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Chemistry journal articles: An interdisciplinary approach to move analysis with pedagogical aims

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ABSTRACT

This article highlights aspects of an interdisciplinary (chemistry–applied linguistics) English for Specific Purposes (ESP) course- and materials-development project. The project was aimed at raising genre awareness among chemistry students and faculty, in addition to improving students' disciplinary reading and writing. As part of the project, full-length chemistry journal articles were analyzed. We describe select results of this analysis and the prominent role played by chemists in the process. Emphasis is placed on the organizational structure of chemistry journal articles, focusing on the Abstract, Introduction, Methods, Results, Discussion, and Conclusion (A-IMRDC) sections. Two predominant organizational patterns emerged from our analyses, specifically A-IMR[DC] and A-IM[R(DC)], with brackets signifying sections merged under one major heading. Move-analysis findings are converted into easy-to-interpret instructional tools labeled "move structures akin to flow charts" for two target audiences (chemistry students and faculty). The rhetorical structure of the chemistry journal article is then compared to journal articles published in biochemistry, an overlapping discipline. The article concludes with pedagogical implications and suggestions for ESP professionals engaged in genre analysis.

1. Introduction

Students who engage in English for Specific Purposes (ESP) benefit from access to and control of genres in their academic disciplines and workplace domains. In fact, "it is through genres that professional objectives are achieved, and . . . through shared generic knowledge that professional solidarity is maintained" (Bhatia, 2004, p. 21). ESP teachers can facilitate student access to valued genres with a pedagogical emphasis on tasks that "raise students' awareness of text features" (Hyland, 2002, p. 20; see also Hyland, 2007, 2009; Wingate, 2012). Genre-analysis tasks, such as those advocated by Feak and Swales (2011), Hyland (2004), Johns (1997), Paltridge (2001), and Swales and Feak (2000, 2004, 2009, 2011), highlight the many elements of writing that must coalesce for objectives to be achieved. These writing elements include lexico-grammatical features, organization, communicative function, disciplinary conventions (e.g., how to report numbers and units, format tables), and content and the ways in which it is presented in text and graphics.

In this article, we highlight aspects of an interdisciplinary (chemistry–applied linguistics) ESP course- and materials-development project that aimed at raising genre awareness among chemistry students and faculty in addition to improving students' disciplinary reading and writing. To frame our discussion, we provide an overview of the 'Write Like a Chemist' project, including its impetus and the four genres targeted for analysis and instruction. We then focus on just one genre, the chemistry journal article, and our analysis of its organizational structure, and compare it to journal articles published

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in biochemistry, an overlapping discipline. We conclude with pedagogical implications and tips for ESP professionals engaged in genre analyses.

2. Background

The 'Write Like a Chemist' project was initially conceived as a response to a Northern Arizona University (NAU) mandate to address third-year undergraduate students' writing needs. Departments had the option of developing third-year writing-intensive courses of their own or requiring students to take English courses. The Chemistry Department chose to develop its own course, but not by itself. The chemistry faculty member who spearheaded the course-development process initiated a "cross-disciplinary alliance" (Wardle, 2004) with an applied linguist in the English Department. The course-development team expanded, at different times, to include two graduate students in applied linguistics and a post-doctoral associate in chemistry.

What has made this project distinct from many others reported in *English for Specific Purposes* is the predominant role played by chemists. They (a) initiated the project; (b) developed criteria for genre and text selection; (c) selected texts; (d) played a major role in genre analyses, materials development, course design, and assessment; (e) contributed content-area expertise at every stage of the project; and (f) collaborated with applied linguists whose language expertise, among other areas of specialization, was vital for the project (Stoller, Horn, Grabe, & Robinson, 2005, 2006). Furthermore, the project resulted in a unique validation approach to move analysis, which has proven appropriate for understanding and teaching chemistry genres. This is the only genre-analysis effort that we know of which has been reviewed and approved by numerous target-discipline representatives, in this case 30 chemistry faculty from multiple US institutions.

The 'Write Like a Chemist' project, driven from the onset by pedagogical aims, targeted two primary audiences. First, we targeted chemistry students (native and nonnative English speakers) at the point in their university studies when they are transitioning to disciplinary reading and writing. Our second target audience comprised chemistry faculty who are not typically trained to teach disciplinary writing; nonetheless, they find themselves doing so when teaching classes with writing expectations, supervising students in their labs, mentoring graduate students, and coauthoring articles with newcomers to disciplinary writing. Chemistry faculty beyond those on the 'Write Like a Chemist' project team ($n = 30$) participated in the project in various ways; they served as informants in early project stages, piloted materials in their classes as they were developed, provided us with feedback, and served as external evaluators.

In line with our commitment to give students access to valued chemistry genres, a read–analyze–write approach to genre-based instruction was developed (Robinson & Stoller, 2007), whereby students read (and reread) authentic texts from the target genre, engage in scaffolded genre-analysis activities, and then write (and rewrite) their own work following predominant disciplinary conventions. With explicit instruction, repeated exposures, practice, feedback, and time, students gradually develop an understanding of disciplinary genres and their layers of complexity (Tardy, 2009). Our efforts led to two tangible outcomes: a textbook (Robinson, Stoller, Costanza-Robinson, & Jones, 2008) and companion website (http://www.oup.com/us/writelikeachemist).

2.1. Genres targeted for analysis

As part of the larger project, four chemistry genres were selected by chemistry faculty for textual analysis and explicit instruction: the journal article, research proposal, conference abstract, and scientific poster. Reasons for selecting these genres varied.

- The journal article is the primary means by which new scientific claims, and the certification of those claims (Berkenkotter & Huckin, 1995), are disseminated in chemistry. Furthermore, starting in the third year of undergraduate study, students are often required to read the primary literature (including peer-reviewed journal articles) as part of advanced undergraduate classes, labs, and research. Moreover, if students are research-group members, they sometimes contribute to the writing of a journal article.
- The research proposal represents the most common way for chemists to solicit research support. Many universities and funding agencies permit undergraduate and graduate students (including chemistry students) to apply for support through the research-proposal process. Raising students' consciousness about the fundamental elements of a research proposal is, thus, pertinent to their needs.
- Posters represent the typical way in which chemistry students and professionals alike disseminate their newest, pre-published research findings at conferences. Furthermore, many institutions (including NAU) showcase student research in annual poster events. To have a poster accepted for presentation requires the prior submission of a conference abstract. By raising students' awareness about the essential elements of this "genre chain," with the conference abstract serving as "a necessary antecedent" for the poster (Swales, 2004, p. 18), students gain confidence about submitting abstracts and preparing posters if, in fact, their abstracts are accepted.

For each of these target genres, a core set of texts was compiled for analysis and later use in materials-development efforts. In Section 2.2, we describe the steps taken to select chemistry journals and articles within them.