Scaffolding analytical argumentative writing in a design class: A corpus analysis of student writing

Maria Pia Gomez-Laich [a,*], Ryan T. Miller [b], Silvia Pessoa [a]

[a] *Carnegie Mellon University Qatar, PO Box 24866, Education City, Doha, Qatar*
[b] *Kent State University, PO Box 5190, Kent, OH 44242, United States*

ARTICLE INFO

ABSTRACT

We report on an interdisciplinary collaboration between writing professors with training in linguistics and a design professor at an English-medium university in the Middle East, where the majority of the students have English as an additional language. We briefly describe the iterative process of redesigning the writing assignments and designing writing workshops to make the design professor's expectations more explicit. We then investigate the impact of the explicit instruction and writing workshops on students' writing. We use a corpus-based tool to compare the writing of students who participated in the workshops to that of students who took the course in a previous semester, when the workshops were not offered. Our analysis points to an improvement in student writing as a result of the disciplinary writing workshops, particularly in the use of linguistic resources to write analytically.

© 2019 Elsevier Inc. All rights reserved.

1. The importance of writing in design

As a field, design is visual and tectonic (Schmalz, 2014). Design professionals are trained as visual artists, using two- and three-dimensional means to depict spaces, objects, and urban environments; they learn to code, sketch, and build physical and digital models; and they explore and examine how design processes can transform everyday experience and effect social change (Schmalz, 2014). In addition to these fundamental skills, strong communication skills are essential for design professionals. For example, design professionals need to be able to develop and defend arguments to convince clients that their real needs will be satisfied by what the designer has to offer (Khoury & Khoury, 2009; Kliment, 2006). However, many professional designers as well as design educators and students are often unaware of the importance of communication skills in design, and few design schools offer training targeting such skills (Kliment, 2006). This presents a serious problem since designers must be able to use language to effectively communicate, articulate, rationalize and defend their designs (Xu, Gilboa, Sayarath, Kabba, & Maeda, 2017). In particular, the need for effective written communication has been increasingly acknowledged by those in the design field. The 2017 *Design In Tech Report* (Xu et al., 2017) lists writing as a key design skill, and Frankel (2009)

finds that designers need to become better at building an argument and using descriptive evidence to support it. In other words, design is no longer a single-skilled profession, and designers need to both cultivate their creativity and develop the ability to write clearly and effectively.

In the present study, we, applied linguists with expertise in writing, collaborated with a design professor to scaffold analytical argumentative writing in a design course at an English-medium university in the Middle East. The design professor in this context was adamant about the importance of strong written communication skills for designers, particularly the ability to write analytically and argumentatively. He commented, "There are a lot of designers out there, but the best ones are those who can argue for the power and value of design" (Mitchell & Pessoa, in press). He was concerned that the writing students produced in his course could be stronger. Although he was interested in improving student outcomes, he lacked the explicit knowledge to teach analytical argumentative writing on his own and felt that our expertise would be valuable in helping students not only in his class, but also in preparation for their future professional lives.

Although writing was a major component of the design professor's course, initial interactions with him revealed that assignment guidelines needed to be clearer and more explicit in terms of genre and rhetorical features. Thus, we embarked on a collaboration with this professor to unpack his tacit writing expectations, redesign four analytical writing assignments to make expectations clearer, and scaffold student writing through four in-class writing workshops (see Mitchell & Pessoa, in press). In this paper, we briefly

---

* Corresponding author.
E-mail addresses: mgomezla@andrew.cmu.edu (M.P. Gomez-Laich), rmill129@kent.edu (R.T. Miller), spessoa@cmu.edu (S. Pessoa).

describe the iterative process of collaboration with a particular focus on the impact of the revised assignment guidelines and writing workshops on students' writing by using a corpus-driven tool, DocuScope, to compare the writing of students who participated in the writing workshops to that of students who did not participate in writing workshops. Since in this course we provided explicit writing instruction in a discipline-specific class, we first briefly contextualize our research in the broader context of previous 'Writing in the disciplines' (WID) studies that have examined the effects of embedding discipline-specific writing instruction into subject teaching. We then focus particularly on genre-based writing instruction based on Systemic Functional Linguistics (SFL), the approach we used to scaffold student writing.

2. The importance of explicit writing instruction

Disciplinary faculty in higher education institutions assign a variety of writing assignments to their students, including lab reports, executive summaries, business plans, case studies, progress reports, company profiles, book reviews, ethnographies, feasibility reports, essay exams, abstracts, annotated bibliographies, editorials, court briefs, company profiles, press releases, literature reviews, etc. (Melzer, 2014). Many of these writing assignments are designed to help students become familiar and fluent with the writing conventions of a given discipline. However, many disciplinary faculty have neither an explicit awareness of their discipline's literacy conventions nor the expertise and metalanguage to teach them (Wingate, 2015). Since they lack training in writing pedagogies, they rely on their own writing experiences as former students and professionals in their field to design and assess student writing. This is an area that deserves attention because most university students do the majority of their writing in courses that are taught by disciplinary teachers, not language teachers.

Research on writing in the disciplines (WID) has looked at the benefits of embedding discipline-specific writing instruction into subject teaching (e.g., Buzzi, Grimes, & Rolls, 2012; Somerville & Creme, 2005; Wingate, Andon, & Cogo, 2011; Yalvac, Smith, Troy, & Hirsch, 2007). For example, Wingate et al. (2011) developed an online discipline-embedded initiative to help pharmacy students to identify, understand and produce different text genres needed for academic study and professional work. In Yalvac et al. (2007), writing instructors collaborated with engineering disciplinary faculty responsible for the delivery of the discipline's curriculum to scaffold the writing of research papers by upper level undergraduate biomedical engineering students. Overall, collaborations between disciplinary faculty responsible for the delivery of the discipline's curriculum and writing instructors result in improved disciplinary writing.

The present study, with its focus on collaboration, could be seen as extending previous 'Writing in the Disciplines' research by focusing on a different discipline (design) and by applying a methodology that combines Systemic Functional Linguistics (SFL) and a corpus-based approach to data analysis. Specifically, we present a collaboration between a design professor and writing specialists aimed at scaffolding analytical argumentative writing in a design course. It is important to mention, however, that the writing assignments students had to complete in this course are examples of a pedagogical genre and do not necessarily reflect the type of writing design professionals do in the workplace. In other words, these assignments are distinct from workplace writing and are grounded in the rhetorical exigencies of the classroom. They do, however, require the application of analytical frameworks specific to the discipline of design and are aimed at helping students develop fluency in the discourse patterns (e.g., argumentation) that they will need to, for example, explain and defend their designs.

3. Approach to scaffolding student writing

Our approach to scaffolding student writing through explicit instruction is grounded in a Systemic Functional Linguistics (SFL)-based approach to genre. SFL is a theory of language developed by Halliday (1985) that sees language as a resource for making meaning in a particular context of use rather than a set of fixed rules and structures (Martin, 2009; Martin & Rose, 2007). SFL considers that meaning and form are inseparable and aims to describe the meaning potential in language and the linguistic choices that are relevant in the construction of different types of genres.

One of the main goals of writing instruction from an SFL-based orientation is that learners understand how language choices are influenced by a genre's social purpose. SFL-based genre instruction aims to make explicit the social purposes of texts, help students identify the features that characterize texts and that help to achieve their communicative purposes, and help students identify how texts are structured in terms of functional moves or stages. This is achieved by making language choices explicit to students and by scaffolding the production of increasingly complex genres. Awareness of the relationship between the goals of a genre and the linguistic resources that realize them can help student writers to develop both their writing ability and linguistic knowledge simultaneously.

Previous studies in SFL-based genre pedagogy have shown the value of explicit instruction in enhancing student writing. However, most such studies have been carried out in primary and secondary school contexts (e.g., Brisk, 2014; Humphrey & Macnaught, 2016), with less research in higher education contexts. Particularly at the university level, explicit instruction of disciplinary writing often requires close collaboration between language specialists and disciplinary specialists (see, e.g., Stoller & Robinson, 2013, for a collaboration between applied linguistics and chemistry faculty). However, there is little research on the outcomes of using SFL-based genre pedagogy in interdisciplinary collaborations in terms of its effects on students' writing. Since the focus of the design course in this study was on analytical argumentative writing, we briefly report on the literature on expectations and challenges of such writing.

4. Analytical argumentative writing: expectations and challenges

Martin (1989) characterizes analytical argumentative texts as those that persuade the audience to adopt a certain intellectual position on a particular issue and argue for the credibility of a well-formulated claim or thesis. Learning to write analytical arguments is a crucial part of students' induction into university-level work (Wu & Allison, 2005). However, for students who come into the university from backgrounds where such analytical writing, and its associated thinking, is not common, such writing poses several challenges. In fact, writing argumentatively is "one of the greatest challenges many English language learners (ELLs) are likely to face" (Hirvela, 2013, p. 67). This is in part because of the nature of the intrinsic demands posed by argumentative writing. It is also in part because university writers, particularly those writing in a second language, may still be in the process of "learning the valued genres of academic communication" (Tardy, 2009, p. 4). Thus, even when these students are expected to produce arguments, they do not always meet this expectation. This gap between instructors' expectations and the writing that students produce may stem from varied and overlapping factors, including lack of academic preparation (Allison, 2009; Harklau, 1994, 2001; Hirvela, 2013), organization of ideas (Coffin & Hewings, 2004), balancing authoritative voice with inclusion of multiple perspectives

(Coffin & Hewings, 2004; Pessoa, Miller, & Kaufer, 2014), and justifying claims with appropriate evidence (Silva, 1993). Given the importance of analytical argumentative writing in the undergraduate curriculum and students' challenges meeting its expectations, scaffolding this type of writing is important.

Previous work (Mitchell & Pessoa, in press) has shown the need to be explicit about when and how to write descriptively, and when and how to write analytically and argumentatively when writing in design. Our understanding of the differences between describing or reporting and writing analytically and argumentatively is based on Humphrey and Economou's (2015) 'Onion model', which is also informed by SFL and is used to refer to the relationship between four different discourse patterns of writing that are valued across academic disciplines (i.e., description, analysis, argumentation, and critique). In this model, description refers to the reproduction of agreed upon knowledge (from the discipline, the reading, or in general). This can be done by presenting information as entities (e.g., *There are three levels of problems of communication according to Weaver: technical problems, semantic problems, and effectiveness problems*) or as events in the form of a narrative that unfolds in time (e.g. *Weaver's model of communication was developed in 1949*).

What differentiates analytical writing from descriptive writing is that, in analysis, the writer goes beyond presenting information as the way things are in the discipline. Analysis, then, involves the re-organization of information in some original way for the purposes of the text, such as applying a disciplinary framework to examples. A disciplinary framework may be thought of as a discipline's agreed-upon classificatory or analytical lenses, and often takes the form of a "received" taxonomy (i.e., given to students) that has multiple different elements. For example, in one of the assignments in the design course, students were asked to use a design heuristic, the useful/useable/desirable (UUD) framework, to critique design decisions on the university's campus. Specifically, students were asked to argue how useful, useable, and desirable a single object was for a specific purpose (i.e., learning, studying, social activities, physical and mental growth, etc.), how that object fit within the architectural space, how this space was part of the entire building and, finally, how the building was part of the campus as a whole. The UUD framework breaks down the factors that contribute to a positive user experience into different factors. When student writers engage in analysis, then, they are to break down a complex text or situation into smaller parts and show how the complex information fits into the elements of the taxonomy. The taxonomy from the disciplinary framework is then used to organize the text. This type of organization is what makes this text analytical rather than descriptive.

The next layer in the Onion model is argumentation,[1] which is a discourse pattern that has an explicit evaluation and typically unfolds with a claim supported by reasons. Argumentation uses both descriptive and analytical language, but does so in the service of an overarching explicit evaluation that is usually made at the beginning of a text. For example, in the first assignment from the design course, the students were to make an explicit evaluation about how good communication design can overcome *noise* (as defined by Weaver, 1949). To do this, the students first had to describe the concept of *noise* in their own words drawing on the course materials. The evaluation that the student made became the claim that was to be supported throughout the text using reasons. Thus, the text is typically organized by a claim-reasons framework. In assignment 1 from the design course, while the entire text should be structured by a claim-reasons framework, the reasons should be

supported with analysis that incorporates description; the student needs to analyze examples (e.g., a particular poster) using design elements (e.g., typography) and blend description of the example with analysis of what has been described. Finally, critique[2] refers to a discourse pattern where the writer challenges some aspect of disciplinary knowledge and positions the reader to accept this alternative position.

Knowing which discourse pattern (i.e., description, analysis, argumentation) is necessary in an assignment can help students identify the language they will need to successfully accomplish the purpose of a text. It is important to note that these discourse patterns are not discrete and do not happen in isolation. That is, writing analytically requires a student to also describe (but in service of the analysis), and writing argumentatively also requires a degree of analysis (in service of the argument). A recurrent problem that we have seen across writing in the disciplines is that many students use description to demonstrate their comprehension of the material, and as a result rely predominantly on descriptive language while overlooking the need to analyze or support an evaluation (Mitchell, Miller, & Pessoa, 2016). It was our goal to help students move from merely reporting on the case to writing analytically and argumentatively.[3]

5. Corpus-driven analysis of student writing

The study of academic writing development in a second language has greatly benefited in recent years by the development of corpora of learner writing, and the increased use of corpus tools in the study of writing development (e.g., Granger, Gilquin, & Meunier, 2013; Lee & Chen, 2009; Wulff & Gries, 2011). In this study, we make use of a corpus-based tool, DocuScope (Ishizaki & Kaufer, 2012a, 2012b), to investigate differences in the writing of students who participated in the writing workshops and those who did not. DocuScope is a dictionary-based text analysis software tool that automatically identifies, classifies, and stores word strings (Ishizaki & Kaufer, 2012a, 2012b). DocuScope is based on Kaufer and Butler's (1996, 2000) representational theory of composition, which asserts that the rhetorical effects that a reader perceives are the result of linguistic choices that an author makes to perform specific functions which create meaning in a text. In this sense, this theory comports with the basic tenets of SFL in that both view linguistic choices and their functional basis as part of a meaning-making system (Eggins, 2005).

The DocuScope tool's dictionaries contain more than 45 million unique English patterns classified into categories of rhetorical experience. The DocuScope dictionaries were developed through extensive and iterative manual coding. Although the dictionaries were created manually, "creating dictionaries by hand is not necessarily a subjective task" (Taboada, Brooke, Tofiloski, Voll, & Stede, 2011, p. 297), and "a manually built dictionary provides a solid foundation for a lexion-based approach" (Taboada et al., 2011, p. 301). Though beyond the scope of this paper, the coding methods as well as an assessment of the internal and external validity of the codings, are described in detail in Kaufer, Ishizaki, Butler, and Collins (2004). Furthermore, Collins (2003) found that the categories in the DocuScope dictionaries discriminate patterns associated with the 15 genres contained in the Brown Corpus

---

[1] The Onion Model uses the label persuasion rather than argument. We opt to use the label argument as it most clearly aligns with the expectations of writing in the design course under study and in writing in the disciplines in general.

[2] In our workshops, we did not focus on this discourse pattern because the specific type of writing that the design professor wanted students to work on did not involve challenging an aspect of disciplinary knowledge.

[3] Although the writing assignments in this course do not necessarily reflect the type of writing design professionals do, they helped students develop fluency in the discourse patterns (e.g., argumentation) that they will need to, for example, explain and defend their designs.

(Kucera & Francis, 1967) and the Freiburg-Brown Corpus (Hundt, Sand, & Skandera, 1999) in ways that comport with the intuitions of human classifiers.

The DocuScope tool analyzes language into categories of rhetorical experience. For example, DocuScope tags the pronoun "I" as a "first person" effect, "if" as associated with a "contingency" effect, and "might happen" as an "uncertainty" effect. These are arranged into groups called dimensions, which are further grouped into clusters (there are a total of 21 clusters in the DocuScope system: Academic Language, Characters, Citation, Confidence, Contingency, Description, Facilitation, Forcefulness, First Person, Future, Information, Inquiry, Interactivity, Metadiscourse, Narrative, Negativity, Positivity, Public Communication, Reasoning, Strategy, and Uncertainty). DocuScope scans a corpus of texts and counts the number of patterns found for each rhetorical effect.

An advantage of DocuScope is that its coding system contains both single words and longer strings (up to 17 words in length); for example, while "I" is coded as "first person", the phrase "in this paper, I will" is coded as metadiscourse indicating the structure of an essay.[4] In previous research, DocuScope has been used to analyze the longitudinal development of multilingual students' academic writing (Miller & Pessoa, 2017; Pessoa et al., 2014), pragmatic functions in academic writing (Zhao & Kaufer, 2013), and features of higher- and lower graded placement essays (Ishizaki & Wetzel, 2008). Although DocuScope has often been used for genre analysis, it should be distinguished from tools whose goal is to classify texts into genres (e.g. Argamon, Whitelaw, Chase, & Hota, 2007; Stein & Eissen, 2008). DocuScope is designed to deepen the understanding of how genre is enacted on the textual surface through language choices (Ishizaki & Kaufer, 2012a, 2012b).

Similar to other tools, such as Biber's (1985) multidimensional analysis, DocuScope identifies genre features based on multidimensional analysis of covariation among variables. However, different from other systems, which capture functional distinctions through analysis of grammatical categories, the DocuScope system directly targets functional categories (i.e., the experience that is created in the reader when a phrase is used) (Klebanov, Kaufer, Yeoh, Ishizaki, & Holtzman, 2016). Similar to Hoey (2005) concept of lexical priming, Kaufer argues that "words in use prime an audience's experience and different words prime different experiences" (Kaufer et al., 2004, p. xvii). Take, for example, the word *smear*: whereas the expression *to smear a politician* contributes to a negative expression, *smearing soap* contributes to an expression of everyday motion, rather than negativity (Ishizaki & Kaufer, 2012a, 2012b, 277).

Although there have been some previous corpus-driven SFL studies, these have been limited in number and many have relied on manual annotation of a very small corpus or a small sample from a larger corpus (O'Donnell, 2014). Use of corpora in SFL research has been limited largely due to the difficulty of automating analysis of the kinds of meaning-based, contextualized uses of language that SFL researchers are interested in (O'Donnell, 2014). Thus, much corpus-based SFL research to date has used corpus tools to investigate specific lexical items (e.g., Flowerdew, 2003) or specific grammatical structures (e.g., McDonald & Woodward-Kron, 2016), which are then interpreted in SFL terms. The tool used in the present study, DocuScope, uses meaning, rather than frequency of specific lexical items or grammatical structures, as its starting point, allowing for a more meaning-based, contextualized understanding of students' writing.

In what follows, we first describe the context of the study and our process of collaboration to scaffold student writing. Then, we report on the outcomes of the collaboration based on a corpus-based analysis of student writing and we compare it to the writing of students who took the class in a previous semester, where the workshops were not offered.

6. Methods

6.1. Context

Our data are drawn from a larger investigation of academic literacy development at a branch campus of an American university in the Middle East, where most of the students have English as an additional language. All courses at this institution are taught in English, and the curriculum largely follows that of the main campus in the U.S. In the present study, we focus on writing in a course titled "The Designed World: A Liberal Inquiry into Design and Human Experience," taken by second- through fourth-year students not majoring in design. The design professor described the course as a reading-intensive and discussion-driven course that introduces students to design history, theory, and criticism. The course comprises four units: communication (visual design), construction (industrial design), interaction (design for experience), and integration (using design principles from the first three units to address complex systems/problems). For each unit, students are required to write an analytical argument paper in which they apply one or more theoretical frameworks from the course to evaluate the design of real-world objects, spaces, experiences, or systems. These papers range from 1000 to 2400 words.

The first paper assignment asks students to write an argument for how *noise* can be overcome through good communication design. Students are instructed to first explain in their own words Warren Weaver's (1949) concept of *noise*, and to apply this disciplinary framework to two or more examples of communication design (e.g., wayfinding systems, documents, posters, data visualizations, infographics). Students are explicitly encouraged to not lose the focus of their argument in their illustration of the examples. The analysis of the chosen examples has to support the argument that noise can be overcome through good communication design.

The second written assignment asks students to use a design heuristic, the useful/useable/desirable framework, to evaluate design decisions of the campus. Students are asked to argue how useful, useable, desirable a single object is for a specific purpose (i.e., learning, studying, social activities, physical and mental growth, etc.), how that object fits within the architectural space interacted, how this space is part of the entire building and, finally, how the building is part of the campus as a whole.

The final paper[5] assignment asks students to explicate the concept of *wicked* problems (Rittel & Webber, 1973) through an example of their choosing (e.g., pollution), and then to argue for the value of a human-centered design approach to address a *wicked* problem. This assignment asks students to consider counterarguments and to draw on multiple theoretical frameworks from the semester to show how such a perspective can help address the problem.

Several of the course objectives stated in the syllabus are directly related to these papers: (1) to study and apply a set of design frameworks to approach ideas, design products, and systems; (2) to develop and strengthen skills in analysis and critical thinking of and about the built world; (3) to develop and strengthen skills in

---

[4] It should be noted that while the DocuScope dictionaries are extensive, they are not exhaustive, and, thus, there may be instances that may not be caught by the DocuScope dictionaries. This is a limitation of any dictionary-based (lexicon-based) corpus analysis.

[5] Although there were four assignments (and we scaffolded the writing of all four), the third assignment was largely descriptive in nature, rather than analytical and argumentative, so we are not including it in our analysis.

academic reading and interpretation; (4) to develop and strengthen skills in argument and scholarly writing; and (5) to communicate interpretations and evaluations in verbal discourse. Our data set contains papers written by two groups of students who completed these assignments, those who received the redesigned assignments and writing workshops, and those in a previous semester before the assignments were redesigned and before the workshops were implemented.

As mentioned earlier, the design professor was interested in improving student outcomes because he was adamant about the importance of strong written communication skills for designers, and he felt that our expertise in supporting disciplinary writing would be valuable for his students. Thus, the collaboration with the design professor was a key component of the study. Next, we describe the process of collaboration with the design professor.

6.2. The process of collaboration

The collaboration with the design professor involved helping him revise his writing assignments and conducting in-class writing workshops prior to each of the four assignments. A detailed explanation of the collaboration with this professor is beyond the scope of this article (for more information, see Mitchell & Pessoa, in press). In brief, our collaboration can be described as a three-part process. First, we tried to understand what the professor valued in student writing through the analysis of papers written by his former students, followed by think-aloud protocols by the professor with these same papers, and interviews with him to unpack his expectations for writing that were not explicit in his assignment descriptions. The second part involved collaborative rewriting of the assignment descriptions and developing materials for the workshops.

After the iterative process of redesigning course materials, we designed workshop materials to scaffold the writing of each of the assignments. In these workshops, we co-taught with the professor to explain the assignment guidelines for each paper and guided the students through brainstorming activities to generate strategies for executing the assignment's structure, functional moves, and connections to course material. We delivered a total of 4 writing workshops; each workshop lasted 80 minutes. The writing workshops occurred in his class approximately two weeks before each assignment was due. There were approximately 20 students in the class.

In the workshop to scaffold the writing of the first assignment, where students were to make an explicit evaluation about how good communication design can overcome *noise* (as defined by Weaver, 1949), we explained that students had to first make an explicit evaluation (e.g., *Noise is reduced in this sign through the effective use of symbols and visual hierarchy*). This evaluation became the claim the student writer had to defend and support throughout the analysis. In making an evaluation, we stated that tempered, nuanced, and balanced evaluations (e.g., the sign is effective in reducing noise to *some extent*) are usually valued across the disciplines because they show complexity of thought and critical thinking. We explained that the text should adopt a claim-reasons framework to create a structure for their text. Students were to use the received taxonomy of design concepts learned in the class (e.g., symbols, visual hierarchy, typography, colors) and focus on two specific elements of the taxonomy (i.e., symbols and visual hierarchy) to analyze a sign, poster, etc. of their choice. These elements became the reasons for how noise was reduced in the sign under study. When analyzing the sign, we emphasized that it was necessary to break down the sign into its components, to describe and interpret the components, and to show how they are examples of effective use of symbols and visual hierarchy. In other words, students needed to analyze a sign (e.g., a particular poster) using design

elements (e.g., typography) and blend description of the example with analysis of what they had described. The key point here is that description had to be used in the service of the analysis and both description and analysis had to be used in the service of the main argument of the text.

We also emphasized that to write a satisfactory text, students also had to rely on the readings from the course to define and explain the elements of the taxonomy. Another feature of analysis and argument we made reference to in the workshop is the acknowledgment of alternative perspectives. Effective analysis and argument imagines a reader who may not agree with the analysis or evaluation of the writer and counters the alternative perspective with more evidence with the use of phrases such as *even, might, seem, although this. . .that, while this. . .that.*

The final part of the collaboration focused on evaluating the outcomes of the collaboration using multiple types of data, including a follow-up interview with the professor to reflect upon the collaboration and its outcomes, and analysis of a corpus of student writing.

6.3. The corpus and analysis

Our corpus-based analysis included student writing from two iterations of the course that did not have the workshops (a total of 230 texts; 190,896 words) and two iterations of the course that did have the workshops (a total of 158 texts; 269,630 words).[6]

As described earlier, we used the corpus-based tool DocuScope in our analysis. This tool was chosen because it is based on a theory of composition that comports with approaches to writing instruction that are grounded in SFL in that both view the learning of new genres as the learning of language choices to achieve a genre's communicative purposes.

Because we were interested in the ways that student writing with the workshops differed from student writing without the workshops, we compared the frequency of occurrence of each DocuScope rhetorical effect cluster in the two sub-corpora. We corrected for multiple comparisons using the Benjamini-Hochberg correction set with a false discovery rate of .05, and we report Benjamini-Hochberg FDR-adjusted *p*-values.

Because the quantitative analysis only shows whether the frequency of each rhetorical function in each sub-corpus differed or not and to what degree, we also conducted subsequent qualitative analyses to better understand how the rhetorical functions were used in the students' texts. This qualitative analysis also allowed us to identify 'false-positives' or miscategorizations. For example, we found that the word *design* was often miscategorized. Most often, it was categorized in the Strategy cluster, which, according to the designers of the software, includes language related to "advantage-seeking, game-playing cognition, plans, and goal-seeking," or as a conscious cognitive state, which, according to the designers of the software, indicates being "cognitively deliberate and conscious,' such as in the phrase *by design*. However, in nearly all cases in the texts in this study, *design* was used in reference to the field of design or to describe the design features of something (drawing on disciplinary knowledge), rather than as a type of strategic action or an indication specifically of conscious action. Thus, we excluded the word *design* from the analysis. Another example is the words *wicked* and *problem*. DocuScope classified both of these in the Negativity cluster, but, as described earlier, one of the assignments asked students describe a *wicked problem*. Thus, we excluded the term *wicked*

---

[6] The reason why there are more texts from students who did not participate in the workshops is that there were more students enrolled in the earlier iterations of the course, which didn't include workshops, than the later iterations, which did include workshops.

problem because it was used in reference to a discipline-specific concept rather than the author's choice to indicate negativity.

7. Results

7.1. Corpus analysis

Our corpus-based analysis revealed that some rhetorical functions occurred significantly more frequently in the writing of students who participated in the writing workshops (higher-occurrence rhetorical functions) while others occurred significantly less frequently (lower-occurrence rhetorical functions). Below, we describe each of these rhetorical functions, with illustrations of usage from students' writing.[7]

7.1.1. Higher-occurrence rhetorical functions

There were four rhetorical functions which occurred more frequently in the writing of the students who participated in the workshops: Academic Language, Negativity, Reasoning, and Citation (see Table 1).

The Academic Language cluster includes abstract and specialized words that are common in academic writing. Within the Academic Language cluster, the writing from the class with workshops was particularly higher in the Specialized Terms dimension, which includes the use of specialized, discipline-specific words. Looking more closely at how students used such terms, we found that these terms were used particularly for the purpose of analysis when introducing and applying a disciplinary framework, as in (1), (2) and (3).

(1) Figure 1 shows the pedestrian sign for the city of Westminster in England. Noise is reduced in this sign through the effective use of symbols and visual hierarchy. Symbols are integral in the creation of universal wayfinding systems, especially when they are well designed and used in the appropriate context. (Khalid, Assignment 1, Noise)

(2) In Figure 1, the sign is also not ordered according to the visual hierarchy system, and this will cause the interruption in understanding the message or in other words noise. As mentioned previously, the way to reduce or eliminate noise is to maintain good communication design; therefore, in this case, maintaining a good communication design means that there needs to be a way of communicating other than text and this can be best done using iconography and visual hierarchy. (Noora, Assignment 1, Noise)

(3) Common spaces such as the [university] campus are designed for people. A common framework that allows us to assess the effectiveness of the [university] campus in delivering academic activities for people is the UUD framework. Designed spaces and their constituent parts should be Usable, Useful, and Desirable. Using this framework, we are able to assess the effectiveness of the [university] campus on a small scale within [this building], branch out to the medium scale where we are looking at classrooms and common spaces, reaching a university-wide scale, and finally the [university]-wide scale. (Issa, Assignment 2, UUD framework)

In (1), the student uses the received taxonomy of design concepts learned in the class (e.g., symbols, visual hierarchy, typography, colors) and focuses on two specific elements of the taxonomy (i.e., *symbols and visual hierarchy*) to analyze a pedestrian sign. These elements become the reasons for how noise is being reduced in the sign under study. In (2), the student also introduces a received disciplinary framework about communication design, including two distinct elements, *location* and *visual hierarchy*. In (3), the student explicitly introduces a design heuristic,

the useful/useable/desirable (UUD) framework to argue how useful, useable, and desirable a single object on campus was for a specific purpose (i.e., learning, studying, social activities, physical and mental growth, etc.), how that object fit within the architectural space, how this space was part of the entire building and, finally, how the building was part of the campus as a whole.

The Negativity rhetorical effect cluster was mostly used in the last assignment of the course, which asked students to identify a *wicked problem*, or a problem that is complex, ill-defined, and strongly impacts society. In this assignment, students were to explain the concept of wicked problems (Rittel & Webber, 1973) through an example of their choosing (e.g., pollution), and then to argue for the value of a human-centered design approach to address the wicked problem. The students in the class that had the workshops more clearly explained why their chosen wicked problem could be defined as a wicked problem through descriptions of negative effects caused by the problem (see (4) and (5) below). On the other hand, the students who did not receive the workshops focused more on descriptions of phenomena (see (6) below).

(4) Electronic waste is a wicked problem that has a long-term impact on the earth. The environmental, societal and economic impact of e-waste is astonishing. Electronic waste contains toxic material such as zinc, lead, barium and chromium. Most of the wasted electronics are disposed of in landfills located in third world countries. This results in groundwater pollution and in the release of toxic chemicals into the air. Overall, the integrity of the earth's resources is threatened. Also, the socioeconomic impact of electronic waste on those living near the electronic waste landfill is fatal. The workers' exposure to the e-waste puts them at risk of suffering from blood diseases, tuberculosis, lung cancer and malfunctioning of the kidney and respiratory system (Lundgren, 2012, p. 20). (Reem, Assignment 4, Wicked Problems)

(5) Air pollution can be considered as a wicked problem because air pollution is one of the biggest issues that causes global warming and water pollution. The causes of air pollution are gases coming from cars, trucks, factories, burning garbage, and agricultural activities. Actually, the polluted air resulted in rise up to the clouds which leads to falling of acidic rains which damage the crops and pollute water which destroys the aquarium life. (Yara, Assignment 4, Wicked Problems)

In (4), the student explains why the chosen wicked problem (i.e., *electronic waste*) can be considered wicked by describing the negative effects of the problem on the environment, society and economy. Similarly, in (5), the student explains why the chosen wicked problem (i.e., *air pollution*) can be defined as 'wicked' by referring to its negative impact (i.e., global *warming* and *water pollution*). On the contrary, in (6) below, written by a student who did not participate in the writing workshops, the student chooses poverty as an example of a wicked problem, but fails to address why poverty is a wicked problem and to describe its negative effects. Although the student makes reference to the effects of poverty on education and nutrition, they are not presented in the context of explaining why poverty can be referred to as a 'wicked' problem.

(6) Let's take poverty as an example of a wicked problem, which design or no other system has been able to solve. The reason design didn't come up with a solution is because the problem itself is so complex. The amount of communication that it requires is so complex that design hasn't been able to figure out a proper solution for it. It's because poverty is connected with education and nutrition in one way or the other, and the economy depends on nutrition as well. These problems are typically offloaded to policy makers or are written off as being too cumbersome to handle by small and individual organizations. (Alana, Assignment 4, Wicked Problems)

Another rhetorical function that occurred significantly more frequently in the writing of the students who participated in the writing workshops is Reasoning. The Reasoning cluster includes language indicating forward reasoning (e.g., *thus, therefore*), backward reasoning (e.g., *because, owing to the fact*) and oppositional reasoning (e.g., *it is not the case that*) and is indicative of logical reasoning in constructing an argument (Pessoa et al., 2014). (7) and (8) below were written by students who participated in the writing workshops.

---

[7] Many of the excerpts were chosen because they include multiple examples of how a certain feature appeared in student texts, allowing us to more efficiently illustrate multiple usages in a shorter text segment. As a result, many of the excerpts shown contain a higher proportion of a certain feature than was typical in the student writing. Nonetheless, the differences between the texts from the group who participated in workshops and those who did not were statistically significant.

Table 1
DocuScope Variables that were Higher in the Group with Workshops.

	Without workshops		With workshops				
	M	SD	M	SD	t	p	d
Academic Lang	57.92	20.28	67.55	15.82	5.00	<.001	0.52
Negativity	14.27	8.58	25.72	16.97	7.90	<.001	0.85
Reasoning	24.40	8.20	27.71	6.99	4.13	<.001	0.43
Citation	5.67	4.56	7.65	3.42	4.61	<.001	0.49

Note: Numbers indicate patterns per 1000 words.

(7) This design makes effective use of visual hierarchy <u>because</u> the sign gets more and more specific based on the spectator's needs. It starts with the least specific information and develops more information depth as the user goes down the sign. <u>By</u> making good use of visual hierarchy, the sign avoids an overload of information and manages to communicate the message concisely. The supplemental information is a <u>way</u> to reduce any noise represented in the top part of the sign, <u>therefore</u> eliminating the semantic issues that could possibly be associated with the sign. <u>While</u> the sign is quite big in size and could have had more information, its quite minimalistic design presented with effective visual hierarchy reduces noise (Ifaz, Assignment 1, Noise)

(8) The library chairs are useful <u>because</u> they serve their purpose. In other words, in terms of the usability component of the UUD framework, it can be stated that the library chairs are usable <u>because</u> they give the user the ability to move from a place to another and rotate to communicate with different people easily. This comes in handy when students have to do group work and interact with the different members of the group" (Raabia, Assignment 2, UUD framework)

In (7), the student structures the text using a claim-reasons framework. The student uses the received taxonomy of design concepts learned in the class (e.g., symbols, visual hierarchy, typography, colors) and focuses on a specific element of the taxonomy (i.e., *visual hierarchy*) to analyze a pedestrian sign. The analysis of this element becomes the reason for how noise is being reduced in the pedestrian sign. The main element of the claim-reason taxonomy is stated as an abstract noun (i.e., *visual hierarchy*) and is linked by logical relations using *because, is a way to, therefore, while*, as in, *This design makes effective use of visual hierarchy <u>because</u> the sign gets more and more specific based on the spectator's needs*. In (8), the student also structures the text using a claim-reasons framework and states why the chairs at the campus' library fit within the architectural space. Specifically, the student relies on a received taxonomy of design concepts (i.e., the useful/useable/desirable (UUD) framework) to organize the reasons-claim framework. As in (7) above, the main element of the claim-reason taxonomy is stated as an abstract noun (i.e., *usability component of the UUD framework*) and is linked by logical relations using *because*, as in, *The library chairs are usable <u>because</u> they give the user the ability to move from a place to another and rotate to communicate with different people easily.*

In contrast, in (9), written by a student who did not participate in the workshops, the student introduces a received taxonomy ("Ideas, Systems, Cultures, Environment, and Values"), but in the subsequent sentences, he does not use logical relations to link his examples to the taxonomy.

(9) A company that is producing pork meat should consider Ideas, Systems, Cultures, Environment, and Values of the Qatari people. The product doesn't fit in with the culture of Qatar as this is forbidden in Islam to eat or sell this type of product. We can see that the producers lacked this aspect of culture before implementing their products. The quote of Papanek explains that integration has to do with decision-making. <u>So</u> for every business, they must look at the aspect of integration before implementing their product. (Patrick, Assignment 4, Wicked Problems)

Finally, Citation is also a rhetorical function that occurred significantly more frequently in the writing of the students who participated in the writing workshops. The Citation cluster is active

when the writer makes reference to others through citation of their words. This cluster also includes the use of words indicating external sources (e.g., *according to, to cite, to quote from the words of, some have argued that*), by which the writer characterizes other writers and their ideas. The DocuScope analysis showed that students who participated in the writing workshops referred more to outside sources, as in (10) and (11) below.

(10) Education City is intended to be an integrated campus; however, its design does not transcend this intent. All the components of an integrated campus should serve a certain purpose in elements such as but not limited to design, location, spacing, form, and function. The architecture should be a tool that facilitates academic activities in an educational campus. <u>Goldberger (2009)</u> illustrates this notion through the Vitrivius' view of the conflicting realities of architecture. He <u>emphasizes</u> the need to shift our view of architecture from a paradox of conflicting realities to a system of co-existing elements that serve a specific purpose such as academic activities. All the buildings within an integrated campus "<u>must simultaneously be useful, well-built and visually appealing</u>" (<u>Goldberger, 2009</u>). The universities, colleges, and facilities within EC may be usable on an individual scale, however, they are not usable when looked at holistically. This is mainly attributed to the large spacing that exists between the universities, and the larger distance that exists between these universities and the facilities available around EC. (Laaibah, Assignment 2, UUD framework)

(11) The pedestrian sign for the city of Westminster effectively uses symbols to convey information. Symbols are integral in the creation of universal wayfinding systems, especially when they are well designed and used in the appropriate context. Paul Rand (1985) <u>states</u> that the symbol is "the common language between artist and spectator" (p.7). A symbol is not necessarily a reproduction, but rather a representation of what is invisible to the spectator. In the case of the pedestrian sign for the city of Westminster, the location of three places (i.e., Bond Street, Oxford Circus, and Grosvenor Berkeley) is signaled [. . .] (Khalid, Assignment 1, Noise)

In (10), the student integrates external voices into her text to develop an argumentative stance. The writer opens up the dialog to external voices using phrases such as *Goldberger (2009) illustrates this notion* and *He emphasizes* and by then citing the author's exact words (i.e., *All the buildings within an integrated campus "must simultaneously be useful, well-built and visually appealing" (Goldberger, 2009)*). The student writer then closes the dialog by moving the reader toward her interpretation of the design of the universities, colleges, and facilities within EC. Similarly, in (11), the student writer also brings in the voices from the course readings (e.g., Paul Rand) to define and explain an element of the received taxonomy (i.e., *symbols*). Specifically, the writer cites course material to frame the analysis. By referring to material from the course reading, the student writer shows that his analysis is sound and authoritative because it relies on authorities in the discipline and it is not happening in isolation from what has been discussed in the discipline. On the contrary, in (12) below, written by a student who did not participate in the writing workshops, the writer succeeds in citing course material, but the cited material does not help the writer to develop an argumentative stance. The writer drops the quotation and fails to connect it to the rest of the text.

Table 2
DocuScope Variables that were Lower in the Group with Workshops.

| | Without workshops | | With workshops | | | | |
	M	SD	M	SD	t	p	d
Forcefulness	23.93	8.51	19.60	7.11	5.25	<.001	0.55
First Person	12.57	14.00	3.68	3.42	7.80	<.001	0.87
Characters	32.52	12.48	28.60	8.32	3.44	.002	0.37
Narrative	35.78	12.28	31.05	8.79	4.16	<.001	0.44

Note: Numbers indicate patterns per 1000 words.

(12)   According to Warren Weaver in 'The Mathematics of Communication', "Noise is the unwanted additions that may be distortions of sound (in telephony, for example), or static (in radio), or distortions in the shape or shading of a picture (television), or errors in transmission (telegraphy or facsimile)." Information is a measure of one's freedom of choice in selecting a message in any medium. Therefore, greater the freedom of choice, the greater is the uncertainty that the message will be interpreted in the way wanted by the sender. (Alana, Assignment 1, Noise)

7.1.2. Lower-occurrence rhetorical functions

There were four rhetorical functions that occurred significantly less frequently in the writing of students who participated in the writing workshops: Forcefulness, First Person, Characters, and Narrative (see Table 2).

The Forcefulness rhetorical effect cluster is active when the writer uses language that is emphatic, intense, insistent, or deals in absolutes or extremes. Looking more closely at the students' writing, we see that the students who did not receive the workshops more often used this type of language in their descriptions and evaluations, as seen in (13) and (14) below, rather than making their evaluations tempered, nuanced, and balanced.

(13)   In my opinion, Design appears everywhere, in each and every aspect of life. For instance, in shopping for clothes and accessories, design along with other factors plays a very crucial role in attracting buyers. (Victoria, Assignment 1, Noise)

(14)   Given the new brand that is was in the region, they had gone all the way with amazing offers and free goodies at the store. (Abeed, Assignment 2, UUD framework)

In (13) and (14), the students give descriptions that use language that is quite strong and absolute; that is, language that 'turns up the volume' (e.g., *everywhere, each and every, very crucial, gone all the way, amazing offers*). The use of such language makes it more difficult for an argument to show complexity of thought or nuance.[8]

On the other hand, the writing of students who received the workshops more often included language that tempered the descriptions and evaluations, as seen in (15) and (16) (e.g., *can help, some sort of idea, I believe, somewhat, more, less*).

(15)   An example of how icons created with ambiguity can help to reduce noise is when you look at the Game Center icons. If you see the Game Center icon in iOS 6 you still get some sort of an idea that the application is related to games since it has symbols of chess, baseball, darts and a rocket ship; however, when you look at the icon for it in iOS 7, you don't get any idea of what the application is about from the icon. The iOS 7 icon for game center I believe is increasing the noise by causing confusion to the user as the icon and the label don't appear to relate to each other. (Aga, Assignment 1, Noise)

(16)   The furniture, rooms, hallways inside a building, as well as its outer environment, should be designed to serve different purposes required by humans. One of the environments in Qatar that are designed to satisfy several purposes is the Education City campus. It can somewhat satisfy the purposes of learning, studying, creating a collaborative and productive environment. In this paper I will focus on the purpose of productivity, and how [university] campus is somewhat effective in encouraging this purpose through multiple scales; encouraging it more in smaller scales such as selection of furniture, and arrangement of studying spaces, while it is less encouraged on larger scales, such as the relationships between the buildings. (Huda, Assignment 2, UUD framework)

The DocuScope analysis also showed that the First Person, Character and Narrative clusters were higher in the writing of the students from the class with no workshops. These clusters will be discussed together since they are closely related. The First Person cluster is active when writers include themselves in their writing or rely on a first person narrator and the use of words indicating self-reference and individualized thoughts and feelings (e.g., *I, me, my, myself* in (17) and (18) below). The Character rhetorical function includes language for naming and describing individuals or entities and is typical of narrative writing and recounting of experiences (Kaufer & Butler, 2000) (e.g., *my family, my niece, our side of the family* in (19) below). The Narrative cluster is active when the writer tells stories about what has happened. Such stories typically involve narrative verbs, indicating punctuated action in the past, structuring plot and action. This dimension is also active when the writer describes units of time as framing for a narrative (e.g., *Every night, just about the time my family leaves the dinner table* in (19) below).

(17)   I drive my car every day, so I find its parts are very important for me. Therefore, I wanted to take this opportunity to focus on something that most of us don't give a big attention to. However, without it we can't drive our cars safely. The first thing I do when I sit in the car seat and start driving is cleaning my windshield from dust. Windshield wipers are used to clean the windshield of a car, so that the driver has an unobstructed view of the road. (Meena, Assignment 2, UUD framework)

(18)   I think such guitars are extremely useful to beginners like me because the built-in tuner comes with a tiny screen that shows me what notes/chords are being played and helps greatly in self-learning. This is exactly how I learnt to play the guitar, without any formal training. In "The Design of Everyday Things", Norman notes that two of the most important characteristics of good design are discoverability and understanding. I believe that the guitar is a good example of discoverability and understanding for me as its functions (such as the amplification or the built-in tuner) are relatively easy to understand and play around with. For instance, even a beginner level guitarist like me can easily tune his/her guitar in the process of discovering to use the tuner. (Valerie, Assignment 2, UUD framework)

(19)   Every night, just about the time my family leaves the dinner table, my niece comes running to me. Carrying her white iPad 2, she holds my hand and drags me to her room, asking me with the most angelic face to read her a bedtime story. With the fake sound of turning pages, I go about reading her a story or two. I smile at the thought that my niece inherited the love of reading from our side of the family. Shockingly enough, a recent statistic shows that the average time that the Arabic child from the age of 6-10 spent on reading is six minutes! That's six minutes outside the school curriculum. (Maria, Assignment 4, Wicked Problems)

---

[8] We do acknowledge, however, that there may be instances where forceful language is appropriate, and that hedging merely for the sake of hedging (i.e., rather than as an appeal to an audience) may also be ineffective.

In (17), (18), and (19), the student writers position themselves as first person narrators and rely on narratives and descriptions of personal experiences (e.g., *The first thing I do when I sit in the car seat and start driving is cleaning my windshield from dust*; *I think such guitars are extremely useful to beginners like me because the built-in tuner comes with a tiny screen that shows me what notes/chords are being played and helps greatly in self-learning*; *Carrying her white iPad 2, she holds my hand and drags me to her room, asking me with the most angelic face to read her a bedtime story*) to initiate their analysis of the importance and usefulness of specific objects using the UUD framework (in the case of (17) and (18)) or the importance of design for addressing a Wicked Problem (in the case of (19)). Although the description of events in the form of a narrative that unfolds in time is an important discourse pattern, students did not succeed in using it strategically to achieve the more complex functions of analysis and persuasion. In other words, students who did not participate in the writing workshops relied too much on description and did not succeed in using it strategically in the service of the argument. On the contrary, the lower occurrence of these rhetorical functions in the writing of students who participated in the writing workshops suggests that the students succeeded in presenting information in a factual, objective manner without extensive description and narration.

On the other hand, the students who received the workshops used language in the First Person, Character and Narrative clusters much less, and when they did use them, the students used them in service of their analysis and argument. For example, in (20) below, we see instances of the First Person (*I'm, I*), Character (*females, males*), and Narrative (*most of the time*) clusters.

(20)   <u>Most of the time</u> when <u>I'm</u> looking for a prayer room <u>I</u> have to figure out in some way which is for <u>females</u> and which is for <u>males</u>. There is a problem with these signs' human figures as they should be more informative than confusing. The problem is with the communication design of the sign. Communication design is how the information or data is designed in a way to communicate with people. And a good communication design is when the information and data is delivered to the targeted audience correctly. The cause of the confusion or misunderstanding in the communication according to Weaver (1949) is called noise. (Babur, Assignment 1, Noise)

However, in (20), we see that the first-person narrative of a personal experience in the first sentence is used to introduce a disciplinary concept, *communication design*. The student then defines this term, and relates it to the disciplinary framework that will be used in the rest of the paper, *noise*. In this way, the initial first-person narrative is not simply a narrative, but it is a narrative that is used in service of subsequent analysis and argument.

7.2. Follow-up interview with the design professor

After our collaboration with the design professor, we interviewed him about his insights on the re-designing of the assignments, the workshops, and student writing. He was very positive about the collaboration and its outcomes. He reflected on how the detailed nature of the assignment guidelines made a difference in helping students better understand his expectations and how to meet them, in contrast to his first original short assignment guidelines:

I guess I realized that sometimes an assignment prompt itself can be like a page long. I've always been under the assumption that a nice short, snappy, concise assignment prompt is good because it's clear, it's short and it will allow them [the students] leeway to go wherever they want with it. But, actually, that's not necessarily the best approach. I think I probably inherit that approach from pretty much every written assignment prompt I've ever gotten. All I ever got as a student was like, one or two sentences, write blah-blah-blah, include this and that. Having

a nice expanded-upon longer assignment prompt that allows you to communicate the faculty expectations will allow you to really encourage them to structure it in a specific way.

The post-collaboration interview showed his appreciation for the more detailed guidelines:

The papers are demonstrating more – like they're showing that they are making more connections between the authors, the in-class material. They're thinking about that material in critical ways and with the new prompts that we're giving them, it's so much more structured.

Thus, from the interview with the design professor, we can see that he found the collaboration to be productive, and that it resulted in clearer and more explicit communication of expectations to students, and, as a result, better analytical argumentative writing.

8. Discussion

In this paper we presented model of collaboration between English faculty and disciplinary faculty that can be useful in meeting the needs of the increasing number of linguistically and culturally diverse students in higher education. In international branch campuses of English-medium universities, increasing numbers of multilingual students have to meet the writing demands and expectations of disciplinary teachers who may not have any training in pedagogy, let alone L2 writing pedagogy. Thus, we argue that collaborations like the one presented in this paper are needed to help disciplinary teachers scaffold L2 writing development. Such a model of collaboration can have a positive impact on teacher development and student writing outcomes, as we observed in this study and as reported in the literature on interdisciplinary collaborations between language experts and teachers in the disciplines at the primary and secondary school levels (see, e.g., Brisk, 2014; Humphrey & Macnaught, 2016; Humphrey, Sharpe, & Cullen, 2015) and to a lesser extent in higher education (see, however, Dreyfus, Humphrey, Mahboob, & Martin, 2016; Pessoa, Mitchell, & Miller, 2018; Pessoa, Mitchell, & Reilly, in press).

The study of academic writing development in a second language has greatly benefited in recent years from the development of corpora of learner writing, and the increased use of corpus tools in the study of writing development (e.g. Granger et al., 2013; Lee & Chen, 2009; Wulff & Gries, 2011). Although limited in number (O'Donnell, 2014), the amount of SFL research using corpus methods has been increasing (e.g., Bednarek, 2010; Hunston, 2013). However, much previous SFL research that has used corpus methods has focused on specific lexical items or specific grammatical structures, rather than having contextualized meaning as its starting point. In addition, there has been little previous corpus-based research investigating the effects of SFL-based instruction. In this study, we made use of the corpus-based tool DocuScope (Ishizaki & Kaufer, 2012a, 2012b) to investigate the effects of a disciplinary writing intervention based on SFL-based genre pedagogy. Although the DocuScope tool does not directly make use of SFL categories of analysis, its use of meaning-based categories of rhetorical functions allowed us to identify changes in students' writing that could be traced to specific aspects of the SFL-based instruction implemented. In this way, the DocuScope tool helped us to confirm not that students were using specific lexis or grammar, but that they were using language to construct valued meanings in their texts.

Our corpus-driven analysis of student writing showed that: (1) there were four higher-occurrence rhetorical functions in the writing of the students who participated in the workshops: Academic Language, Negativity, Reasoning, and Citation, and (2) there were four rhetorical functions that occurred significantly less frequently

in the writing of students who participated in the writing workshops: Forcefulness, First Person, Characters, and Narrative. These differences point to improvement in student writing compared to the semester where no writing workshops were offered, particularly in the use of linguistic resources to write analytically. Students who participated in the workshops more consistently used specialized, discipline-specific words to frame their analysis using design theory; effectively introduced and integrated the course authors to set up the argument; and highlighted both positive and negative features of communication design. Thus, our study provides further support for the importance of discipline-specific literacy interventions (De La Paz, 2005; Monte-Sano, 2010) emphasizing the role of explicit focus on language, as exemplified by SFL-based genre pedagogy, to scaffold student writing development (Coffin, 2006; Humphrey & Macnaught, 2016).

9. Pedagogical implications

The present study has a number of pedagogical implications. First, our findings highlight the importance of explicit writing instruction. We argue for the effectiveness of the Onion Model (Humphrey & Economou, 2015) for scaffolding analytical argumentative writing to unpack the language features of description, analysis, and argument needed to effectively write analytical argumentative texts. Writing instructors can use model texts and deconstruct them with students by using guiding questions to call the students' attention to the main purpose of an assignment, its specific stages, whether they will mainly need description, analysis, or argument to effectively complete the assignment, and what the language of each looks like. Although some researchers have argued that using model texts represents genres too narrowly and inhibits students' creativity as writers (e.g., Elbow, 1999; Smagorinski, 1998), model texts allow student writers, particularly those writing in a second language, to notice specific uses of language that reflect the text's purposes. We suggest, however, that instructors go beyond simply supplying model texts by helping students develop explicit knowledge of rhetorical features by making these features explicit for students.

We also suggest that assignment descriptions and rubrics take into account rhetorical functions and the language through which they are realized. For example, it is helpful to have explicit instructions stating that there should be little elaboration or extended description, and instructions could include examples of language that enacts the discourse patterns needed for the assignment. Assessment rubrics should also reflect linguistic choices as they construe rhetorical functions.

References

Allison, H. (2009). High school academic literacy instruction and the transition to college writing. In M. Roberge, M. Siegal, & L. Harklau (Eds.), *Generation 1.5 in college composition: Teaching academic writing to U.S.-educated learners of ESL* (pp. 75–90). New York: Routledge.

Argamon, S., Whitelaw, C., Chase, P., & Hota, S. R. (2007). Stylistic text classification using functional lexical features. *Journal of the American Society for Information Science and Technology, 58*, 802–822.

Bednarek, M. (2010). Corpus linguistics and systemic functional linguistics: Interpersonal meaning, identity, and bonding in popular culture. In *New discourse on language: Functional perspectives on multimodality*. pp. 237–266. New York: Bloomsbury.

Biber, D. (1985). Investigating macroscopic textual variation through mutlifeature/multidimensional analysis. *Linguistics, 23*, 337–360.

Brisk, M. E. (2014). *Engaging students in academic literacies: Genre-based pedagogy for K-5 classrooms*. New York: Routledge.

Buzzi, O., Grimes, S., & Rolls, A. (2012). Writing for the discipline in the discipline? *Teaching in Higher Education, 17*, 479–484.

Coffin, C. (2006). Learning the language of school history: The role of linguistics in mapping the writing demands of the secondary school curriculum. *Journal of Curriculum Studies, 38*, 413–429.

Coffin, C., & Hewings, A. (2004). IELTS as preparation for tertiary writing: Threats or opportunities for advanced non-native speakers? In L. Ravelli, & R. Ellis (Eds.), *Analysing academic writing: Contextualized frameworks* (pp. 153–171). London: Continuum International Publishing Group.

Collins, J. (2003). *Variations in written English: Characterizing the rhetorical language choices in the Brown Corpus of Texts* Unpublished doctoral dissertation. Carnegie Mellon University.

De La Paz, S. (2005). Effects of historical reasoning instruction and writing strategy mastery in culturally and academically diverse middle school classrooms. *Journal of Educational Psychology, 97*, 139–156.

Dreyfus, S., Humphrey, S., Mahboob, A., & Martin, J. M. (2016). *Genre pedagogy in higher education. The SLATE project*. London, UK: Palgrave Macmillan.

Elbow, P. (1999). Individualism and the teaching of writing: A response to Vai Ramanathan and Dwight Atkinson. *Journal of Second Language Writing, 8*, 327–338.

Eggins, S. (2005). *An introduction to systemic functional linguistics* (2nd ed.). New York: Continuum.

Flowerdew, L. (2003). A combined corpus and systemic-functional analysis of the problem-solution pattern in a student and professional corpus of technical writing. *TESOL Quarterly, 37*, 489–511.

Frankel, L. (2009). Communicating design research knowledge: A role for ethnographic writing. *International Association of Societies of Design Research: Design/Rigor & Relevance, 3507–3516*.

Granger, S., Gilquin, G., & Meunier, F. (2013). *Twenty years of learner corpus research: Looking back, moving ahead*. Louvain, Belgium: Presses Universitaires de Louvain.

Halliday, M. A. K. (1985). *Introduction to functional grammar*. London, UK: Edward Arnold.

Harklau, L. (1994). ESL versus mainstream classes: Contrasting L2 learning environments. *TESOL Quarterly, 28*, 241–272.

Harklau, L. (2001). From high school to college: Student perspectives on literacy practices. *Journal of Literacy Research, 33*, 33–70.

Hirvela, A. (2013). Preparing English language learners for argumentative writing. In L. C. de Oliveira, & T. J. Silva (Eds.), *L2 writing in secondary classrooms: Student experiences, academic issues, and teacher education* (pp. 67–86). New York: Routledge.

Hoey, M. (2005). *Lexical priming: A new theory of words and language*. London: Routledge.

Humphrey, S., & Economou, D. (2015). Peeling the onion – A textual model of critical analysis. *Journal of English for Academic Purposes, 17*, 37–50.

Humphrey, S., & Macnaught, L. (2016). Functional language instruction and the writing growth of English language learners in the middle years. *TESOL Quarterly, 50*, 792–816.

Humphrey, S., Sharpe, T., & Cullen, T. (2015). Peeling the PEEL: Integrating language and literacy in the middle years. *Literacy Learning: The Middle Years, 23*, 53–62.

Hundt, M., Sand, A., & Skandera, P. (1999). *Manual of information to accompany the Freiburg-Brown Corpus of American English.*. Retrieved from http://clu.uni.no/icame/manuals/FROWN/INDEX.HTM

Hunston. (2013). Systemic functional linguistics, corpus linguistics, and the ideology of science. *Text & Talk, 33*, 617–640.

Ishizaki, S., & Kaufer, D. S. (2012). Computer-aided rhetorical analysis. In P. McCarthy, & C. Boonithum-Denecke (Eds.), *Applied natural language processing: Identification, investigation, and resolution* (pp. 276–296). Hershey, PA: Information Science Reference.

Ishizaki, S., & Kaufer, D. (2012). Computer-aided rhetorical analysis. In P. McCarthy, & C. Boonithum-Denecke (Eds.), *Applied natural language processing and content analysis* (pp. 276–296). Hershey, PA: Information Science Reference.

Ishizaki, S., & Wetzel, D. (2008). Computerized rhetorical analysis of L2 freshman placement essays. In *Paper presented at the conference of the American Association for Applied Linguistics*.

Kaufer, D. S., & Butler, B. S. (1996). *Rhetoric and the arts of design*. Mahwah, NJ: Lawrence Erlbaum.

Kaufer, D. S., & Butler, B. S. (2000). *Designing interactive worlds with words: Principles of writing as representational composition*. Mahwah, NJ: Lawrence Erlbaum.

Kaufer, D. S., Ishizaki, S., Butler, B. S., & Collins, J. (2004). *The power of words: Unveiling the speaker and writer's hidden craft*. Mahwah, NJ: Lawrence Erlbaum.

Khoury, M. P., & Khoury, T. E. (2009). Writing and research for graphic design within undergraduate studies. In *International Association of Societies of Design Research: Proceedings of the 3rd IASDR World Conference on Design Research* (pp. 839–846). Seoul: Society of Design Science.

Klebanov, B. B., Kaufer, D., Yeoh, P., Ishizaki, S., & Holtzman, S. (2016). Argumentative writing in assessment and instruction: A comparative perspective. In N. Stukker, W. Spooren, & G. Steen (Eds.), *Genre in language, discourse and cognition* (pp. 167–192). Boston: de Gruyter.

Kliment, S. A. (2006). *Writing for design professionals: A guide to writing successful proposals, letters, brochures, portfolios, reports, presentations, and job applications for architects, engineers, and interior designers*. New York: W.W. Norton & Company.

Kucera, H., & Francis, W. (1967). *Computational analysis of present-day American English*. Providence, RI: Brown University Press.

Lee, D. Y. W., & Chen, S. X. (2009). Making a bigger deal of the smaller words: Function words and other key items in research writing by Chinese learners. *Journal of Second Language Writing, 18*, 149–165.

Martin, J. R. (1989). *Factual writing: Exploring and challenging social reality*. New York: Oxford University Press.

Martin, J. R. (2009). Genre and language learning: A social semiotic perspective. *Linguistics and Education, 20,* 10–21.

Martin, J. R., & Rose, D. (2007). *Working with discourse: Meaning beyond the clause* (2nd ed.). New York: Continuum International Publishing Group.

McDonald, D., & Woodward-Kron, R. (2016). Member roles and identities in online support groups: Perspectives from corpus and systemic functional linguistics. *Discourse and Communication, 10,* 157–175.

Melzer, D. (2014). *Assignments across the curriculum: A national study of college writing.* Boulder, Colorado: University Press of Colorado.

Miller, R. T., & Pessoa, S. (2017). Corpus-driven study of information systems project reports. In L. Flowerdew, & V. Brezina (Eds.), *Learner corpus research: New perspectives and applications* (pp. 112–133). New York: Bloomsbury.

Mitchell, T. D., Miller, R. T., & Pessoa, S. (2016). Longitudinal changes in use of Engagement in university history writing: A case study. In L. Lai, A. Mahboob, & P. Wang (Eds.), *Multiperspective studies of language: Theory and application* (pp. 153–163). Beijing: Foreign Language Teaching and Research Press.

Mitchell, T. D., & Pessoa, S. (2019). Scaffolding L2 disciplinary writing in Qatar: A case study of a design teacher's development. In L. Seloni, & S. Henderson Lee (Eds.), *Second language writing instruction in international contexts: Language teacher preparation and development.* London: Multilingual Matters (in press).

Monte-Sano, C. (2010). Disciplinary literacy in history: An exploration of the historical nature of adolescents' writing. *Journal of the Learning Sciences, 19,* 539–568.

O'Donnell, M. (2014). Systemic functional linguistics and corpus linguistics: Interconnections and current state. In F. Yan, & J. J. Webster (Eds.), *Developing systemic functional linguistics: Theory and application* (pp. 345–369). Sheffield, UK: Equinox.

Pessoa, S., Miller, R. T., & Kaufer, D. (2014). Student challenges and development in the transition to college literacy at an English-medium university in Qatar. *International Review of Applied Linguistics, 52,* 127–156.

Pessoa, S., Mitchell, T. D., & Miller, R. T. (2018). Scaffolding the argument genre in a multilingual university history classroom: Tracking the writing development of novice and experienced writers. *English for Specific Purposes, 50,* 81–96.

Pessoa, S., Mitchell, T. D., & Reilly, B. (2019). Scaffolding the writing of argumentative essays in history: A functional approach. *The History Teacher* (in press).

Rittel, H., & Webber, M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4,* 155–169.

Schmalz, B. (2014). *The Architect's guide to writing for design and construction professionals.* Australia: The Images Publishing Group.

Silva, T. (1993). Toward an understanding of the distinct nature of L2 writing: The ESL research and its implications. *TESOL Quarterly, 27,* 657–677.

Somerville, E. M., & Creme, P. (2005). 'Asking Pompeii questions': A co-operative approach to Writing in the Disciplines. *Teaching in Higher Education, 10,* 17–28.

Smagorinski, P. (1998). How reading model essays affects writers. In J. Irwin, & M. A. Doyle (Eds.), *Reading/writing connections: Learning from research* (pp. 160–176). Newark, DE: International Reading Association.

Stein, B., & Eissen, M. (2008). Retrieval models for genre classification. *Scandinavian Journal of Information Systems, 20,* 93–119.

Stoller, F. L., & Robinson, M. S. (2013). Chemistry journal articles: An interdisciplinary approach to move analysis with pedagogical aims. *English for Specific Purposes, 32,* 45–57.

Tardy, C. M. (2009). *Building genre knowledge.* West Lafayette, IN: Parlor Press.

Taboada, M., Brooke, J., Tofiloski, M., Voll, K., & Stede, M. (2011). Lexicon-based methods for sentiment analysis. *Computational Linguistics, 37,* 267–307.

Weaver, W. (1949). The mathematics of communication. *Scientific American, 181,* 11–15.

Wingate, U., Andon, N., & Cogo, A. (2011). Embedding academic writing instruction into subject teaching: A case study. *Active Learning in Higher Education, 12,* 69–81.

Wingate, U. (2015). *Academic literacy and student diversity: The case for inclusive practice.* Bristol: Multilingual Matters.

Wu, S. M., & Allison, D. (2005). Evaluative expressions in analytical arguments: Aspects of appraisal in assigned English language essays. *Journal of Applied Linguistics, 2,* 105–127.

Wulff, S., & Gries, S. (2011). Corpus-driven methods for assessing accuracy in learner production. In P. Robinson (Ed.), *Second language task complexity: Researching the cognition hypothesis of language learning and performance* (pp. 61–88). Philadelphia: John Benjamins.

Xu, J., Gilboa, A., Sayarath, J., Kabba, F., & Maeda, J. (2017). *Design in Tech Report 2017.* https://designintechreport.files.wordpress.com/2017/03/dit-2017-1-0-7-compressed.pdf

Zhao, H., & Kaufer, D. (2013). DocuScope for genre analysis: Potential for assessing pragmatic functions in second language writing. In N. Taguchi, & J. M. Sykes (Eds.), *Technology in interlanguage pragmatics* (pp. 235–259). Amsterdam: John Benjamins.

Yalvac, B., Smith, H. D., Troy, J. B., & Hirsch, P. (2007). Promoting advanced writing skills in an upper-level engineering class. *Journal of Engineering Education, 96,* 117–128.