Returning to an Industry-informed Technical Writing and Communication Course Design

Dr. Alyson Grace Eggleston, The Citadel

Alyson G. Eggleston received her B.A. and M.A. in English with a focus on writing pedagogy and linguistics from Youngstown State University and her Ph.D. in Linguistics from Purdue University. Her research and teaching interests are in technical and scientific writing pedagogy and the interaction of language and cognition. She is an Assistant Professor in the Department of English, Fine Arts, and Communications at The Citadel, The Military College of South Carolina.

Dr. Robert J. Rabb P.E., The Citadel

Robert Rabb is an associate professor and the Mechanical Engineering Program Director at The Citadel. He previously taught mechanical engineering at the United States Military Academy at West Point. He received his B.S. in Mechanical Engineering from the United States Military Academy and his M.S.E. and PhD in Mechanical Engineering from the University of Texas at Austin. His research and teaching interests are in mechatronics, regenerative power, and multidisciplinary engineering.
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At inception, technical writing course design was informed by military and industry needs. Changing student demographics during the 20th century, coupled with a spate of retirements of military- and industry-connected technical writing instructors, resulted in deep changes to both technical writing as a field and the way it is taught [1]. These reverberations continue in present day technical writing classrooms. Current government and industry stakeholders are aware that technical and engineering employees could benefit from continuing education in technical writing [2]. Many government agencies and industries have realized that they may have a superior product or service, but they miss opportunities because their grant or proposal writers conveyed improper or inadequate information. And while the conventional focus on rhetorical positioning in technical writing courses can result in more careful student writers, this paper calls for a return to producing effective authentic documents—those written work products that demonstrate awareness of known and unknown readers, document project management, and are written to make reading easy. Moreover, these authentic documents should be situational, and produced in response to real project demands, as opposed to written products that exclusively attempt to imagine appropriate responses to hypothetical situations.

Realizing this need, this paper identifies key pathways for developing and strengthening ties between academic institutions and industry stakeholders that have been successful at the The Citadel. Using student success indicators in a technical writing and communication course designed for engineering students, quantitative and qualitative results from two case studies are presented. Results are extracted from pre- and post-testing of student performance indicators at The Citadel, as well as from surveys to gauge student perceptions of performance and confidence. The first case study presents evidence of student performance gains observed after completion of a device repair guide project, produced for iFixit, a consumer-focused device repair company, to meet the needs of real users. The second case study presents evidence of student performance gains after implementing a condensed version of an industry-requested workshop on proposal writing. This paper makes recommendations for technical writing course design and assessment, as well as the demonstrated merits of building industry-informed projects in the technical writing classroom, putting rhetoric in action.

Introduction

More than a historical footnote, the teaching of technical writing began as a joint enterprise between the academy and military and industry-stakeholders [1]. Initially a consequence of the Servicemen’s Readjustment Act of 1944, Public Law 346, technical writing classes were increasingly offered in the post-war years, and initially were designed and taught by instructors with their own military and industry experience—which necessarily informed the chosen student learning outcomes for these curricula. As these instructors began to retire, the field of technical writing and its pedagogy was broadened by educators and theorists whose mission was establishing programmatic goals for the discipline that would define it as just as sufficiently rigorous and grounded in theory as tangential disciplines, e.g., Rhetoric and Composition. This clash of goals brought with it an essential conflict between two pedagogies. The retiring instructor cohort valued praxis, and student success was defined as demonstrated competency in
producing authentic documents [3], such as reports, memoranda, requests, etc., whereas the then incoming instructor cohort prized a process-based approach to writing, which made space for reflection, social responsibility, and audience awareness. Current approaches to technical writing process and pedagogy affirm an integrative approach [4]-[8] wherein the creation of authentic documents or field-typical documents [7] is situated against an increasing need for engineering students to improve their rhetorical and audience awareness, as well as their understanding of a device user’s experience [9].

**Background**

Industry and academia have uniformly acknowledged the need for engineering graduates to improve communication skills [10]-[12]. The American Society of Mechanical Engineers (ASME) recommend curricular design that supports “effective communication, persuasiveness, diplomacy, and cultural awareness” [11]. Meanwhile, ABET, the accreditation board for engineering programs in the US and abroad identifies communication as a key student learning outcome: “(3) demonstrate an ability to communicate effectively with a range of audiences” [12].

The call for creating authentic documents is well-received within the field of Technical Communication, as well. Textbooks targeting future engineers and scientists emphasize the need for exposure to and real-world application of common professional documents and reports, including: research briefs, Requests for Proposals (RFPs), proposals, and impactful presentations [13]-[14].

The Technical Writing and Communications course described here emerged in 2015 as a result of collaborations between a humanities instructor and the School of Engineering at The Citadel. Developed from a needs-based assessment survey that sought to identify pain points for the program, growth trajectories, and desired outcomes, initial offerings of this course used a Project-based Learning (PBL) approach to provide sophomore-level exposure to authentic documents. PBL-approaches to teaching feature opportunities for reflection, knowledge scaffolding, and confronting the boundaries of one’s knowledge [15]. Studies in STEM-specific PBL approaches suggest that low- and intermediate-performing students, as well as minority students, demonstrate statistically significant performance gains when provided with an experiential teaching approach, but the reasons for this success are not well understood [16]. Students’ work culminated in four projects submitted throughout the semester:

1) Professional Portfolio; includes authentic documents, e.g., resume, cover letter, situational-response memos, elevator pitch recordings and self-reflection paper.

2) Technical Manual Evaluation; produce a summary evaluative report on three familiar user manuals of students’ choosing. Self-reflection, included.

3) Technical Reporting; produce a concise, summative research brief on an engineering topic of personal interest, documented with a discipline-appropriate style. Self-reflection, included.

4) Oral Briefing; deliver a short oral presentation to a peer audience, explaining
significance of technical report topic, and demonstrating adept audience interaction. Self-
reflection, included.

In Fall 2018, two sections of the Technical Writing and Communications course received an altered project line-up, while one section retained the prior curriculum. For two pilot sections, the second project, (2) Technical Manuals, was replaced with the iFixit Technical Documentation project—an experiential, collaborative device repair project. This project is coordinated by iFixit, a wiki-based site that empowers users to fix their own electromechanical devices and share their technical knowledge with the world [17].

**Industry-informed Teaching**

Industry-led service-learning is also a key component of the iFixit Technical Documentation Project [18]-[20]. iFixit’s non-profit arm, iFixit EDU, connects students with online content explaining the economic, ecological, and even ethical rationale for owner-repair—while also demonstrating a user-oriented template for effective repair procedure documentation. The collaboration between iFixit’s technical writers, the iFixit-trained course instructor, and students results in an almost turn-key, online experience, entirely populated with student-created content that is subject to iterative feedback cycles before final approval by iFixit technical writing staff. At completion of each milestone, iFixit technical writers provide feedback for students, targeting technical prose; formatting; link navigation; image quality and lighting; and overall site usability. At project completion, students have performed essentially a corporate-led service that benefits a company and global users, producing a real-world product that can also be added to their resume [14].

Local industries are also a rich source of collaboration and input, resulting in increased relevancy of course content and reinforced industry-academe partnerships [9]. Seeking to identify and address emergent technical writing challenges at the local, industrial level, the authors also met with industry partners, conducted a needs-based assessment, and used those results to create a new summative final assignment in the technical writing and communications course—as well as propose a workshop for the benefit of the industry partner’s technical writing teams.

Initial meetings with the industry partner probed current challenges being experienced with collaborative workplace writing. Given a summary table of collaborative writing styles, as shown in Table 1, the industry partner was asked to choose which style best resembled their own. Industry partners were also asked for benchmarks of technical writing competency and success. These responses were used to create learning outcomes for both the institution’s students and attendees of the proposed workshop. Finally, industry partners were asked for evidence of pernicious, reoccurring issues related to technical prose, the results of which were also incorporated into a final assignment for the Technical Writing and Communication class, and the proposed industry partner workshop.
### Table 1: Collaborative Writing Strategies

<table>
<thead>
<tr>
<th>Writing Strategy</th>
<th>Description</th>
<th>When to use</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-author</td>
<td>One member writes for the entire group.</td>
<td>For simple tasks.</td>
<td>Efficient; simple style.</td>
<td>May misrepresent group consensus.</td>
</tr>
<tr>
<td>Sequential</td>
<td>Each member is assigned a specific part.</td>
<td>For asynchronous work with poor coordination.</td>
<td>Easy to organize; simplifies planning.</td>
<td>Version control issues arise with subsequent writers.</td>
</tr>
<tr>
<td>Parallel Writing: Horizontal Division</td>
<td>Writing assignments are distributed randomly and are produced in parallel.</td>
<td>When high volume of rapid output is needed and group is well coordinated.</td>
<td>Efficient; high volume of output.</td>
<td>Redundant work can be produced; stylistic differences; doesn’t leverage individual talents well.</td>
</tr>
<tr>
<td>Parallel Writing: Stratified Division</td>
<td>Writing assignments are assigned based on skillsets and are produced in parallel.</td>
<td>When high volume of rapid output is needed and group is well coordinated with clearly defined roles.</td>
<td>Efficient; high volume of quality output; better use of individual talent.</td>
<td>Redundant work can be produced; stylistic differences; potential overload of information.</td>
</tr>
<tr>
<td>Reactive Writing</td>
<td>Members create a document in real time, while others review, react, and adjust to each other’s changes and additions without much pre-planning or explicit coordination.</td>
<td>Small groups; high levels of creativity; high levels of consensus on process and content.</td>
<td>Can built creativity and consensus.</td>
<td>Very hard to coordinate; version control issues.</td>
</tr>
</tbody>
</table>

Results from structured interviews with the industry partner indicate that their technical teams use the Parallel Writing: Stratified Division model to produce responses to RFPs. This approach produces overlapping, redundant work that must be reworked by a senior member, typically at deadline. Overall communicative efficiency also suffers. Industry partner SMEs and technical writers struggle with compliance to varying protocols, while also failing to ask the right questions of each other to ensure a quality proposal document. Industry partners also conceded that writing and stylistics have changed in the last twenty years, however their younger technical writers still struggle with some fundamentals: developing a top-down structure to theme development in their proposals; information organization; incorporating visual elements; and concise writing.
Seeking a project that would reinforce the industry-selected Parallel Writing Stratified Division model, the iFixit technical documentation project was selected because successful completion requires student teams to assign clear roles to group members, producing documentation and visuals for multiple portions of their repair guides and troubleshooting documentation. This industry-motivated course change provokes students to grapple with stylistic differences that emerge in multi-authored writing, as well as the intellectual work of identifying and cutting redundant or unnecessary information and images.

**Research Questions**

In collaborating with iFixit EDU and industry partners, it became clear that today’s technical writing student needs exposure to producing written documentation products in a multi-stakeholder environment, while subject to the attendant pressures of feedback and deadlines. Content must be taught and demonstrated in a way that nominally resembles what will be expected from future SMEs in the workplace, ensuring that students transfer abilities between academic and professional domains. This change in teaching methods provoked the following research questions:

1) Experiential, collaborative learning is a better contextual match for workplace learning than traditional approaches. What changes in student performance can be observed after its implementation?

2) Are competencies gained through collaborative learning persistent and allow students to apply their acquired abilities in novel domains?

**Assessments**

The iFixit Technical Documentation project is a technical writing project requiring students to document simple repair procedures for older electromechanical devices, as well as cell phones, computers, and tablets. Working in groups of 3-5, student groups were assigned a device, toolkit, camera, and lab space to create documentation for e-waste-designated devices, for which there was no preexisting documentation on the iFixit site. The project was organized along 5 major milestones, outlining each phase of the documentation project. Completion of each milestone [18] was subject to approval by iFixit technical writers and the instructor. The final product was evaluated by peer teams at the institution.

1) **Getting Started:** Provides learner content and primers in how to use site resources, creating a profile, and registering student teams. Example successful Project Proposals are detailed, and students are asked to complete a resource checklist and then send all proposals to iFixit.

2) **Milestone 1:** Provides resources for the creation of a Troubleshooting wiki for each device, with planned repair guides linked under appropriate sections. Troubleshooting wikis provide general device information, and require students to research known common repairs as well as anticipate repairs that are likely to be needed due to the normal wear of moving parts and device design choices.
3) **Milestone 2:** Provides tips for the creation of a Device page that will house all device-related information, including device general research, Troubleshooting wikis, and future Repair Guides.

4) **Milestone 3:** Provides a tutorial in the proper pairing of device photography and technical prose, such that both are semantically redundant, and either could be followed in isolation to correctly execute a repair process. Students create 5-7 Repair Guides for various device components that they identified in their Project Proposal.

5) **Milestone 4:** Provides standards for usability testing and peer review of the three resource pages described above (Troubleshooting wiki, Device page, and Repair Guides).

**Results**

Qualitative and quantitative surveys administered at the beginning, middle, and end of the iFixit Technical Documentation Project indicate that students’ perceptions of the project were positive. 43% of students cited professional communication as the most important thing they took from the project, an important consequence of the consistent feedback and approvals required by the iFixit technical writing team—as well as the accountability each team member had to his or her team. The remainder cited group formation dynamics and learning to adhere to strict timelines for completion as major takeaways.

In response to the question, “What recommendations for improvement would you make for this project?”, 75% of the 39 responders provided no recommendations for improvement or expressed satisfaction, with 25% relaying concerns related to the devices they were assigned for the project or similar logistical issues. Student commentary to this effect is given below:

- “I think this is one of the most valuable projects I have ever done in my college experience thus far.”

- “I believe that this project is a great way to get students involved in a relatively easy project while learning about many key communication and teamwork skills.”

- “Good project for those who have never done any technical writing. Also, a great refresher for those who have.”

That said, some concerns were raised during a subsequent survey administered near end-term. In response to the question, “Are there any other comments about your experience that you would like to share?”, some students mentioned concerns regarding the compact timelines of the iFixit project, and the desire for increased accountability among team mates for project completion.

Quantitative results show that despite significant differences in academic abilities across technical writing sections (Prob > F, 0.0192*), students maintained performance parity during and after introduction of the iFixit Technical Documentation project. This suggests that
experiential, collaborative work offers real benefits to struggling to intermediate-performing students in particular, a result supported in other studies [9]. In Figure 1, an ANOVA of 56 incoming GPA observations shows a significant difference of means. Meanwhile, Figure 2, shows initial disparities of ability did not affect final grades; all sections performed similarly, (Prob > F, 0.6204).

![Figure 1: Means of incoming GPAs among course sections](image1.png)

![Figure 2: Means of final scores among course sections](image2.png)

**Conclusion and Future Work**

Dialogue and collaborations with industry resulted in key changes in teaching methodology in a Technical Writing and Communication course taught to engineering students at The Citadel. Results of a needs-based assessment and structured interview with an industry partner showed emergent ability gaps in theme development; information organization; incorporating visual elements; and concise writing. Implementing an experiential, corporate-led, technical writing
project reinforced the application of technical writing principles and authentic document creation, while also highlighting for students the importance of professional communication. Moreover, student response to this project was positive, indicating that they appreciated a more hands-on approach. Some students reported concerns with the length of the project or other logistical issues, and this feedback guides the current implementation of this project during Spring 2019, which features a reduction in project scope and semester duration. Quantitative results indicate that (1) experiential collaborative learning has an impact, especially for struggling or intermediate-level performers; and (2) this impact is persistent through the duration of the course, resulting in performance parity for cumulative course scores.

References


