nearby small towns, more distant urban areas, and international communities. Students come to the institution with a range of backgrounds and skill levels, and as is true of many small, inexpensive, public institutions, our campus attracts first-generation and non-traditional college students. Many of these students work long hours to pay for their own educations. This variety of students and skill levels, the limited funding at the institution, and the fact that instructors teach at least four three-credit courses a semester in addition to their service and scholarship commitments creates a challenging environment for education.

We have discovered that it is possible to meet these challenges by thinking creatively, working in small stages and steps, and collaborating across disciplines. We have learned that by honoring the unique context of our programs and their broader connections to the institution and community, we can create significant learning opportunities for our students while also meeting service commitments to the university and surrounding community.

The course English 360: Science and Technical Writing was instrumental in teaching us these lessons. Teresa Henning, one of the co-authors of this article whose background is in English, routinely teaches the course, but since the course is a required course for both science and humanities majors, Henning routinely consults with the department chair of

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science who at the time the course was offered was co-author Elizabeth Desy whose background is in biology. Desy is now Dean of the School of Arts, Letters, and Sciences (ALS) and is even more invested in serving a variety of populations as she considers how to make the best use of the limited resources in ALS. English 360's mix of majors and disciplines created the fertile atmosphere for a cross-disciplinary class project that would ultimately work to positively impact a variety of populations including college students, P-12 students, science and humanities faculty, and local community members.

General Learning Outcomes for English 360

The overall goal for English 360: Scientific and Technical writing is to help students realize that both scientific writing and technical writing have the same aim: to manage "technical information in ways that allow people to take action" (Johnson-Sheehan, 2007, p. 5). While this learning goal may seem basic, students find it difficult to write in a manner that emphasizes the audience's needs rather than the writer's needs or the subject matter. To help ease students into audience-based thinking and writing, most technical writing experts advocate as Michael Salvo (2002) does that students participate in "repeat[ed] cycles of observing, critiquing, articulating and creating designs of information objects [i.e. texts]" and write for 'real' audiences in 'real' contexts (Johnson-Eiola, 2004). In addition to supporting these two pedagogical tenets, the course must also be accessible to both humanities and science students. The science in the course cannot be so technical that it prohibits the participation of humanities students yet it cannot be so basic that it prohibits science students from effectively applying their learning.

Given all these potentially conflicting course goals and requirements, some might argue that science and technical writing should in fact be two separate courses: one scientific writing and one technical writing. Certainly, such a separation exits at larger campuses. However, the small size of our institution does not make it possible to separate these courses. Neither group of students (science or humanity) is large enough to justify the creation of a separate course.

In the spirit of best serving the unique populations that take English 360, co-author Henning began to look for a real, on-campus project that might allow her to meet a variety of needs. When speaking to co-author Desy at an ALS retreat, Henning discovered that SMSU's Natural Science Museum could become an ideal candidate for such a project. Desy directs the museum but does not receive any reassigned time to do so and must operate the museum on a shoe-string budget. As Semper (1990) notes, while museums at small colleges and universities are important educational and community-based resources for science learning, they are often understaffed and under funded. SMSU is no stranger to such constraints; it is often difficult for the museum to bring in quality, new exhibits that are engaging and educational. However, despite these challenges, Desy facilitates museum visits for roughly 1,200 students and teachers from P-12 schools in the area.

Besides enhancing college students' understandings of audience and helping the museum add to its exhibits in a creative and inexpensive manner, a project for the museum provides an important out-of-classroom context that can enhance all students' understand-

ings of science. Out-of-classroom contexts add to and improve the learning of science. The Teaching and Learning Research Programme's "Beyond 2000" report (2006) suggests a need for "science education for citizenship," which would help young people develop a broad appreciation of science and the natural world around them (Millar and Osborne, 1998). Informal educational venues such as museums can contribute to "science education for citizenship" (i.e., science literacy) by stimulating the curiosity of young people about science and the natural world around them (TLRP Commentary, 2006).

This project also engaged students in meeting several of the Association of American Colleges and Universities' (AAC&U) "LEAP" initiative liberal education outcomes that all students should achieve during their undergraduate study. Outcomes especially relevant to the learning outcomes of English 360 include:

- Outcome One: "knowledge of human culture and the natural world" through study of such subjects as science, social science, math, humanities and art (AAC&U, 2005).
- Outcome Two: "intellectual and practical skills" such as "written and oral communication" skills (AAC&U, 2005).
- Outcome Three: "intellectual and practical skills" such as "inquiry, critical and creative thinking" (AAC&U, 2005).
- Outcome Four: "intellectual and practical skills" such as "teamwork" (AAC&U, 2005).
- Outcome Five: "individual and social responsibility" expressed through such behaviors as "civic responsibility and engagement" (AAC&U, 2005).

English 360 Museum Exhibit Assignment Description

As an experiment, Desy and Henning agreed to let English 360 students try their hands at creating poster-size exhibits for the museum. Henning agreed to direct the project and require that students complete the assignment in a PowerPoint poster template which would allow the Science Department to print successful projects on their GIS printer rather than sending the posters out for printing, an expense that would be prohibitive.
To keep the project manageable and to capitalize on the mix of majors and abilities, Henning required students to work in self-selected teams or three or four; this requirement also has the added benefit of linking this project to LEAP Outcome Four: "teamwork" (AAC&U, 2005). During the selection of teams, Henning urged students to make sure that their group consisted of at least one science major and at least one experienced PowerPoint user. Figure 1 provides the exact wording of the assignment.

The assignment in Figure 1 relates to several of the course's learning outcomes as well as several LEAP Outcomes. First, the assignment's focus on audience and context emphasizes writing with consideration for purpose, audience, and the conventions of the discourse community (or organization) and genre (e.g., memo, letter, report, etc.) in communicating. This emphasis on communication aligns this assignment with LEAP Outcome Two: "written and oral communication" skills (AAC&U, 2005). Successful posters need to be sensitive to the variety of audiences and purposes museum exhibits can serve

Figure 1. English 360 Technical Description Poster Assignment.

English 360 Technical Description Poster Project: For this assignment, you will be required to work in a team of three or four to create a technical description for the SMSU field science museum. Your technical description will need to be written for a 4th grade audience and will need to be formatted as a poster. Groups will be assigned one of the following topics: butterflies vs. moths; prairie plants; Minnesota wetlands; Minnesota prairies; or fish of Minnesota. Your group will be expected to do research on your topic and cite that research in your poster (if necessary). Only credible, scientific sources may be used. Wikipedia and .com web sites MAY NOT BE USED!

In addition to creating a poster, your group will have to turn in:
A transmittal memo (about 2 single-spaced pages) addressed to me that overviews the topic/poster and discusses what document design choices the group made to meet the needs of the rhetorical situation. You should especially discuss how the document's content and design is appropriate for 4th grade users as well as how the design will fit with the other exhibits in the museum.

- ✓ *A revised version of the activity memo* **submitted to me on 3/6/07** that summarizes the group's activity to that date, discusses the results achieved, and offers a plan for future work. Please be sure to refer to Chapter 21 for more specific guidelines.

- ✓ *A thumbnail printing of your poster* that addresses the guidelines for technical descriptions found in Chapter 17.

- ✓ *An electronic PowerPoint copy* of your poster that you email to me.

Supporting materials that represent all planning and drafting the group has done as well as the results from in-class peer review.

Grading Criteria

Folders will be evaluated for how well their documents:
- ✓ engage specific audiences through the use of appropriate details and stylistic choices;
- ✓ make use of patterns of organization appropriate for the various documents in the folder;
- ✓ organize information in a manner that is reader-centered;
- ✓ follow the design principles of balance, alignment, grouping, consistency, and contrast;
- ✓ make use of correct grammar and spelling (documents need to be as flawless as possible).

while also being sensitive to the design and space constraints of this unique genre (i.e., a PowerPoint poster).

Also, this assignment, like others in the course, requires that students work together to solve a communication problem (i.e., how to best convey technical, scientific information to a young, lay audience). Solving this communication problem requires that students draw on a variety of strategies including but not limited to: applying critical thinking skills to a communication task; making use of credible, reliable, and relevant source material; working with others in a manner that is congenial, civil, productive and responsible; managing documents in a variety of electronic documents (e.g., MS-Word, PowerPoint, and email); using patterns of organization in a manner that is appropriate for a specific communication situation; and varying levels of style and language use for a specific communication situation. Successfully meeting these assignment outcomes requires the use of skills related to LEAP Outcome Three: "inquiry, critical and creative thinking" and LEAP Outcome Four: "teamwork" (AAC&U, 2005).

Finally, the public and service learning aspects of the assignment (i.e., posters go on display and do not just remain in the teacher's in box) align it in LEAP Outcome Five "civic responsibility and engagement" (AAC&U, 2005) while also making it possible that more students might meet these assignment's learning goals with a degree of excellence.

English 360 Museum Exhibit Assignment Classroom Outcomes

In considering the outcomes of this project, this article will first consider outcomes that affected students taking the course and then consider broader impacts on those outside the classroom. First and foremost, the nature of this assignment did allow undergraduates to excel in technical writing in an atypical manner. As already noted, good technical writing manages information "in ways that allow people to take action" (Johnson-Sheehan, 2007, p. 5). Good technical writing is also often "interactive and adaptable, reader-oriented, produced collaboratively, and visual" (Johnson-Sheehan, 2007, p. 5). Managing information in the manner Johnson-Sheehan describes requires students to apply LEAP Outcome One: "knowledge of human culture and the natural world," LEAP Outcome Two: "written and oral communication" skills and LEAP Outcome Three: "intellectual and practical skills" such as "inquiry, critical and creative thinking" (AAC&U, 2005).

In addition to meeting these LEAP Outcomes, it is also important to reiterate that all of the course's museum exhibit projects strongly support LEAP Outcome Four: "teamwork" (AAC&U, 2005) as well as meeting Johnson-Sheehan's (2007) requirement that good technical writing is collaborative as this project was completed in teams of three or four students. The students' teamwork was further enhanced by the assignment's link to the museum. As Semper (1990) notes, experiences in museums support peer interaction (i.e., teamwork). Peer interaction enhanced students' learning in English 360 in two ways. First, in their class visit to the museum before designing their posters, college students worked together to complete a worksheet designed to help them analyze the existing exhibits and plan for how their own exhibit could fit into the museum (see Figure 2). Secondly, peer interaction was maintained throughout the writing of this project through

Figure 2. Natural History Museum Fact Finding Sheet.

1. Look at the example posters in the museum, and explain:
   - ✓ What is the focus/topic of each?
   - ✓ How are they formatted?
   - ✓ How are source citations/references handled?
   - ✓ In what ways do they seek to engage a fourth-grade audience?
   - ✓ How do they partition their subject?
2. What material does the museum have concerning your topic? In what ways might you utilize this information? Build on this information?
3. Record any additional useful information about the museum here:

activities in and out of class. Students were given some time each class period to work on their projects together, and they made informal, one-minute, progress reports to the whole class. In addition, teams met out of class or through email to complete their project on time.

As this overview of outcome suggests, this assignment allowed students to meet requirements related to technical writing, the assignment's grading criteria, and LEAP Outcomes. This point becomes most evident when one closely considers two examples of student work from this project that are currently on display at the museum: Moths and Butterflies of Southwest Minnesota and Prairie Plant Directory. Each example can be viewed by clicking on its respective title.

Moths and Butterflies of Southwest Minnesota was the most unique of all of the student group projects in that they were the only ones who departed from the standard poster template. In the group's transmittal memo discussing their writing choices for the assignment, they noted that they departed from the template in the effort to give their poster a "circular feel" that mimics the life cycle of these insects. This group's circular design choice for the poster is significant in that it allows them to integrate the technical writing principle of visual design (Johnson-Sheehan, 2007) with that of producing a "reader-oriented" (Johnson-Sheehan, 2007) document. This design choice also integrates several of the LEAP Outcomes including Outcome One: "knowledge of human culture and the natural world, " Outcome Two: "written and oral communication" skills, and LEAP Outcome Three: "intellectual and practical skills" such as "inquiry, critical and creative thinking" (AAC&U, 2005).

Apart from the overall visual design, an astute reader will also notice other reader-oriented writing choices. For instance, in order to help their audience distinguish between the types of insects, these writers use concrete, sensory details like skinny, fat, knobs, and feathery which help a young audience imagine these insects' differences. Such reader-oriented choices allow the writers to again integrate LEAP Outcome One: "knowledge of human culture and the natural world, " with Outcome Two: "written and oral communication" skills (AAC&U, 2005). Pictures further reinforce the poster's meaning, and the

judicious uses of primary colors help further attract a young audience and demonstrate LEAP Outcome Three: "intellectual and practical skills" such as "inquiry, critical and creative thinking" (AAC&U, 2005).

Also, this poster's style makes attempts to interact with its audience. Even though they are writing to a young audience, the authors of this poster do not "talk down" to the audience and do not avoid using technical terms. However, when technical terms like "nocturnal" are used, they are defined simply and directly. Additionally, the writers use a series of interactive questions to help young viewers engage with the poster. Finally, the authors of this poster clearly cite their work which models good research behavior for young students, but also orients part of the poster toward a teacher audience by providing teachers with resources to which they can refer when they return to their classrooms after visiting the museum. All of these writing choices demonstrate further evidence of these students successful fulfillment of LEAP Outcome One: "knowledge of human culture and the natural world" and Outcome Two: "written and oral communication" skills (AAC&U, 2005).

The Prairie Plant Directory makes use of a standard poster template that is commonly used by science majors for research posters that they create in their science courses. In the team's transmittal memo discussing their writing choices for the assignment, the authors explain that they decided to stick to the traditional template as doing so, "helped them keep the material organized." Here, the authors echo Johnson-Sheehan's (2007) point that good technical writing should manage information; keeping material organized is one way to do that. Keeping material organized is also a feature of good writing thus aligning these authors' work with LEAP Outcome Two: "written and oral communication" skills (AAC&U, 2005).

However, this poster's organization is enhanced by some customizations the authors made to the template. Readers will notice that the longer columns of the template are divided by dashed lines, and that pictures are alternatively placed on the right and left. Both of these customizations use a kind of "visual grammar" to help readers navigate the document easily. Also, the background color of each column while not a primary color is the cheerful color (purple, blue, yellow, or green) that a young audience is likely to find appealing. The flowers themselves are appealing as well, and the alternative left/right placement capitalizes on this fact quite well by continually drawing the eye to the poster. This poster's design customizations are significant in that these customizations allow the authors to integrate the technical writing principle of visual design (Johnson-Sheehan, 2007) with that of producing a "reader-oriented" (Johnson-Sheehan, 2007) document. These customizations also allow the authors to integrate three LEAP Outcomes: Outcome One: "knowledge of human culture and the natural world, " Outcome Two: "written and oral communication" skills, and Outcome Three: "intellectual and practical skills" such as "inquiry, critical and creative thinking" (AAC&U, 2005).

Another way that the Prairie Plant Directory stays "reader oriented" (Johnson-Sheehan, 2007) and aligns itself with LEAP Outcome Two: "written and oral communication" skills (AAC&U, 2005) is that it takes advantage of the local context of SMSU. In addi-

tion to the Natural History Museum, SMSU is also home to a small, wilderness preserve which includes a reconstructed prairie. One of this poster's underlying purposes is to inform the audience of these plants in the hopes that teachers and students will also make the wilderness preserve part of their visit (or a return visit if weather prohibits a visit to the preserve). The campus map helps to further reinforce this point.

As was true of "Moths and Butterflies of Southwest Minnesota," this poster's style makes attempts to interact with its audience. The authors of this poster do not "talk down" to the audience and do not avoid using technical terms. They also use a series of interactive questions to help young viewers engage with the poster. Here again, the authors of this poster clearly cite their work which models good research behavior for young students and orients part of the poster to a teacher audience by providing teachers with resources to which they can refer when they return to their classrooms after visiting the museum. All of these writing choices demonstrate further evidence of these students successful fulfillment of LEAP Outcome One: "knowledge of human culture and the natural world" and Outcome Two: "written and oral communication" skills (AAC&U, 2005).

English 360 Museum Exhibit Assignment Community Outcomes

In addition to positive learning outcomes for students in the English 360 course, this project also positively impacts the P-12 students who visit the museum. As is evident through such national initiatives such as STEM and Project Kaleidoscope (PKAL), there is growing concern about our nation's ability to adequately prepare a scientific- and math-literate workforce for the 21st-century. One way to deal with this concern is to provide students with both formal and informal education in the area of math and science. Informal education, such as a field trip to SMSU's Natural Science Museum, provides one way of stimulating the curiosity of young people about the natural world (TLRP, 2006; Roscoe 2006). By designing exhibits that are creative, visually appealing, and informative, English 360 students not only contribute to the museum in general, but they also contribute very specifically to the learning of these young people thus aligning the work of English 360 students with LEAP Outcome Five: "individual and social responsibility" expressed through such behaviors as "civic responsibility and engagement" (AAC&U, 2005).

On top of contributing to the learning of its visitors, students in English 360 also have a chance to impact positively the way young people respond to the museum. This fact is important because as Semper (1990) indicates experiences in museums can motivate children (and adults) to become more inquisitive. Also, since this museum is housed on campus, the work of students in English 360 has the potential to extend relationships between an institution of higher learning and the surrounding community (Rao, Shamah, & Collay, 2007). This latter point is particularly crucial for our institution as the rural nature of our environment means that the SMSU can serve as the catalyst for educational innovation by its commitment to supporting, encouraging, and providing community-based learning for its students. These connections to the community further allow students to meet LEAP Outcome Five: "individual and social responsibility" expressed through such behaviors as "civic responsibility and engagement" (AAC&U, 2005).

Project Reflections: Directions for Us and Others

On the whole, we were pleased with the outcomes of this project for a number of reasons. The mix of disciplines, the mix of writing and science, and the mix of formal (classroom) learning and informal (museum) learning yielded several positive outcomes for SMSU college students and the local community. First, the value of university students' educational experience was enhanced through a hands-on, applied class project. Secondly, students honed their problem-solving, communication, research skills, and their small group, interpersonal, communication skills. Finally, in so doing, students performed a valuable service for both the university and local communities by enhancing the educational value of SMSU's Natural History Museum.

Given this project's success we are excited by the prospect of developing other projects where a mix of disciplines and contexts is possible and hope that we have excited others to pursue similar projects. However, there are a few additional directions we would like to take such projects in the future. First, if we pursue such a project again, we would build in more formative evaluation and invite the users of the museum to evaluate their experiences with the museum and the new exhibits. We would also be more deliberate in sharing with others at our own institution what we did and how we did it so that they too might be inspired to creatively problem by creating connections among various disciplines and contexts. We would also try to involve more faculty in similar projects and be more deliberate about making notes of our reflections and learning along the way. Finally, in pursuing more projects, we would try to keep in mind that this project was successful because it was relevant to local needs and conditions of our institution and surrounding community. We would be careful in the future to continue to honor the unique contexts of our institution and community.

In sum, we view what we did as a possible prototype or model for creatively addressing our institution's limited resources with respect to time and money. We have come to realize that seeing such solutions requires creative thinking, optimism, and willingness to problem solve. One must learn to be proactive, and rather than letting constraints drive one's work, one needs to learn to drive the constraints and use them as an opportunity for making connections. We have also learned that small steps can allow one to make big moves in creating such solutions. Making connections across disciplines and populations (e.g., college students, college faculty, P-12 students, P-12 teachers, and community members) does not require large curriculum revisions.

In our instance, this one small project had a synergy that surprised us as we were able to make multiple connections across disciplines, populations, and learning outcomes. Not only did this project help our students to successfully meet a variety of local and national learning outcomes, but it helped us reflect on our work and create connections among ourselves, our students, our institution, and local constituencies. Our openness to seeing connections and willingness to work in small steps helped us create some valuable outcomes and connections that we hope to replicate in future projects that build on this initial small but significant step.

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