“They Don’t Get the Respect they Should”: An examination of visual communication disciplinary practices in composition and the biological sciences

by

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DEDICATION

To all of my family who have never wavered in their support, especially to Mom and Dad who always believed I could.

And to James for offering love and encouragement, mainly through convenient cheesy TV quotes.
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ABSTRACT

This study investigates the similarities and differences of visual communication practices and conventions in the composition and biological sciences disciplines. Although scholars and instructors in Writing across the Curriculum (WAC) and composition have examined disciplinary differences in written communication, little is known about disciplinary differences of visual communication. While writing has been the central focus of composition classes, visuals are often key components of the composing process for individuals working in natural sciences fields like the biological sciences.

This dissertation reports the results from a two-part qualitative analysis research project: 1) an examination of how composition and general science-writing textbooks discuss visual communication conventions and 2) an evaluation of interviews with six instructors, three from composition and three from the biological sciences, who discuss their professional use of visuals. Specifically, the terms used to describe visuals, the pedagogical topics covered when teaching visual communication, and the participants’ processes for composing and reading visuals were examined.

The results indicate that some visual communication practices, conventions, values, and expectations noted through the study occur in similar manners in both the biological sciences and composition disciplines. Meanwhile, differences between these two disciplines do appear; some distinctions fall cleanly along disciplinary lines, while others are unique to individual participants, seemingly because of their particular experiences and specializations. Because these disciplinary distinctions exist, instruction of visual communication practices also differs across these two disciplines. Notably, though, visuals are crucial components of communication in both
disciplines, yet participants in composition and the biological sciences agree that they find a lack of effective visual communication instruction.

This examination suggests that as WAC and composition instructors clarify their understanding of the use of visuals in a variety of academic writing contexts, they might enhance students’ awareness of visual communication conventions in composition and potentially aid their transfer of visual communication skills from composition courses to those in the biological sciences and other disciplines.
CHAPTER 1
INTRODUCTION

Most American colleges and universities require students to take at least one composition course, typically in the first year, which is expected to prepare students for communicating in their classes throughout the university and in their occupations and other real-world situations. Instructors and scholars in the composition discipline have spent decades considering how writing works as “a central tool for learning, thinking, and communication” and how best to teach students the skill of writing (“NCTE Core Values”). However, even with decades of scholarship to draw on in the composition field, often faculty in other disciplines have concerns about students’ seeming lack of preparation to communicate well in those disciplinary contexts.

The Writing across the Curriculum (WAC) Movement was one attempt to address this concern. During the middle of the 20th century, composition scholars began to consider how the conventions and practices of writing in composition might correspond with or differ from those in other disciplines. These individuals began examining aspects of writing, such as processes, genres, and texts, to determine how disciplinary contexts influence the types of writing being produced within them. As a result, WAC and Writing in the Disciplines (WID) programs and courses were designed at some institutions beginning in the 1970s to guide students’ awareness of similarities and distinctions across disciplinary writing conventions and instructors’ teaching of these practices. Though the implementation of these programs and courses differ from institution to institution, and consequently their impact on student learning varies, as Chris Thaiss and Tara Porter found in their 2010 survey of 2600 colleges and universities in the United States and Canada, 625 institutions of the 1338 responding institutions claimed to have WAC programs or initiatives (47%). Of those, 432 programs (32%) emphasized “learning disciplinary
conventions of writing and speaking” (556). The prevalence of WAC/WID curricula and scholarship indicates its perceived value within composition as a way to expand students’ preparation for communicating in a variety of disciplinary contexts.

While composition and WAC/WID scholars have focused on learning about disciplinary conventions of written communication, not much is known about disciplinary conventions of visual communication. In fact, the National Council of Teachers of English (NCTE), the professional association for the composition discipline, has created and housed a number of Position Statements on Writing that present guidelines for instructors to support their “research and teaching in the field of writing” (“NCTE Core Values”). As indicated by their title, the majority of these statements center on writing, indicating that written communication is the mode most valued within the composition discipline. Yet, when examining the texts and composing practices of other disciplines, especially those in the sciences, technology, engineering, and mathematics (STEM) fields, visual communication is a prominent mode used by members of those disciplines for communicating information. For example, James G. Speight explains the value of visuals in science and engineering fields when he writes the following:

The presence of tables, charts, and graphs is a major difference between science and engineering writing and other types of writing. Tables, charts, and graphs are essential to good scientific and engineering writing and are an effective means of presenting results. In fact, it is only rarely that a scientific or engineering audience will not expect to find them in any report of paper or presentation. (59)

Thus, for instructors who concentrate their teaching on WAC/WID pedagogy, a broader examination of disciplinary visual communication practices and conventions might be useful to prepare students for communicating in diverse academic situations.
Beginning the Examination of Visual Communication across Disciplines

Experts of any subject possess and use tacit knowledge, that which is vital to a task but difficult to articulate clearly to another. Thus, experts communicating within a discipline’s conventions often do not consciously notice the expectations placed upon communication, especially visual communication, by a disciplinary audience. As a result, students are not always explicitly made aware of the importance of visual communication in these disciplines and are not taught how to prepare themselves for communicating in that manner, especially in composition contexts where visuals (e.g.: tables, graphs, photographs, charts, maps, illustrations, etc.) are not often a central component of the curriculum. In other words, at times there is little focus on helping students learn visual communication best practices in their own discipline or in WAC/WID courses to help guide students’ abilities to transfer visual communication learning from composition classes into other disciplines.

Hence, this dissertation project begins the examination of how visuals are used and taught within different disciplines. The term “visual” will be defined more fully in Chapter 2, however, the definition is left deliberately open because visuals are continuously being adapted because technological advancements ease visual design and because visuals are being used to serve new purposes and convey different data within a discipline (as will be mentioned briefly in the discussion of pedigree charts below). In composition, cultural visuals, such as advertisements, informational brochures, posters, photographs, billboards, or comics, are often what are addressed in classes, typically in rhetorical analysis activities. And when it comes to scholarly publications in composition, rarely are visuals included within documents. On the other hand, in disciplines like those in STEM fields, visuals are used quite differently from composition, both in professional practice and in the classroom. For instance, in natural sciences disciplines, visuals
are used in the classroom to help students understand science content and interpret information that would be difficult to present in written form. Publications often include many visual representations because much of the data utilized in science is more effectively presented in a visual than in writing.

However, for this dissertation project, it would not be practical to examine visual communication conventions in such a wide range of disciplines. Thus, I have narrowed the focus of my examination to the biological sciences. It is representative of all science disciplines in that it comprises a variety of specializations that use a wide variety of visuals: some that are unique to those individual contexts and others that are more universal to the entire discipline. As with all natural sciences fields, the biological sciences mean to examine the relationships of natural phenomena, specifically those occurring in and to organisms. Members of the natural sciences discipline convey their research in a variety of manners, including the use of visuals in posters, oral presentations, scholarly articles, and websites. However, because members of the biological sciences discipline examine biological processes and relationships rather than chemical, physical or other natural processes, the visuals used may be unique to that content. For instance, in the chemical sciences a central research activity is to produce new chemical substances, so chemical equations are used to illustrate these chemical reactions. These visuals, however, would not be found as often in biological sciences communication. So my examination of visual communication in the biological sciences contains studies of visuals unique to this particular discipline as well as visuals that might be used more universally in conventions and practices within all natural sciences disciplines.

Communication conventions are central for grasping information being conveyed in visuals in different disciplines. While there is not space in this dissertation to describe many of
the visual communication conventions in the composition and biological sciences disciplines and sub-disciplines, a few will be discussed through this project. For instance, pedigree charts are a convention of the biological sciences, which are visuals that work essentially like a family tree that visually indicate ancestral and offspring genetic markers. There are certain ways to design and read these visuals, and once the conventions are known, an individual could read and decipher the information provided in most pedigree charts. Recognizing that this type of visual is useful for conveying specific information and that it has design criteria that must be met for readers to understand that information helps an observer comprehend instances in which the types of data and means of expressing that data might or might not differ across disciplinary contexts, and what that means for student audiences who are moving back and forth across those disciplinary boundaries.

To best explain the usefulness of this research, I first will overview the history of WAC and the focus on research on the transfer of learning within WAC/WID and composition. Then I will indicate key distinctions between visual communication practices in composition and the biological sciences to preview the implications for research on this topic.

**The Importance of Disciplinary Writing Conventions in Composition Pedagogy**

The Writing Across the Curriculum (WAC) movement was created in response to the introduction of open admissions programs at universities after World War II. During this time, society and academia were calling for students to improve their writing in all of their classes, not just ones that had traditionally been viewed as writing-centered. Since then, WAC pedagogies, though implemented to varying degrees in classes and programs, asked instructors to consider whether writing skills might be valued universally across disciplines or might be discipline-
specific. Scholars like Susan Peck MacDonald, Charles Bazerman, Dorothy Winsor, and others have examined the ways members of different disciplines communicate and why certain types of communication are valued by each of those disciplines. Likewise, research on students’ transfer of learning of writing skills, like that done by Lucille Parkinson McCarthy, Anne Beaufort, Linda S. Bergmann and Janet Zepernick, Marilyn Sternglass and others, keeps expanding.

As a result, composition course curricula have often been adapted to include explicit discussions of how writing skills might transfer across communication contexts in order to help students be better prepared to write effectively in other classes and contexts. In the “Principles for the Postsecondary Teaching of Writing” executive summary put forth by the Conference on College Composition and Communication in 2015, principle 8 states, “Sound writing instruction supports learning, engagement, and critical thinking in courses across the curriculum.” Instructors realize this principle when they “create opportunities for students to recognize expectations for writing within their disciplines and use writing to help them prepare to participate in their intended disciplines.” In essence, the governing body within the field of composition is encouraging instructors to understand and teach the ways writing skills might transfer across disciplinary boundaries to be used in new contexts.

Individual instructors and programs have made their own decisions about how best to integrate this objective into their courses. Some have integrated textbooks, like Elizabeth Wardle and Doug Down’s *Writing about Writing*, to reinforce helping students “transfer their writing-related skills from first-year composition to other courses and contexts” (“Writing about Writing – About”). Numerous supplemental resources have been published to help instructors consider how to integrate writing transfer of learning into their pedagogies. Also, some colleges and universities have instituted Writing Across the Curriculum (WAC) programs, such as University
of Minnesota, University of Central Florida, Appalachian State University, University of Alberta, and Washington State University, that are designed to support faculty in integrating more communication (typically written communication) projects in their classes and bring greater awareness of the ways communication is valued in various disciplines across campus. Other institutions, such as University of California at Santa Barbara, Iowa State University, Philadelphia University, and Eastern Connecticut State University, have created WAC programs that include Writing in the Disciplines (WID) courses housed in the program or spread across disciplines. And some institutions have created programs that combine these approaches.

On the whole, these programs concentrate their instruction on written communication. Iowa State University is one exception as courses are centered on written, oral, visual, and electronic modes of communication. Even as visual communication has become a more prominent topic in composition textbooks and classrooms, the lack of research being done on visual communication conventions in composition, in other disciplines, and of visual communication transfer is noticeable. The goal of this project is to create openings for that conversation to begin.

**Transfer of Learning in Composition**

But what exactly is transfer of learning and how does communication transfer work? David N. Perkins and Gavriel Salomon, two educational psychologists, in their influential article “Transfer of Learning,” lay out a basic understanding of transfer as what happens when “learning in one context enhances or undermines a related performance in another context” (2). Writing scholars have since adapted this definition to help it apply to primarily written communication skills and knowledge.
In “Mapping the Questions: The State of Writing-Related Transfer Research,” Jessie Moore lists the disciplinary methods for studying writing-related transfer, noting that it has been done through surveys of faculty and students; focus groups with faculty and students; interviews with faculty, students, and organization supervisors; classroom observations; and composing-aloud protocols. Yet even with numerous studies comprised of a variety of research methods, “very little classroom-based research illuminates the existence of transfer” (Nowacek 10). Evidently transfer does not necessarily happen quickly or in immediately visible ways. In “Teaching for Transfer,” Perkins and Salomon work to help scholars identify transfer by discussing three subsets of transfer: Near and far transfer, which designates how closely related one situation is to another (22); low road transfer, which occurs when routine knowledge is triggered by similar conditions in a new context, and high road transfer, which occurs only with more effort to search for connections (25); and positive transfer, when learning is enhanced by adapting prior knowledge to a context, and negative transfer, when learning is undercut by adapting prior knowledge to a context (22). These distinctions help instructors and scholars understand the ways transfer can work, but they also help to explain why sometimes it is easy for students and instructors to see certain types of transfer occurring but not at other times.

What is important to note is that the process of transferring learning is complex and does not necessarily occur automatically. Perkins and Salomon coined the “Bo Peep” theory of transfer: instances where instructors (as well as academic disciplines, educational institutions, and workplace organizations) hold assumptions that transfer will simply occur without guidance or support (24). Russell and Yañez reinforce this point when they claim, “Learning is not neatly ‘transferred’ from one activity to another” (336). Thus, many, including Perkins and Salomon, make arguments that perhaps the “designing [of] instruction to meet the conditions needed to
foster transfer” is a way to help guide students’ recognition of what knowledge could prove useful in multiple contexts.

The difficulty with trying to examine even one discipline’s communication conventions and practices is that it takes a lot of time and effort. And even if composition instructors want to help students understand what is expected to communicate effectively in other disciplines, instructors should not be expected to (and truthfully could never possibly) learn all of the communication conventions of all disciplines. This hurdle likely explains why so much of the WAC research on skills and transfer of learning between disciplines has been focused on the students. Well-known examples include Lucille Parkinson McCarthy’s and Anne Beaufort’s longitudinal studies of individual students attempting to transfer writing knowledge across several academic contexts, Mary Jo Reiff and Anis Bawarshi’s cross-institutional study examining how students access and use prior genre knowledge in a composition course, and Chris Anson and Lee Forsberg’s investigation of students’ abilities to transfer writing knowledge from classroom to internship settings, to name a few. Each of these researchers do note implications for instructors needing to make transfer more explicit, but without much discussion as to what that pedagogy might look like. Reiff and Bawarshi sum up a generalized perspective of the need to teach for transfer when they note, “We remain mindful of Perkins and Salomon’s conclusion that ‘to the extent that transfer does take place, it is highly specific and must be cued, primed, and guided’” (331).

Informing students that they need to be concerned with transfer of learning appears to be a simple solution. However, this seemingly modest statement does not deal with the fact that instructors would need to have solid awareness of communication conventions and practices of their own discipline as well as general understandings of communication contexts or activities in
other disciplines. Instructors typically are not expected to be experts in disciplines beyond their own, and frankly should not be. So while not an impossible undertaking, guiding students’ disciplinary awareness becomes a task that is more complex than the definitions of teaching for transfer insinuate.

If at least a general awareness of other disciplines’ communication values would be useful for instructors’ abilities to teach for transfer, there are two questions that must be posed:

1. What specific knowledge is most useful for instructors to know about various disciplines’ communication practices and conventions?

2. How can this knowledge be quickly and easily obtained?

Rebecca Nowacek has offered a logical answer to the first question when she comments in *Agents of Integration: Understanding Transfer as a Rhetorical Act*, “As individuals move from context to context, they receive cues, both explicit and implicit, that suggest knowledge associated with a prior context may prove useful in the new context” (12). And one of the key ways in which learners receive cues for considering transfer is through the instructor’s written and spoken language, specifically through terminology that might or might not be special to a particular disciplinary context. Thus, Nowacek argues, “A shared vocabulary…might help students make connections among disparate contexts” (16). Examining terminology is one method for considering what specific communication tasks are and how individuals conceptualize the task and the processes for completing or viewing the task. Comparing the terms used in different disciplines yields understanding of instances where disciplinary practices and conventions might align and diverge. Pinpointing these occurrences enables instructors to articulate specific skills or knowledge that might transfer across disciplinary contexts or to explain the rationale for certain skills or knowledge being valued in one context but not another.
Visual Communication Transfer Possibilities between Composition and the Natural Sciences

The focus on researching writing transfer is deemed important work for composition scholars and instructors; however, research on the transfer of visual communication skills from composition to disciplinary courses has not been examined as thoroughly. Similarly, popular composition textbooks offer little-to-no discussion of the ways in which visual communication is practiced outside of the composition discipline. While it is understandable that members of the field of composition have spent more energy on written communication, this lack of attention to visuals is problematic for the growing number of students who will be moving into majors that value visuals equally or more than writing.

Traditionally in the field of composition, written text is most valued in documents: Written text conveys claims and provides evidence; the document organization relies on written text; and audiences read and skim written text to glean main ideas and concepts. However, this is not typically the case for documents composed in science disciplines. Luc Pawels remarks, “Verbal style, rhetoric, and structure…cannot be separated from the visual aspect, since the two modes of expression and their complex interplay make up scientific argumentation” (x). While written text is still vital to convey noteworthy research in science, often visuals convey some or all evidence, document organization relies on both written and visual components, and audiences can read and skim only visuals or a combination of visuals and abstracts, captions, or other brief written pieces of text to glean main ideas and concepts. In sum, the disciplinary differences between visual communication conventions—the purposes, practices, and expectations—in composition and the sciences are, at times, sizeable.

While the sciences privilege quantitative, numeric data that is suited for being presented in visual form, data in composition typically takes a qualitative, discursive form that is not suited
for visualization. This difference in these disciplines’ methods for conveying new knowledge affects both the researcher/writer’s processes of composing and the audience’s processes for reading documents. In fact, the differences between these processes differ enough that several universities have created online resources to help students navigate how to compose and read science articles. Columbia University, Duke University, Hampshire College, Michigan State University, Purdue University, and Rice University, among others, have publicized these sorts of resources. Of the content included in each, three key concepts stand out. First, they all mention that visuals are central in communicating an article’s main ideas. For example, a Purdue University Libraries interactive resource by Michael Fosmire mentions, “Figures are often included to make the data more compact and intuitive, and Tables organize data in one place for easier reading. Understanding Figures and Tables is EXTREMELY important in understanding a paper.” Second, all of the resources mention the complexity of reading scientific articles. In one example, Mary Purugganan and Jan Hewitt from Rice University write, “The worst way to approach this task is to treat it like the reading of a textbook—reading from title to literature cited, digesting every word along the way without any reflection or criticism.” Michael J. Hanson and Dylan J. McNamee of Columbia University provide detailed directions for grasping an article’s main points by skimming both written text and visuals, the first three items to pay attention to being the introduction, the section headings, and the tables, graphs, and captions. Third, scientific readers use visuals as cues to determine how much, if any, of the written text should be read. Ann McNeal from Hampshire College comments, “A scientist will often read the figures and tables before deciding whether it is worthwhile to read the rest of the article!”

These fundamental differences suggest that the approaches taken by most writers and readers in composition, essentially concentrating on textual features, might not transfer readily to
writing and reading situations in the sciences. For WAC/WID and composition instructors who seek to enhance students’ abilities to transfer communication knowledge from composition classes into their major classes and beyond, rethinking the ways visuals are taught and used across disciplines may be a particularly fruitful area for enhancing transfer. Focusing on these types of visual communication practices are significant because the American Academy of Arts & Sciences notes that majors in the humanities, disciplines that traditionally value written communication over visual, made up only 10.4% of bachelors degrees awarded in 2013 ("Bachelor’s Degrees in the Humanities"). Conversely, the National Student Clearinghouse reports that science and engineering degrees, disciplines that value visual communication, grew by 19%. Since 83% of college students take composition courses ("Humanities by the Numbers"), and many of those are currently or soon will be enrolled in a science class, they would likely benefit from composition courses, instructors, and textbooks illustrating communication conventions in disciplines beyond the humanities, especially when conventions and practices, like these with visual communication, are so dissimilar.

Of course, not all composition courses, textbooks, and materials are designed using WAC pedagogy or have transfer of learning as a goal. And yet, there is benefit for individuals to recognize disciplinary cultures and histories in order to better understand them. As C.P. Snow, in “The Two Cultures” notes, the two cultures of science and writing are polarized to the point that though “comparable in intelligence, identical in race, not grossly different in social origin…had almost ceased to communicate at all” (169). He recognizes the differences between the disciplines’ cultures and histories, and yet concludes that the lack of understanding between the two “is a sheer loss to us all. To us as people, and to our society. It is at the same time practical and intellectual and creative loss” (171). For instructors wishing to convey composition’s
disciplinary conventions to their students, an examination of such disciplinary distinctions might be beneficial, in part, to help bridge that separation. In addition, contrasting two very different rhetorical situations, like how visuals are treated within a writer’s or reader’s practices in the natural sciences versus composition, perhaps helps students recognize why disciplinary conventions exist and what factors valued by a discipline influence conventions and practices or vice versa. That awareness may help students be more attuned to the expectations of the composition discipline and their composition instructors.

One challenge for providing students with cross-disciplinary awareness of visual communication knowledge might be attributed to the fact that written communication is most valued in composition courses and by composition instructors. Even though perhaps most composition pedagogies do not take a WAC or WID approach, there is more interdisciplinarity, more integration of various technologies, and more emphasis on visuals and transfer. The authors of the WPA Outcomes Statement for First-Year Composition highlight these issues by including in the definition of “composing” the fact that writers “attend to elements of design, incorporating images and graphical elements into texts intended for screens as well as printed pages.” And go on to note that students should “adapt their composing processes to different contexts and occasions,” and “understand, analyze, and negotiate conventions for purpose, audience, and genre, understanding that genres evolve in response to changes in material conditions and composing technologies and attending carefully to emergent conventions.” These statements do not necessarily argue for teaching increased awareness of a variety of disciplines’ contexts, but they do invite consideration of it, even to the extent for which doing so helps to better articulate the reasoning behind the communication conventions in composition.
Dissertation Overview

The purpose of this study is to examine how visuals are used in the composition and biological sciences disciplines in order to help instructors become more conscious of their own discipline’s visual communication conventions and in turn instruct students’ disciplinary visual communication awareness. This dissertation discusses two research projects, an analysis of composition and science-writing textbooks and interviews with composition and biological sciences instructors conducted in the fall of 2015 at Iowa State University. This study examines visual communication terminology, practices of reading and composing with visuals, and the teaching of those visual communication conventions to students within the disciplines of the biological sciences and composition. Given the central goals of composition courses to provide students with communication skills and knowledge that they can apply in a variety of contexts, this dissertation is my attempt to expand the knowledge of visual communication practices and conventions in two distinct disciplines available to composition instructors and scholars.

This dissertation is divided into seven chapters. In Chapter One, I have briefly outlined the importance of research on transfer in WAC/WID and composition courses and introduced significant disciplinary distinctions of visual communication practices between composition and the natural sciences to demonstrate how my study will address an area of communication research that has so far been absent. In Chapter Two, I provide a literature review that illustrates my theoretical framework, and Chapter Three discusses the methodology behind the two research projects. Chapter Four discusses the visual communication terminology and pedagogical topics found in an analysis of science-writing and composition textbooks. Chapters Five and Six relay results from interviews of three composition instructors and three biological sciences instructors: Chapter Five considers how these instructors implement those visual
communication terms and pedagogical topics in their classroom practices, and Chapter Six examines these instructors’ professional use of visuals in their reading and composing practices. In Chapter Seven, I conclude with some final thoughts and suggest possible actions that individual instructors, scholars, and programs in composition and the biological sciences can take to enhance awareness of visual communication conventions in these two disciplines and opportunities for students’ transfer of learning.
CHAPTER 2
LITERATURE REVIEW

In order to understand and contextualize the visual communication practices and conventions employed by members of the composition and biological sciences fields, I consulted a number of scholars from both of these disciplines. In the first section of this chapter, I define visual/visual communication as a method for conveying messages to audiences. Next, I briefly trace the history of visual communication research in composition to illustrate how the instruction of visuals in composition classrooms has evolved and why it is still under debate. I also explore research on visual communication from the natural and biological sciences fields, which highlights how visuals are a central component to scientists’ research and student instruction. I then describe research on how the socially constructed nature of disciplines impacts how students often have difficulty effectively communicating in new disciplinary contexts. And finally, I overview the literature on how language within disciplines is also socially constructed, and thus similarly can create confusion for both instructors and students as they discuss communication conventions and attempt to move between contexts. Previous research in all of these areas has guided my research and informed my analysis of data.

Visual Communication Defined

It would be appropriate to start by establishing how “visual” and “visual communication” are operationally defined in this study. While the visual is more commonly being discussed in composition research, it is a term often not explicitly defined. In this dissertation, I adapt Edward Tufte’s definition of design, who claims that a “visual” is a print document or element within a print document that “communicate[s] information through the simultaneous presentation of words, numbers and[/or] pictures” (10). From this definition, I use “visual” in two ways. First, a
visual comprises any display of information or data not verbal or numerical in form; a message being presented by a picture or technical image. For example, in *Reading Images: The Grammar of Visual Design*, Gunther Kress and Theo Van Leeuwen explain that visuals include but are not limited to “maps, diagrams or representations with a technical function—photographs illustrating a particular landform or estuary or settlement type, in a geography textbook, for instance” (15). And Cynthia Selfe defines visuals as including “still images, pictures, drawings, [and] graphics” (69). Even though a visual is distinct from written language, a visual can include verbal components (e.g.: text positioned in the cells in a table) or work in conjunction with written language (e.g.: a caption or label) to convey a message.

Second, “visual” can refer to the design of a page or document. As Charles Kostelnick explains, “visual” in this sense encompasses “elements—textual, spatial, and graphic—that orient us perceptually and rhetorically when we encounter a document” (9). These document elements are important for the author’s message because the text, images, whitespace, typography, etc. all impact the information being presented. As Daniel B. Felker explains, “The organization and format of a document may be just as important as its language. The degree to which the document is matched to the capabilities of its users and the setting of its use may affect comprehension as much as clearly written sentences” (2).

Visual communication, then, as defined by Jean Trumbo, is a “process of sending and receiving messages using visual images and representation to structure the message” (“Visual” 420). Essentially, visual communication demonstrates the fact that visuals “tell a story” and are integral to or are the sole components of some types of communicative texts (Trumbo “Essay” 379). Karen Schriver, when describing document design in *Dynamics in Document Design*, explains that visuals and verbal text can work together to “catch the attention of busy readers”
and connect “with the readers’ knowledge, experience, beliefs and values” (166). Schriver goes on to note five ways in which written visuals relate to written text: to be “redundant,” “complementary,” “supplementary,” “juxtapositional,” and “stage-setting” (412-3). Visuals serve a variety of purposes, including telling “the same story” as, helping a reader “understand the key ideas” in, or “forecast[ing] the content” of the written text (412-3). Hence, visual communication often can work in tandem with written or other modes of communication to convey information.

However, visuals convey meanings on their own. For example, as Kress and Van Leeuwen note, visuals work as “independently organized and structured message[s]—connected with the verbal text, but in no way dependent upon it” (17). Authors of many science-writing textbooks articulate this tension; for example, Janice R. Matthews and Robert W. Matthews note in Successful Scientific Writing, “Visual material supports the printed message….Each visual aid must contribute an essential part to the written or spoken story, and each must be capable of standing on its own without reference to the text” (56). Thus, we see the complexity of visuals: they not only can work on their own to convey information but they also can do so in relation to other elements in a document. Thus, audience members must be prepared to analyze and interpret visuals on their own and as parts of a whole in order to understand meaning.

Gunther Kress, et al., in Multimodal Teaching and Learning, observe, “Previous educational research has focused primarily on linguistic resources (talk, reading and writing), reflecting the dominant view of learning as primarily a linguistic accomplishment” (28). In this dissertation, however, I recognize, like Kress and his colleagues, that visuals can convey messages and fulfill communicative purposes; hence, it is sensible for researchers to examine how visuals are used in their respective fields. It is also reasonable for composition instructors interested in modes of communication beyond writing to also examine how a variety of academic
genres integrate visuals. In the next two sections, I explore how scholars in composition and in the biological sciences have examined visuals in their disciplinary practices and pedagogies.

**Visual Communication Research**

Since my examination of visual communication is centered in the composition and biological sciences disciplines, I will overview the research performed regarding the practices and instruction of visual communication in those two fields. It must be noted first, though, that visual communication is its own field of study. In some ways, the visual communication field addresses visuals similarly to composition and the biological sciences. They recognize the need for the analysis of how visuals convey information and audiences interact with those visuals. However, because visuals are the principal topic of study in the visual communication field, members more critically examine a variety of concepts specific to images and visualization, including cognitive and color theories, perception and psychology, and the physiology of vision. While these concepts might be useful for members in composition and biological sciences disciplines, those individuals do not often need such a detailed theoretical understanding. Members of the biological sciences use visuals to present biological processes and relationships that would be difficult to present in written form, and visuals occur most often in composition courses in order to help students consider their own composing processes or the key arguments in cultural texts. Though some of the studies in the visual communication field, such as those on visual rhetoric, are applicable to the study of visuals in composition and the biological sciences, a broader presentation of visuals is necessary for most examinations of visual communication in these two disciplines. The next two sections outline how scholars in the composition and biological sciences disciplines study visual communication practices and instruction.
Visual Communication Research in Composition and WAC

In this section I overview the movement within the field of composition toward researching visual communication and teaching visuals in the classroom. While scholars and instructors discuss rationales and best methods for analyzing, writing about, and composing with visuals, little scholarship has considered how experts in the composition field compose and read visuals. Composition scholars also have not performed much research on visual communication practices and conventions of other academic disciplines in order to improve instructor and student awareness of variations in visual communication conventions. Therefore, my research seeks to fill this gap so that instructors can better understand and articulate visual communication conventions of composition and expand their instruction for preparing students to transfer their communication skills to contexts where visuals might be used differently.

Prior to the 1990s, the composition discipline’s research of visuals was limited because written text was primarily valued. The original call for composition classes came from the need for students to read and write effectively combined with academic disciplines taking “little direct interest in writing” (Russell 3). As David R. Russell explains in “American Origins of the Writing-across-the-curriculum Movement,” after World War II returning GIs flooded into post-secondary institutions, reinforcing the need for classes that teach practical communication skills like writing (8). However, by the 1990s, scholars like Gunther Kress became concerned about composition classes maintaining such a narrow focus, noting the following:

[It] has meant a neglect, an overlooking, even suppression of the potentials of representation and communicational modes in particular cultures….Or, to put it provocatively: the single, exclusive and intensive focus on written language has dampened the full development of all kinds of human potential, through all the
sensorial possibilities of human bodies, in all kinds of respects, cognitively and affectively. (85)

Around the same time, The New London Group, like Kress, argued that up until this point, “literacy pedagogy…has been a carefully restricted project—restricted to formalized, monolingual, monocultural, and rule-governed forms of language,” and they called for attention toward “mutiliteracies” (61). And those observations moved other scholars toward the importance of visual communication; for example, Diana George argued that educational institutions should spend time developing students’ visual literacies because they are integral to discussions of basic literacy” (14) and Charles Hill reinforced that idea, noting “so many of the texts that our students encounter are visual ones, and…visual literacy is becoming increasingly important for everyday social functioning and even for success in the workplace” (119). Thus, these scholars called for composition scholars and teachers to consider ways to incorporate communication literacies beyond written text into the classroom.

And that call began to be heard. In 2004, the National Council for Teachers of English articulated the purposes of teaching visual communication practices in composition classes in their “Beliefs about the Teaching of Writing” statement:

Throughout history, print has often been partnered with pictures in order to convey more meaning, to add attractiveness, and to appeal to a wider audience....Writers need to be able to think about the physical design of text, about the appropriateness and thematic content of visual images, about the integration of sound with a reading experience, and about the medium that is most appropriate for a particular message, purpose, and audience. (101)
And in February of 2016, a revised statement was published that further expanded the need for broadening the focus of composition to include non-written modes of communication. It reads

> Writing instruction should support students as they compose with a variety of modalities and technologies. Because students will, in the wider world, be using word processing for drafting, revision, and editing, incorporating visual components in some compositions, and including links where appropriate, definitions of composing should include these practices; definitions that exclude them are out-of-date and inappropriate. (“Professional Knowledge for the Teaching of Writing”)

Thus, the definition of writing instruction has evolved to include a wider variety of communication modes, including visuals.

Debate continues as to whether visual communication should be integrated into composition classrooms, and for those who think it should, how best to do so. Initially, the thought was that students simply needed "the abilities necessary to comprehend, interpret, and critically respond to the textual forms that they will encounter as members of the culture" (Hill 119). Yet, scholars like Lester Faigley, Diana George, Cynthia Selfe, Anne Francis Wysocki, among others, argued that reading and responding to visuals was not enough. As Sean D. Williams discusses the verbal bias inherent in composition pedagogy in “Part 1: Thinking Out of the Pro-verbal Box,” he notes that composition instructors do not limit reading assignments to only verbal texts, but instead often have students read magazines or online texts or watch television or movies (22). That being said, rarely are those same instructors asking students to compose nonverbal texts. And Williams declares, “Writing about any of those texts is not the same as writing them” (23). While this response is accurate, there has been little evidence
demonstrating that asking students to produce visuals is in fact more useful than having them analyze visuals.

So what instructors do in their classes ranges from teaching visual analysis skills to document design best practices to technology skills for designing visuals. Assignments and activities like photo essays, visual arguments, and blogs have also been put forth as methods for students to learn to communicate using visuals. However, composition instructors face many hurdles as they work to better integrate visual communication into their courses. For instance, according to Anderson, et al.’s 2005 survey asking how composition instructors integrated multimodality in their classes, 84% of the 45 respondents said they teach multimodal assignments on an individual level rather than having visual instruction standardized in programmatic curriculum (69). Also, many of these teachers felt like they need more pedagogical development opportunities, training on software and technologies, and effective instructional materials in order to better integrate these types of assignments in their classes.

Likely some of the difficulties of teaching visual communication stem from the fact that visuals traditionally have not often been discussed or utilized in composition scholarship: The texts that members of the discipline are reading and writing themselves often do not contain visual elements. Sean D. Williams conducted a review of articles in *College Composition and Communication, College English, and Journal of Advanced Composition* from 1990-1998, and observed that only four articles dealt with nonverbal text (24). Since the field does not have a long-standing tradition of communicating research via visuals, when asked to convey disciplinary visual communication practices and conventions to students, composition teachers do not have an abundance of exemplary texts to draw from.
Perhaps because scholars started addressing this topic 20 years ago, it should not be surprising that even with the more recent influx of ideas for teaching visual communication in composition, little scholarship has addressed visual communication practices in other disciplines and how composition courses might prepare students for academic writing in fields that consider visuals a key element of communication. Even with the influence of WAC scholarship that has influenced many composition instructors to help students consider how knowledge and skills learned in composition courses could be transferred and adapted to new composing contexts, research on disciplinary communication practices has primarily focused on written communication. For instance, Charles Bazerman and Christina Haas have examined reading processes of scientists and a science student, respectively; Gay Gragson and Jack Selzer investigated the roles writers of science articles place on readers; and Ann Blakeslee, Neal Lerner, and Greg Myers have studied the composing practices of scholarly articles, lab reports, and review articles, respectively. A handful of researchers, such as Chris Chabot and Warren Tomkiewicz; Deborah Clark; Lisa Emerson, et al.; and Patricia Johnston have also examined the teaching practices of science faculty, but again have focused chiefly on written communication.

Few composition scholars have begun to consider the necessity of understanding how communication modes beyond writing work in other disciplines, Blakely Duffelmeyer and Ellerton’s article, “Critical Visual Literacy: Multimodal Communication Across the Curriculum” being one of the few. Scholars who tackle disciplinary visual communication practices often do so from a technical communication perspective. For example, Deanna Dannels and Julie Dyke Ford study the disciplinary communication practices taught in engineering classes (Dannels) and in technical communication classes for engineering students (Dyke Ford), and visual communication is one aspect of their examinations. Joanna Wolfe has also argued that
professional communication instructors should include instruction on interpreting quantitative visuals in their classes. While these studies may be useful for composition scholars to consider how visuals are used in a similar field, the goals of technical communication courses are generally centered upon helping students communicate specific information in professional/work genres. Meanwhile, composition courses usually are focused on guiding students’ writing processes by asking them to analyze others’ communication practices and practice their own composing and reflecting skills in order to enhance their confidence as writers within a variety of contexts. Even though some discussions about visual communication by technical communication scholars might be applicable for composition contexts, the overarching goals of the two disciplines’ courses mean that it is probably useful for scholars in the composition and WAC/WID disciplines to examine visual communication and the ways in which members of different disciplines compose and read visuals and teach students to follow those same practices.

The composition scholars I have cited here make important arguments about the significance of visual communication and why it should be studied and taught in composition classes. They also have initiated examinations of writing communication practices across disciplines and argued that these types of studies are useful for scholars and instructors who seek to help prepare students for communicating across contexts. At the same time, they have overlooked how members of the field compose and read visuals in their academic work, and how, in turn, those visual communication practices and conventions are taught to students in composition classes. Through this dissertation, I focus on these particular gaps. However, to fully understand how visual communication conventions and practices in composition differ from those in the natural sciences and to consider possibilities for transfer across these disciplines, I also must examine visual communication research in the biological sciences.
Visual Communication Research in the Natural and Biological Sciences

In this section I overview research on visual communication in the natural and biological sciences. Much of this research centers on how and why visuals are used to convey information in science articles and textbooks. Researchers have also examined the problems readers, chiefly students, have reading and interpreting visuals in articles and textbooks. However, not often examined are how members of the biological sciences compose and read visuals, how that knowledge influences the teaching of visuals, and whether that instruction correlates to what is presented in disciplinary textbooks. My research seeks to fill this gap so that instructors can more explicitly recognize and articulate disciplinary visual communication conventions and expand their instruction of teaching students how to communicate using visuals in scientific contexts.

Visual communication has almost always, if not always, played a prominent role in science communication. According to J.R. Martin and Robert Veel, “The history of scientific diagrams goes back as far as the history of modern science itself” (84). In support of this idea, in Communicating Science, Alan G. Gross, et al. rhetorically analyze a number of scientific articles published from the 17th century to the present. Through their examination, the scholars recognize that the purpose of visuals in scientific articles shifted from being a component of presentation in the 17th c. to working as part of the argument in the 18th c. and beyond. By the 20th c., “the widespread use of numbered tables, figures, and equations reflects not only the equal attention given to the visual and the verbal in the modern scientific article, but also the high value placed on mathematization and quantification” (181). Thus, we see that visuals have evolved to become commonplace in the composing practices of scientists.

In fact, Wolff-Michael Roth and G. Michael Bowen’s survey of five ecology journals revealed that there are “about 15 visual representation[s] per ten journal pages” (236), and Jay
Lemke’s survey of 43 scientific articles demonstrated that “there can easily be three to four each of graphics displays and mathematical expressions separate from verbal text per page” (89). These studies reinforce many scientists’ and scholars’ acknowledgements of the importance of visuals in science communication, articulated by Lemke in “Multiplying Meaning: Visual and Verbal Semiotics in Scientific Text” when he writes, “Science is not done, is not communicated, through verbal language alone. It cannot be” (89). He clarified his meaning by noting that visuals can convey particular scientific knowledge better than written language. He specified that verbal language does not clearly express “degree, quantity, gradation, continuous change, continuous co-variation, non-integer ratios, varying proportionality, complex topological relations of relative nearness or connectedness, or nonlinear relationships and dynamical emergence” (87). In Science from Sight to Insight, Alan G. Gross and Joseph E. Harmon create seven categories for what visuals do, including, “express data trends,” “express time-space relationships,” “virtual witnessing of what a scientist saw,” “and “reveal the function of equipment” (53). All of these relationships and processes are crucial to communicating science; without visuals to convey those elements, scientists would find the task difficult or even impossible.

And since visuals have been such an important component to scientific communication in general, it is not surprising that visuals are also significant for science instruction. In fact, researchers like Jewitt, et al. and Kress, et al. study multimodality in science classrooms; Bowen and Roth; Dimopolous, Koulaidis, and Sklaveniti; and Miller investigate the distinctions between visuals used in science textbooks and articles; and Roth, Bowen, and McGinn explore the distinctions between visuals in high school and college textbooks.

Researchers have also examined how often and why visuals appear in science textbooks. For example, Roth, et al. observe in Critical Graphicacy, “There are between fifteen and twenty-
four visuals used on every ten pages in science textbooks depending on country (Brazil, Canada, Korea), grade level, and subject area (biology, chemistry)” (xii). Michelle Cook, et al. synthesize experts’ explanations of why visuals are vital for communicating science even for instructional purposes, noting similar ideas to Lemke, such as “graphics are ideal for representing abstract and invisible concepts in science that are difficult to describe with text alone (Buckley, 2000). They are also useful when communicating multiple relationships and processes” (240). However, they extend their review to include specifically how visuals are useful for students learning those scientific concepts, relationship, and processes, when they write, “Visual representations can attract attention and motivate students (Mayer, Bove, Bryman, Mars, & Tapangco, 1996), as well as improve retention (Peeck, 1993) and facilitate linkages between new knowledge and existing knowledge (Roth, Bowen, & McGinn, 1999)” (240). This research indicates that visuals are central to textbooks of all levels as well as scientific scholarship.

Yet many researchers have found that science students often have significant difficulty comprehending and interpreting information in visual displays. Part of this difficulty stems from the inherent perspective that language is a more valuable method of communicating science than visuals. Guther Kress, et al. observe, “The representational requirements of scientific texts may be masked by those who presently set the agendas for school education, because of the high social and cultural value placed on linguistic resources within education and traditional linguistic approaches to texts in the classroom” (141). If individuals outside the discipline who do not recognize the effective ways for communicating and instructing within the discipline are setting instruction standards, students might not be interacting with visuals in a truly useful manner.

Other causes of the difficulties students have with visuals include Erin M. McTigue and Amanda C. Flowers rationalization in “Science Visual Literacy: Learners’ Perceptions and
Knowledge of Diagrams,” as they note, “Although graphics can provide important information, they can also add complexity to the task of comprehension” (580). These challenges include comprehension not only of the meaning of the visuals but also of the meaning of the relationship between visuals and written text, of knowing what information is vital and in what order it should be examined (580). Likewise, Michelle Patrick Cook examines how students’ prior knowledge and interactions with visuals affect their reading of them. And scholars like G. Michael Bowen and Wolff-Michael Roth expand that point by distinguishing visuals included in textbooks from those contained in scientific articles, observing

Graphical representations in scientific journal texts provide more resources for interpretation and are less ambiguous than those which appear in high school or college texts….It is therefore not surprising when high school and university students do not learn to interpret graphs and that even university science graduates have difficulties providing standard interpretations of these inscriptions.

(320)

And that concern is noteworthy considering McGinn and Roth’s articulation that “such visual representations are central to the work of creating science and to communicating science to others” (20). Thus, Dimopoulos, et al. argue that a variety of types of visuals should be shown in classrooms to enhance scientific literacy (212). If instructors want students to recognize the importance of visuals in science communication, students will need practice interpreting and potentially creating visuals and the arguments within them.

When considering that eventually science students will perform their own research and need to create their own visuals, if students have trouble interpreting visuals, the likelihood of them being able to create strong visuals is remote. If, as Lynda Walsh and Andrew B. Ross’s
research demonstrates—that 74% of surveyed STEM researchers learned to create visuals “by imitating published graphical models”—then more examination of the types of visuals used in classroom settings and the methods of visual communication instruction is needed (127). Plus, researchers like Yrgö Engeström have observed instances in which visuals are designed in such a way as to hinder students’ abilities to understand them. He describes how visuals in texts are often “two-dimensional linearity” that are attempting to “illustrate three-dimensionally the relations[hips]” among objects and processes (248). If the visuals in textbooks do not present information well, it might be unlikely for students to fully grasp the material and, in turn, create their own meaningful visual displays. Through this dissertation, I explore how members of the biological sciences discipline learned visual communication practices and conventions and how they instruct students of these same values. This news is beneficial for composition scholars too because it introduces the possibility of providing aid to students for transferring their learning of visual communication practices and conventions across these disciplines.

**Communication Situated in the Disciplines**

Through my dissertation, I argue that there are benefits for individuals to recognize disciplinary cultures and histories in order to better understand them and the visual communication occurring within them. In this section I overview the construction of academic disciplines as well as how both expert and novice members of disciplines learn and engage in discipline-specific communication conventions. This examination is important as instructors guide students’ disciplinary learning while they are, at the same time, navigating a variety of disciplines with different communication conventions and expectations and attempting to transfer their learning across those contexts. Specifically, disciplinary instruction and learning practices of visual communication ought to be investigated because often concepts are taught and
learned implicitly. By examining how disciplines themselves have formed, we are better able to recognize how visual communication works within those disciplines to convey knowledge.

The emphasis on communication by American colleges and universities has had a somewhat circuitous history. The universal composition approach originated when the U.S. higher educational system was adapting to the literacy needs of an ever-changing student population from the late 19th to late 20th centuries. David R. Russell, in “American Origins of the Writing-across-the-Curriculum Movement,” relates that as the boundaries of disciplines were being shaped, written language moved out of the disciplines because it was regarded as “an arhetorical, unproblematic recording of thought or speech, unworthy of serious intellectual attention” (4). Since writing was considered supplemental to real learning, instructors shifted their limited class time to more “useful” methods of helping students learn disciplinary content.

As a result, English departments, starting with Harvard in the 1870s, took over the job of helping students learn to write, giving the act of writing and of teaching writing the perception of being universal skills. And that perception has persisted, as Anne Beaufort in College Writing and Beyond notes, “Most teachers of writing think of themselves as generalists” (10). However, she goes on to explain, “Research in composition studies and linguistic anthropology and literacy studies in the last 30 years has shown there is really no viable commodity called ‘general writing skills’ once one gets beyond the level of vocabulary, spelling, grammar and sentence syntax” (10-11). Which is why, as early as 1913, James Fleming Hosic wrote that faculty were noticing that “pupils often express themselves well in the English classroom, and very badly elsewhere.” This observation signifies the understanding that academic disciplines have their own distinctive methods for communicating effectively and those conventions, practices, audiences, purposes, and contexts do not always translate uniformly from one discipline to another.
In fact, many researchers would argue that disciplines are socially constructed communities. Stephen Toulmin defines “discipline” in this way, explaining,

A collective human enterprise takes the form of a rationally developing “discipline” in those cases where men’s shared commitment to a sufficiently agreed set of ideals leads to the development of an isolable and self-defining repertory of procedures; and where those procedures are open to further modification, so as to deal with problems arising from the incomplete fulfillment of those disciplinary ideals. (359)

Toulmin’s definition shows that disciplines are held together by shared beliefs and processes for achieving goals. In other words, as Carolyn R. Miller explains in “A Humanistic Rationale for Technical Writers,” “Knowledge cannot be separated from the knower; the knower cannot be separated from the community” (51). McGinn and Roth support this perspective by noting, “Knowledge emerges from a nexus of interacting people, agencies, materials, instruments, individual and collective goals/interests, and the histories of all these factors” (15). In sum, knowledge does not simply exist; it is interpreted and conveyed through a variety of systems.

In fact, knowledge is created, explored, and problematized within a discipline by methods that can be unique to individual disciplines. Robert J. Connors explains that a discipline “is shaped by the choices historians [within the discipline] make: the sources relied upon, the figures and events emphasized, the cause-and-effect relationships identified and explored” (3).

Essentially, the types of evidence required, the processes examined, the tools used to perform research, etc. are influenced by the intentions and choices set by those working in the discipline, and therefore, might be unique to that particular discipline. Susan Peck MacDonald more specifically examines disciplinary distinctions for defining and communicating knowledge in her
book *Professional Academic Writing in the Humanities and Social Sciences*. She notes that members of the hard sciences “focus on clearly defined problems” (22), while participants of social sciences and humanities have “less well-marked or more permeable boundaries” within which to engage with problems (24). These discipline-specific ways of creating and displaying knowledge then affect the way communication is used: to explain concept-driven knowledge, as in the sciences, or to interpret text-driven knowledge, as in the social sciences and humanities.

Thus, communication is central to advancing disciplinary knowledge. Each discipline has its own way of presenting information, of demonstrating relationships, of providing evidence, and of using language (which will be discussed in the next section) to spread current knowledge and create new knowledge. As Cheryl Geisler notes, “Expertise cannot simply be equated with the increasing mastery of facts. Instead, an important component of expertise is attention to the rhetorical processes by which these facts are created and disseminated in texts” (210). Ann M. Penrose and Steven B. Katz in *Writing in the Sciences* explain further, writing, “The process of building scientific knowledge is best described not through individual facts, but through the achievement of consensus about what counts as fact” (16). Penrose and Katz’s comment taken generally illustrates how disciplines have their own unique methods for viewing and examining the world, and communicating that knowledge to others.

This belief demonstrates that the communicator must know the community members’ expectations to truly be persuasive. Miller clarifies this point, stating, “To write well is to understand the conditions of one’s own participation—the concepts, values, traditions, and style which permit identification with that community and determine the success or failure of communication” (52). And Penrose and Katz argue that students entering a discipline must come “to know the conventions of their fields, to understand the underlying assumptions and attitudes
that give rise to these conventions, and to understand how to work within them in order to be heard” (20). This understanding, however, can be difficult for students who are just entering the discipline. As socially constructed entities, disciplines are not like swimming pools, in which an individual leaps in becoming immediately and completely immersed. Instead, Jean Lave and Etienne Wenger describe the process of joining a disciplinary community as “legitimate peripheral participation”: Individuals enter a discipline “peripherally,” as “a way of gaining access to sources for understanding through growing involvement” (37).

And this access is difficult to achieve because as Ann Blakeslee notes, students “initially may lack the knowledge and skills necessary to undertake [disciplinary] tasks or they may be forced to rely on their existing skills and knowledge, which may be insufficient or inappropriate for the tasks” (135). Thus, students must communicate in specific disciplinary communication contexts, and learn particular strategies distinctive to the discipline so that over time they might develop expertise. David R. Russell and Arturo Yañez explain the significance of this dilemma when they ask, “And how—if at all—will [students] make sense of the knowledge and writing in the discipline they are being introduced to, in terms of the writing they do in other courses and life activities?”

In fact, researchers have found that students can have difficulty recognizing when writing knowledge is specific to certain contexts and when learning can be transferred more universally. In “A Stranger in Strange Lands” and College Writing and Beyond, Lucille Parkinson McCarthy and Anne Beaufort, respectively, follow students through several writing courses to study their attempts to transition writing knowledge across several academic contexts. Both found that many of the writing assignments given to the students had similar purposes, but the students differed in how well they identified the tools and knowledge they possessed and applied to each situation.
McCarthy’s student, Dave, “interpreted them as being totally different from each other and
totally different from anything he had ever done before” (136-7). However, Beaufort’s student,
Tim, noticed and acted upon the differences between “the relationship of reading to writing” and
the “norms for written texts” in two disciplinary classes (68). Though two individuals is a small
sample, these studies illustrate that students have varying degrees of awareness of how some
knowledge may be specific to a disciplinary context and other knowledge may be valued more
universally. Helping students more explicitly consider these distinctions perhaps could aid their
abilities to transfer their learning across contexts more productively.

Many scholars argue that lack of explicit instruction is part of the reason students do not
recognize the purposes for disciplinary communication conventions. For instance, Amy
Alexandra Wilson writes the following:

Students have always encountered a variety of representations in schools: From
listening to lectures to understanding gestures to viewing diagrams, students have
long been charged to make sense of multiple modes. However, they have not
often received instruction on why these modes are important to each discipline or
on how these modes might be used to reach discipline-specific goals and to
display particular types of content. Moreover, students have often not received
instruction on how and why the forms of texts they are expected to write might
vary as they participate in different disciplines. (442)

Even when instructors explicitly teach these conventions and expectations, students still might
have difficulty recognizing disciplinary distinctions because sometimes the experts have
difficulty recognizing and articulating that knowledge and the communication conventions
necessary for students to effectively join the disciplinary community—the knowledge is tacit and
cannot fully be articulated. Or, as Wilson notes, “Each individual teacher may enact her or his
discipline in idiosyncratic ways, and…disciplinary practices may overlap” (436). What all of
these observations tell us is that “because writing is so varied, it is hard to study (and teach),”
and I would add that it is hard to learn for this reason as well (Russell and Yañez).

And these difficulties indicate why research on disciplinary communication conventions
is useful: An examination of disciplinary distinctions might expand individuals’ understanding of
a discipline’s conventions in order to expand teaching of those conventions to students. This task
stems from Yrgö Engeström’s rationale for expansive learning, a practice in which students “find
out how their misconceptions are manufactured in school” (254). In “Non Scholae Sed Vitae
Discimus: Toward Overcoming the Encapsulation of School Learning,” Engeström proposes
helping students create what Lauren Resnick calls “continuity between what one knows outside
school and what one learns in school” (qtd. in Engeström 243). He writes, “Since school is a
historically formed practice…the initial step toward breaking its encapsulation is that students
are invited to look at its contents and procedures critically, in the light of their history” (254). My
research stems from Engeström’s argument because I ask instructors to examine their methods of
composing and reading visuals, activities influenced by conventions and expectations valued by
the discipline; likewise, I ask those individuals to examine their classroom instruction practices,
which occur in classroom contexts also rooted in discipline. Each of these individuals bring their
own idiosyncrasies to their composing, reading, and teaching of visuals, which also should be
examined in order to locate why students have such difficulties. However, narrowing the
examination of disciplinary communication to visuals and visual communication creates
additional complexity to this research because, as has been demonstrated, visual communication
has not always been given equal attention in teaching as written communication.
And while knowledge and communication of that knowledge is constructed within the boundaries of individual disciplines, language and terminology used to convey knowledge and those communication conventions are too. Language is central to communication and members of a discipline must be able to convey their expertise to others in the field and to the general public. In order to do so, appropriate language is necessary for precise communication, which, in turn, binds the discipline together. Thus, my next section examines how language is situated in the disciplines, how differences in terminology might hinder learners, and what scholars and instructors are doing to combat those complications.

**Language Situated in the Disciplines**

Language, as oral and written communication, is a central component of my examination of these two distinct disciplines’ communication conventions and practices. As mentioned in the previous section, the ways in which knowledge is conveyed are often specific to certain disciplines. Within that observation is a relationship between the words, oral and written, a discipline employs to refer to, describe, and/or discuss visuals. As members of a discipline discuss visual topics, the listener must recognize that the language being used has been constructed, employed, and adapted throughout the discipline’s history; in other words, the terms used have specific meanings that might be unique to the discipline. In “Marxism and the Philosophy of Language,” Mikhail Bakhtin defines the dialogic as the notion that language can only be understood as dialogue, writing that every utterance “is socially oriented in its entirety,” that it exists in relation to everything that has been uttered before and that will be uttered after (1215). This theory is important for my research for two reasons: First, as mentioned, members of a community—in this case a discipline—create the language needed to best communicate knowledge within the community as well as to outsiders. Second, as Bakhtin states, “Word is a
two-sided act,” signifying that the meaning of language is socially constructed, determined within a particular context of the sender, the receiver, and the situation in which a message is conveyed (1215). These understandings of how language works impact how members of a discipline communicate their experiences with visual communication and the ways in which students begin to learn: What makes sense in one disciplinary context might not hold the same meaning in another, and the distinctions in the terms used might obstruct students’ abilities to understand the different ways of thinking and communicating in different fields.

Gregory Clark, in *Dialogue, Dialectic, and Conversation*, explains that members of a discipline “begin to define their common interpretations of experience that they can treat as their collective reality, a reality constituted in terms of the shared needs, values, and purposes that are the foundation upon which they can sustain the cooperation that maintains their community” (7). As members of the discipline discover their needs, values, and purposes, they have to then be able to articulate them to provide “an understanding that not only binds [them] together as a cooperating community but also provides a foundation for [their] continued communication” (4). By doing so, the discipline’s members might employ language that has context-specific nuances: terms that have distinct definitions or terms entirely unique to the discipline. Charles Bazerman reinforces this argument, writing, “Getting the words right depends not just on an individual’s choice. The words are shaped by the discipline….The words arise out of the activity, procedures, and relationships within the community” (47). Thus, language is not arbitrary; members of a discipline use particular language because it demonstrates disciplinary values and processes of thinking, seeing, and knowing. Individuals not situated within the discipline might not fully comprehend the meanings of certain terms or realize that a word might have a different, discipline-specific meaning.
In a university setting, this lack of awareness is problematic for members of other disciplines and students seeking to enter a discipline to communicate with those in the discipline. Bakhtin offers a metaphor to explain, writing, “A word is a bridge thrown between myself and another. If one end of the bridge depends on me, then the other depends on my addressee” (1215). So what happens to the bridge if the word being thrown is not known by the receiver or not understood as the sender intended it? Scholars see this disconnect occurring, and note that students have to learn and relearn language in each new context. David Bartholomae in “Inventing the University” notes, “The student has to learn to speak our language, to speak as we do, to try on the peculiar ways of knowing, selecting, evaluating, reporting, concluding, and arguing that define the discourse of our community” (4). Essentially, language is a factor for students learning to be members of a disciplinary community and for proving they are members of that community. For instance, Miles Kimball’s study in “Visual Design Principles” relates the language used in literature and by designers, design educators, and design students to determine how they think about and define the design principles they use. Though there are general similarities in the definitions the participants give, on the whole there is diversity in how individuals use the term. The disparity and ambiguity indicated might create problems for members of the field if language is part of what is shaping a discipline.

As mentioned, terminology can be puzzling: A word might be used to mean many things or several words might be used to mean the same thing. For example, Luc Desnoyers illustrates his own confusion while researching visuals in science communication and finding a variety of definitions for the word “graphs”: “Cleveland (1984) defined graphs as figures that have scales and convey quantitative information, which included statistical maps….Harris (1999) defined graphs (or plots, which he considers a synonym) as one category of charts…a graph is then “a
chart that graphically displays quantitative relationships between two or more groups of information” (164). And other scholars make claims as to how differences in terminology create “confusion” (Mokkink, et al. 737), “conjure up inappropriate images” (Fulwiler 114), “mislead” (Ochsner and Fowler 122), and make it “difficult to relate knowledges” (Bracken and Oughton 375). David R. Russell and Arturo Yañez interviewed instructors of general education courses in “‘Big Picture People Rarely Become Historians’: Genre Systems and the Contradictions of General Education” and found “‘Effective writing’ was universally acknowledged as an important goal of general education courses. But there was no agreement on what effective writing is, no operational definition useful for pedagogy.” More specifically, Dan Melzer analyzed 2100 undergraduate writing assignments from multiple disciplines, and found the use of “research papers”/“term papers” differ across disciplines and instructors disagree on “research methods, what counts as evidence, how research papers are structured, and the persona the writer is asked to take on” (W255).

Researchers like Toby Fulwiler also found instances in which instructors used different terms to describe similar problems students have. For example, he writes, “One college teacher talks about ‘faulty reasoning,’ a second about ‘developing ideas logically,’ and a third, ‘coherence,’ while high school teachers mention ‘systematic’ and ‘precise’ thinking and elementary teachers ‘staying with one idea’” (125). Thus, in “Perceived Roadblocks to Transferring Knowledge from First-Year Composition to Writing-Intensive Major Courses,” Gerald Nelms and Ronda Leathers Dively conclude that the “disparity” in vocabulary probably affects students’ ability to transfer their learning from one discipline to another (227). Moreover, how individuals use different terms to mean similar things or use similar terms to mean different things indicate differences in the ways communication is valued in each disciplinary context. In
other words, language is an indication of disciplinary distinctions, and though those distinctions are necessary, they are often not closely examined by members of the discipline.

Mark Waldo generalizes how differences in vocabulary create barriers for students and instructors who seek to help students communicate in new disciplinary contexts when he writes:

As teachers and researchers, they speak, write, and think in languages that separate and even isolate them into smaller and smaller groups. As a critical requirement of their jobs, they teach their students to speak, write and think in the languages, helping them to develop increasingly sophisticated cognitive behaviors. (4)

While specialized language is necessary for experts to speak with one another, Waldo notes, “The more evolved the expertise, the smaller the group with which it can be shared” (4). Yvonne Merrill examines diverse academic languages in a study of general education faculty at University of Arizona in faculty development workshops. She found that the instructors had trouble explaining their disciplinary ways of thinking; they “had to translate what they knew into a form that others could understand and apply to their particular contexts.” Merrill’s research helped her to see “one of the endemic problems of higher education—departmentalization—result[ed] in regional, mutually exclusive languages and the need for both faculty and students to participate in interdisciplinary discussions.” The language used in this instance illustrates differences in disciplinary perspectives; because members of these disciplines think about teaching and communicating differently, their terms differ and confusion occurs.

Progress has been made to specifically point out the ways in which terms are used similarly and differently across disciplines with the goal of helping instructors better talk about communication with students. For instance, Dennis Bohr and Georgia Rhoades in “The WAC
Glossary Project: Facilitating Conversations Between Composition and WID Faculty in a Unified Writing Curriculum” describe how the WAC program at Appalachian State University has created an online glossary designed to help composition and disciplinary instructors begin to learn each other’s language for helping guide student learning. This glossary lists terms dealing with writing processes (invention, writing to learn), types of writing/writing assignments (empirical evidence, summary, argument, collaborative writing), rhetorical terms (discourse, rhetorical situation, multimodal writing), among others (“WAC Glossary of Terms”).

It must be noted, however, that I found no terms dealing with visual communication in this glossary. The closest terms included were “multimodal writing,” texts “not limited to traditional print alphabetic writing” (“Rhetorical Terms”), and “artifact,” which can include “a sculpture or painting in an Art class” (“Kinds of Writing/Writing Assignments”). Though visual communication is valued as a mode of communication across academic disciplines, this glossary is limited in its usefulness by noting only terms significant for written communication.

Thus, my research seeks to locate and compare visual communication terms used in composition and science-writing textbooks and by composition and biological sciences instructors. My work goes a step beyond simply creating a list or glossary of common terms by also considering whether this language is specific to a discipline or context. As Kenneth Bruffee notes, “Concepts, ideas, theories, the world, reality, and facts are all language constructs generated by knowledge communities and use by them to maintain community coherence” (777). So by examining discipline-specific textbooks’ and instructors’ language, the conventions and practices occurring within the discipline are also uncovered for examination.
Research Questions

The literature addressed in this chapter indicates gaps in previous research on disciplinary practices and conventions of visual communication. The overview of literature in this chapter has demonstrated that neither composition nor biological sciences researchers have examined the ways members of the discipline compose and read visuals. Likewise, there is an absence of examinations of discipline-specific uses of visuals and language used to discuss visuals and visual communication across disciplines.

My dissertation project seeks to address and fill these gaps by examining how visuals are composed, read, and taught in the composition and biological sciences disciplines. I identified three research questions that guided this dissertation project:

1. How do textbooks in the biological sciences and composition disciplines teach visuals?
   a. What terms are used to describe visuals and visual communication?
   b. What topics are covered when instructing the practices and conventions of visual communication?

2. How do disciplinary instructors conceptualize and use visuals in their own work and teach the practices and conventions of visual communication to students?

3. Where are the intersections and disconnects of the practices and conventions of visual communication between the two disciplines?

To answer these questions, I designed a research project in which I analyzed science-writing and composition textbooks and invited six instructors from the biological sciences and composition disciplines to be interviewed with the goal of discovering visual communication conventions in the two disciplines. The next chapter describes in complete detail the methods used in my study.
CHAPTER 3
METHODS

For this project, I employ a qualitative approach to my research to learn about the similarities and differences of visual communication practices and instruction in composition and the biological sciences. In this chapter, I describe the methodology behind a two part project: a textual analysis of composition and science-writing textbooks completed in spring 2015 and an interview project conducted in fall 2015. The interview portion of the project included participants from Biological Sciences programs and a Communication across the Curriculum (CAC) program, which houses composition and advanced communication courses. These research methods provided me with the viewpoints of textbook authors and instructor participants, all of whom presumably work within disciplinary conventions in their own research and convey those conventions and practices to their students. I use Corbin and Strauss’s grounded theory approach to generate theory directly from the data collected in both studies to examine the visual communication conventions in these disciplines. In this chapter I provide context for my research, including the theoretical frameworks informing my methodology, my researcher positionality, and the processes for collecting and analyzing my data.

Theoretical Frameworks

John Creswell reminds us that theoretical frameworks “shape the content of a qualitative project” (15). For both the textual analysis and interview projects I am guided by Corbin and Strauss’s grounded theory approach, which is intended “to move beyond description and to generate or discover a theory, an abstract analytical schema of a process” (Creswell 62-3). I employ these methods to discover the terms and topics covered by composition and science-writing textbooks as well as by composition and biological sciences instructors. I then analyze
these results to discover how visual communication is taught similarly and differently in these
two disciplines and what that might mean for instructors and students working within the fields.

**Grounded Theory**

Grounded theory methodology was developed by Barney Glaser and Anselm Strauss as a
way to ground relevant theory in data, to have a way to make “comparisons between data to
identify, develop, and relate concepts” (Strauss and Corbin 10). Eventually, these two
collaborators evolved to describe grounded theory methods and procedures differently. While
Glaser’s method uses inductive reasoning, Strauss’s method, designed in collaboration with
Juliet Corbin, uses both inductive and deductive reasoning within systematic procedures. In their
words, “Theory derived from data is more likely to resemble the ‘reality’ than is theory derived
by putting together a series of concepts based on experience or solely through speculation (how
one thinks things ought to work)” (12). Thus, I employed Strauss and Corbin’s approach because
it offers analysis as both systematic and creative, allowing the researcher to use analysis tools
“flexibly and as extensions of their own abilities” (99). Since my research project consisted of
two parts, this flexibility was an important component for my work with a wide range of data.

I made use of grounded theory in a traditional way when analyzing the composition and
science-writing textbooks. I initially located visual communication terminology in the textbooks’
tables of contents and indexes. Then, since open coding and data collection are integrated
activities, I examined sections of the textbooks dealing with visual communication and designed
codes out of the patterns of discussions and instruction occurring in those sections. Once I had a
sense of “where to start, what to look for, and how to recognize it when [I saw] it” through the
open coding process, I then grouped like categories together and re-assessed the textbooks,
selectively coding for the nine confirmed visual communication topics (223). This process allowed me to uncover which discipline’s textbooks valued which visual communication topics.

However, my research could not end there because I also needed to know whether the practitioners and instructors in these disciplines held the same expectations and practices of visual communication. Corbin and Strauss note, “people do not invent the world anew each day. Rather, they draw upon what they know to try to understand what they do not know. And, in this way, they discover what is similar and different about each object and thus define them” (75).

Asking biological sciences and composition instructors about their disciplines’ visual communication practices and conventions and analyzing what they say in a systematic way while still leaving room for individual variations was the best way to attain understanding of the ways members of these disciplines practice and teach visual communication within the expectations of the disciplines. By using the terms and topics located in the textbook research as starting points for coding data from the interviews, I was able to discover what participants find significant about visual communication in their disciplines and use those reoccurring topics to add, delete, or redesign categories rather than force categories onto the data. In sum, “grounded theories, because they are drawn from data, are likely to offer insight, enhance understanding, and provide a meaningful guide to action” (12).

**A Comparative Study of Disciplinary Texts**

While the process of grounded theory allows for a novel approach for discovery of common and disciplinary-specific visual communication topics, my research is also grounded in concepts and methods that have been useful for those who have come before me. Since, as C. Jewitt, et al. note, “Communicative systems have evolved to satisfy societal needs and that modes such as writing or gesture are organised to function with respect to these needs,” it is
necessary to make sense of the larger disciplinary contexts to understand why certain conventions exist, especially since some conventions are valued by multiple disciplines while other conventions are more discipline-specific. One method for examining disciplinary conventions is to compare texts in the same genre across disciplines.

In *Professional and Academic Writing in the Humanities and Social Sciences*, Susan Peck MacDonald inspects academic writing in these two fields in part by examining sample texts. She argues the need for researchers to analyze the texts that are being composed in disciplines when she writes, “In the last decade, literary theory has produced a flood of journal articles and monographs about the problematics of interpretation but has said comparatively little about the *textual* features through which literary theories and interpretations are constructed” (6). She goes on, expressing why examining texts can provide valuable knowledge: “Texts provide one of our richest sources of information about social practices, and at the same time texts are not simply epiphenomena; they help create communities (Bazerman), they act on us, they shape how we relate to each other as professionals and shape what we can and cannot do” (7-8).

Elizabeth Rowley-Jolivet expresses similar points of view in her article “Different Visions, Different Visuals” when she writes, “Visual communication, like other forms of discourse, is a social act, deeply embedded in cultural practice and conventions” (148). In this article, Rowley-Jolivet compares scientific conference presentations across the disciplines of geology, medicine, and physics to learn how communication practices, specifically visual ones, are embedded in the social practices of each discipline and of the sciences as a whole.

Building on these researchers’ work, I compared documents as well as instructors’ perceptions of disciplinary communication in the biological sciences and composition to discover how disciplinary communication conventions are reinforced. Like Rowley-Jolivet, I
was interested in the ways in which scientific disciplines, specifically the biological sciences, use “their own visual languages to satisfy the[ir] communicative needs” in ways that differ from the written communication practices valued by the composition discipline (146). I examined the ways in which textbooks and members of composition and the biological sciences disciplines consider professional communication, specifically that occurring in scholarly articles.

Gross, Harmon, and Reidy articulate a key reason for using articles as an object of study. They note, “Articles have become the canonical form for the communication of original scientific results” (4). Thus, these documents are highly scrutinized by members of the discipline both for accuracy of content and for meeting the design and organization conventions of the field. A second reason for my examination of scholarly articles is that it is a genre that members of both disciplines compose, read, and use in their instruction. Many genres of composing do not occur in both of these disciplines, such as scientific posters, and having texts that have a direct correlation make for a more accurate comparison and contrast process.

And while scholarly articles do exemplify the ways in which members of a discipline demonstrate their learning and convey knowledge, I examined and compared how discussions of this communication practice occur in disciplinary textbooks and classroom activities. These instructional resources are designed to explicitly help students learn the discipline’s conventions for communication and practice. MacDonald cites Carolyn R. Miller’s observation that “we should expect academic texts to display common features resulting from the academy’s focus on learning and knowing” (12). Lawrence J. Prelli, in *A Rhetoric of Science: Inventing Scientific Discourse*, expands upon Miller’s point, arguing, “Textbooks constitute the main communicative medium for propagating conventional ways of thinking about and doing a particular science….Textbooks present the accepted findings, terms, concepts, methods, and procedures of
a field” (91). Thus, textbooks seem a logical place to discover both the communication conventions of a discipline as well as the practices for conveying those conventions to new members of the field in classrooms. However, textbooks are also limited by the fact that they are simply one tool an instructor uses to teach; therefore, I realized I also needed to examine how instructors teach visual communication in their classes.

### A Comparative Study of Disciplinary Instructors’ Interviews

In order to gather the best information about the similarities and distinctions of the ways visual communication is taught across these two disciplines, I relied on a series of discourse-based interviews. Many scholars interview as a method of research because, as Robert S. Weiss explains in *Learning from Strangers*:

> [An interview] gives us access to the observations of others….We can learn also, through interviewing, about people’s interior experiences. We can learn what people perceived and how they interpreted their perceptions. We can learn how events affected their thoughts and feelings. We can learn the meanings to them of their relationships, their families, their work, and their selves. (Weiss 1)

In *Interviewing as Qualitative Research*, Irving Seidman explains the usefulness of interviews, noting, “Interviewing, then, is a basic mode of inquiry. Recounting narratives of experience has been the major way throughout recorded history that humans have made sense of their experience” (8). And qualitative interviews have been used to contribute significant knowledge to humanities and social science fields because they “provided descriptions of phenomena that could have been learned about in no other way” (Weiss 12) and have helped researchers to “gain insight into educational and other important social issues through understanding the experience of the individuals whose lives reflect those issues” (Seidman 13).
Interviews have been used by many composition researchers to study a variety of groups’ and individuals’ communication and classroom experiences. For example, researchers interested in communication distinctions across disciplines and the ways students might or might not transfer their knowledge across such contexts have often interviewed students about their processes of learning and transferring communication skills (Carroll, Chiseri-Strater, Eves-Bowden, Fraizer, Haas, Herrington, McCarthy, Reiff and Bawarshi, and Sternglass, to name a few). Interestingly, far fewer of these researchers have interviewed instructors about their observations of disciplinary communication conventions, processes of learning to practice within those communication conventions, and transmitting that knowledge to students.

Some of these studies are narrowly focused on how certain development opportunities affected instructors’ teaching practices or expectations (Blakeslee, et al., and Walvoord et al.). However, others have more broadly inquired about instructors’ perceptions of general academic writing or writing in a specific discipline (Dias, et al; Hyland; Russell and Yañez; and Thaiss and Zawacki). Researchers like Anne J. Herrington interviewed chemical engineering instructors to learn about classroom writing conventions, and Lucille Parkinson McCarthy used instructor interviews to examine “assignments, purposes for having students write, and the instructional techniques [the instructors] used to accomplish their purposes” (238-40). In “Mutt Genres,” Elizabeth Wardle conducted instructor and TA interviews to examine “the types of genres students were assigned” (774). And Rebecca Nowacek interviewed instructors of a team-taught multidisciplinary sequence to learn how they shift among roles as they try to guides students’ learning as they tried to transfer their knowledge from one assignment to the next. These types of interviews illustrate the usefulness of interviews for researchers to investigate instructors’ perceptions of their disciplinary visual communication knowledge, practices, and pedagogies.
Using similar interview methods as these researchers, I focused my study on interview participants’ language and perceptions of reading, composing, and teaching. Interviews allowed the participants to use their own language and to discuss visuals through the lenses of their discipline and individual work. The interview process challenged me since visual communication pedagogy is not often studied and not always made a central component of instruction in the biological sciences and composition. Hence, I could not assume that all of the participants explicitly discussed visual communication in their classes. However, I did assume that they all used visuals in some capacity in their teaching. Thus, to let them articulate their own use of visuals, I asked them to provide me with three documents prior to their interviews, a classroom assignment/activity (see Appendices C-H), a textbook/teaching resource, and a scholarly article, which will be discussed more fully later in this chapter. Having these documents on hand allowed the participant to speak confidently about the visual communication practices they subscribed to and for me to literally see some of these attributes of visual communication. These methods helped me demonstrate that disciplinary and individual factors influence reading, composing, and teaching practices and the terminology used to discuss visuals, and that sometimes these tacit factors can be brought to the surface through dialogue.

By comparing textbooks’ and instructors’ instruction of visual communication, I was able to develop a more complete picture of the ways visual communication is and is not valued in these two disciplines, the similarities and differences in these values, some of the ways disciplinary conventions are taught, and the similarities and differences in these instruction practices. All of this information provide awareness of ways that instructors and researchers can work to more explicitly convey these disciplinary conventions and the rationales for such

1 Because the six participants’ textbook/teaching resources and the scholarly disciplinary articles are all under copyright, I am only including their classroom activities in the Appendices.
conventions to students and to locate ways to better help students transfer knowledge across two disciplines that value and practice visual communication in very distinct ways.

**Researcher Positionality**

As John Creswell writes, “Researchers bring their own worldviews, paradigms, or sets of beliefs to the research project, and these inform the conduct and writing of the qualitative study” (15). The position that the researcher takes is set in a liminal space where objectivism and subjectivism come together. Thus, like any other researcher, I have personal biases that I must make explicit in that “they influence the conduct of inquiry” (15).

My key biases in this project are tied to my grounding in the disciplinary conventions of composition and WAC. Even though I understand that communication expectations and values differ from discipline to discipline, at times I found that the language I was using to discuss the practices and instruction of visual communication was not translating well to the biological sciences participants. What this meant was that I often had to work harder to clarify a question or ask the biological sciences participants to clarify their meanings in ways that I did not do as often with the composition participants. For that reason, I had to actively work to not make assumptions about the composition participants’ meanings, but to ask them to tease out their meanings so that their perspectives rather than my own are the ones being discussed.

Because I have been steeped in WAC pedagogy, one of my main goals in my teaching and research is to help students and instructors be more mindful of the communication practices that are valued in the composition discipline as well as in other disciplines. Being explicit about why effective communication can differ in different disciplinary contexts is valuable for students to begin to consider ways of transferring communication knowledge and skills across these contexts, and for instructors to help students with those processes. However, not all composition
courses are designed with the idea of transfer in mind. So I had to be mindful in my framing of questions to participants as well as in the framing of my analysis and discussion of my findings to consider how awareness of disciplinary conventions is often tacit and how being reflective of those conventions is meaningful to instructors in ways beyond guiding transfer.

**Study One: How Visual Instruction in Composition Textbooks differs from that in Science-writing Textbooks**

For this initial study, I wanted to examine the similarities and differences of the visual communication topics addressed in composition textbooks and science-writing textbooks. Since there are disciplinary differences between visual communication conventions—the purposes, practices, and expectations—when writing and reading in composition and the sciences, an analysis of these textbooks helped me understand how students are guided in their understanding and application of these practices and conventions.

I gathered nine composition textbooks and eight science-writing textbooks in order to determine how they help teach visual communication. (More explanation of my selection process for these texts occurs in Chapter 4). I initially implemented a grounded theory approach, which as Strauss and Corbin note allows me to generate a general explanation of a process, action, or in this case terminology, created from the views of a large number of participants. Though grounded theory methods traditionally are applied to methods like surveying and interviewing, I applied them here to locate discussions of visual communication in each of these texts.

Specifically, I sought to learn the terminology and the ways those terms are used by textbook creators, who are scholars steeped in disciplinary conventions who work within those conventions and teach them to students. As Corbin and Straus note, “people do not invent the world anew each day. Rather, they draw upon what they know to try to understand what they do
not know. And, in this way, they discover what is similar and different about each object and thus define them” (75). By examining terminology and the topics discussed in textbooks, I began to understand how members of these disciplines understand and disseminate visual communication knowledge and practices. (This list of terms and topics, as well as a more detailed explanation of my researching and organizing processes can be found in Chapter 4).

After examining the visual communication terms and topics in the science-writing and composition textbooks, I realized I needed to discover whether members of these disciplines use visual communication in these ways and in what manners are these terms and topics presented in classrooms. Specifically, how do practitioners in these fields read and compose visuals? Do teachers use similar terms in their classrooms, and do they have the same meanings within or across disciplines? Are the visual communication topics discussed in the textbooks also presented in the classroom, or are some subtracted or others added?

From the textbooks I learned what several authorities in the disciplines suggest about visual communication conventions, but I still needed to find out if what was being put into practice in the classrooms corresponded. Consequently, I decided to conduct another study in which I interviewed composition and biological sciences instructors about their perceptions of visual communication conventions and how they teach those conventions to students. I incorporated my findings of visual communication terms and topics in science-writing and composition textbooks into these interviews to determine how dissemination of information in textbooks aligns to that in real classrooms. All of this research took place at Iowa State University (ISU), a land-grant institution with a STEM focus and a CAC program that specifically emphasizes written, oral, visual, and electronic communication.
Study Two: Interviews with Biological Sciences and Composition Faculty

The findings from the science-writing and composition textbook analysis prompted me to wonder if instruction in the classroom incorporated the use of the same terms and topics as the textbooks. I selected biological sciences as the natural sciences field to research because administrators in the CAC Program, which houses ISU’s composition and professional communication courses, has worked extensively with faculty in that field to create composition courses for a biological sciences Learning Community (an initiative to aid academic success by which students from the same major take courses together) and for Biological Communication, an advanced communication course offered only to biological sciences majors with the goal of having them learn and practice conventions of scientific communication. Thus, I conducted IRB approved (see Appendix A) interviews with composition and biological sciences instructors to examine the terminology used and individual perceptions of disciplinary visual communication practices and conventions as well as the instructors' methods for teaching these practices and conventions to students.

I specifically was interested in having instructors address the following questions:

1. **Terminology:** How do instructors talk about visual communication similarly or differently? What specific terminology is used to discuss visual reading, composing, and teaching practices? Are terms shared across the disciplines? Do different terms used in different disciplines mean the same thing? Are similar terms used to mean different things in different disciplines? Are visual communication terms discussed in textbooks used similarly or differently in classroom teaching?

2. **Instructors' assumptions:** What are instructors' assumptions about visual communication reading, composing, and teaching practices in composition and in the
biological sciences? What practices or conventions do instructors assume to be discipline-specific or universal? Are assumptions shared by instructors across the disciplines? Are individual instructors' assumptions shared with those in textbooks?

I collected three documents demonstrating visual communication conventions from the participants because grounded theory results from building theory out of gathered data: A classroom assignment/activity, a textbook/teaching resource, and a scholarly disciplinary article. I then conducted a 90-minute video-recorded interview with each participant. The discussions of these interviews can be found in Chapter 5.

**Participant Selection**

The central goals of this research project are to discover how instructors in composition and biological sciences compose, read, and teach visuals in scholarly writing and how they define and use visual communication terminology in these practices. For a research project of this magnitude, I knew I could not include many participants because of the large amount of data I was collecting from each individual and the amount of time I was asking each participant to provide. Thus, I decided on six participants, three of whom would need to be instructors teaching in one of the two biological sciences departments at ISU and three who would need to be instructors teaching in ISUComm, the CAC program that houses both foundation composition courses and advanced communication courses. For comparison purposes, I wanted an even number of participants from each field and participants who would be willing to consent to a 90-minute recorded interview.

Because the ISUComm program is invested in offering both general and discipline-specific composition and advanced communication courses, especially for science-related fields, I decided to invite a wider range of composition instructor participants than perhaps would be
possible at another institution. To gauge how distinctive the pedagogies are in some of these discipline-specific courses, I invited one general composition instructor, one instructor who teaches a composition course for a biological sciences Learning Community, and one instructor of a Biological Communication course, one of the advanced communication courses in ISUComm. This provided me the ability to not only analyze the similarities and differences between the views of the composition instructors and biological sciences instructors, but also to analyze any similarities and differences among the perspectives of instructors in composition.

Because Iowa State is a university of science and technology, there are two departments and 11 majors housed within the interdepartmental biology program. (See Table 1). Since I did not have a direct connection with any biological sciences instructors, I did not limit which departments or majors these participants came from. I did, however, seek out participants who are more aware of pedagogy than typical instructors are.

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</table>
To recruit participants, I contacted professors who I knew had connections with biological sciences instructors as well as the Program Coordinators for the Center for Excellence in Learning and Teaching. I sent out emails to those individuals requesting their help. I also employed snowball sampling methods to recruit other potential participants from those whose names I was given. Over the course of four months, I recruited six participants. I met with each of them individually to talk through the research process and answer any questions. I also provided them with a consent form prior to beginning the research (see Appendix B); some of them signed it at the initial informative meeting while others waited to sign it at the interview. Each participant is described more fully below and a list of participants is found in Table 2.

Participant #1: Brenda, ISUComm: Biological Communication

Brenda was recently a Ph.D. student in the Rhetoric and Professional Communication (RPC) program at ISU. She has a B.A. in Biology and has done extensive curricular design and research on the Biological Communication course to engage students in public science communication and was awarded a Teaching Excellence Award in 2014.

Participant #2: Kasey, ISUComm: General Composition

Kasey was a 5th year student in the RPC Ph.D. program at ISU. She had six years of experience teaching college-level writing at three institutions. She has taught a variety of composition courses, including Honors sections and a learning community for engineering students, and professional communication courses, including technical writing and business communication. Her research interests included multimodal pedagogy in the composition classroom and how reflection activities help promote students’ knowledge transfer.
Participant #3: Lauren, ISUComm: Composition for a Biological Sciences Learning Community

Lauren was a 2nd year Ph.D. student in the RPC program at ISU who also completed her M.A. coursework in the corresponding Master’s degree program at ISU. She had spent the previous several years working as a nurse, so had a firm grounding in the practices of scientific communication. Since starting as a graduate teaching assistant at ISU, she had been teaching and working to adapt the curriculum for a first-year composition course designed for the Biology Education Success Teams (BEST) learning community, designed to help first-year biology students navigate through their program.

Participant #4: Lyann, Biology: Ecology and Evolutionary Biology

Lyann was a full professor in the Department of Ecology, Evolution, and Organismal Biology and also worked in the Biological/Pre-Medical Illustration Program. She obtained her Ph.D. from ISU in Botany, and taught several courses that she took as a student, giving her a unique perspective on how the curriculum has and has not changed. Her area of expertise was in plant systematics and evolution, specifically in identifying and mapping new species of bamboo.

Participant #5: Mike, Biology: Plant Pathology and Microbiology

Mike was a full professor in the Department of Ecology, Evolution, and Organismal Biology with Ph.D.s in Plant Pathology and Environmental Sciences. He had worked for many years at ISU in Extension and Outreach, educating farmers and master gardeners about crop disease and pest management. Over the past few years, he worked primarily with graduate students, and recently created a professional speaking skills course designed to help biological sciences students effectively convey their research through oral presentations.
Participant #6: Natalie, Biology: Microbiology

Natalie was a senior lecturer in the Microbiology program at ISU. She had a Ph.D in Molecular, Cellular, and Developmental biology and had been teaching at the college-level since 1989. She had taught a variety of courses at this university, including Orientation in Microbiology, a microbiology senior seminar, and general classes in biology, genetics, and microbiology. Her area of expertise was in intracellular pathogens.

<table>
<thead>
<tr>
<th>Table 2: Research Participants and Their Research/Teaching Area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ISUComm</strong></td>
</tr>
<tr>
<td>Brenda</td>
</tr>
<tr>
<td>Kasey</td>
</tr>
<tr>
<td>Lauren</td>
</tr>
<tr>
<td><strong>Biology</strong></td>
</tr>
<tr>
<td>Lyann</td>
</tr>
<tr>
<td>Mike</td>
</tr>
<tr>
<td>Natalie</td>
</tr>
</tbody>
</table>

I must note that the composition participants are all advanced PhD students or were recently PhD Students while the biological sciences participants are full professors or senior lecturers, who have significantly more years of teaching experience than the composition participants. This discrepancy is a result of the fact that very few advanced lecturers and professors in ISUComm teach the foundation and advanced communication courses; alternatively, very few graduate students in the biological sciences are instructors of record of courses or have had the extensive pedagogical training that the Rhetoric and Professional Communication PhD students have had. While the experience levels of the participants differ, these were the participants available for study.
Research Instruments

Documents

I began the research project by collecting three documents from each participant:

1. A scholarly disciplinary article that they think exemplifies good visual communication conventions in their field.

2. One classroom assignment/activity that they created and use in their classes that features visual communication.

3. An excerpt from a textbook/teaching resource that they use to teach visual communication.

Seeing the participants’ views on what demonstrates good visual communication conventions in scholarship helped me adapt interview questions to ensure I understood the specific conventions that the participants recognize and possibly adhere to in their own composing and teaching. Likewise, having the classroom assignment/activity and textbook/teaching resource excerpt that instruct disciplinary visual communication aided my ability to adapt interview questions to understand the key visual communication terms and topics covered in the instructors’ classes.

Interviews

Because the participants were each discussing visual communication, I was interested to discover whether or not they might use non-verbal communication in meaningful ways. The likelihood seemed strong since visual communication is often used to reinforce written language or to represent information that written language cannot, and gesturing is often used during verbal interactions to reinforce spoken language or when spoken language is not sufficient. Thus, I recorded all of the interviews with video recorders rather than audio recorders.
I conducted the six interviews with one Canon Vixia HF M500 video recorder that caught all of the participants’ comments as well as allowed me the chance to observe their gestures and expressions. Each of the interviews were held at times and locations selected by the participants to make the project as convenient as possible for them. I set up the video recorders just prior to the interviews, ensuring that the participants face, arms, and hands were visible. I originally considered examining the gestures of the participants as they spoke; while I did not do that, seeing the participants’ physical reactions did, at times, support observations I made about the participants’ tone or feelings about a particular topic.

The questions for the interviews with individual participants asked about their disciplinary background, what visual communication terms they use and how they are defined, how they compose and read scholarly disciplinary articles, how they read student compositions, and how they teach visual communication practices and conventions in their classes (see Appendix B for the full list). During these individual interviews, the participants and I used the key visual communication terms and topics from my textbook analysis research as well as the three documents they submitted to help guide our discussions, which are related in Chapter 5.

**Data Analysis**

**Data Prep**

The interviews yielded approximately 9 hours of video-recorded data. Questions for each of the interviews are listed in Appendix C. After I conducted the interviews, the files were uploaded to Atlas.ti, a qualitative research software program that allows researchers to code video and audio recordings without transcribing them. As part of this process, I assigned pseudonyms to all participants.
Analysis Overview

The procedures for analyzing the interview data occurred in three stages. Initially, I coded the interview videos for the visual communication terms and topics list created during the textbook analysis portion of the research project. I was interested in discovering both similarities and differences in the ways participants in the same discipline, across disciplines, and the participants and the textbooks use these terms and engage with these pedagogical topics.

To best manage the coding of so much data, I purchased a subscription for qualitative analysis software. I first researched which were the best qualitative research software packages for video- and audio-recorded data. That process led me to two companies, both of which offered free 30-day trials, so I piloted both programs using the recordings of the first two interviews. In many ways the programs offered similar or equitable functions, as in the methods provided for outputting the patterns of codes. However, I selected Atlas.ti because the function for selecting specific sections of video for coding was more intuitive, and thus I could code more quickly. Since I had approximately 9 hours of video to inspect, and would need to review and code each video multiple times, the fact that Atlas.ti allowed for more efficient selection was a benefit.

Though my original plan was to use the videos for all of the analysis and data organization and only transcribe quotes that would go into the final paper, I did eventually transcribe the interviews in their entirety. I performed a manual transcription of the interviews because I realized that the ability to quickly return to terms or phrases in Microsoft Word through the “Find” function would speed up my analysis process. While all of my coding did occur in Atlas.ti, I used the transcriptions to quickly locate their thoughts on specific terms and topics. I did, however, return to the videos to verify the accuracy of my transcriptions and to remind myself of the interviewees’ tone when discussing certain topics. This process quickened my ability to pinpoint and validate critical comments that I wanted included in the paper.
Textbook Data Analysis

My analysis of composition and science-writing textbooks provided two lists that informed my data analysis practices: Visual communication terminology used and pedagogical topics covered in the instruction practices. Here I will overview my methods for the textbook data analysis, though a complete account of this process is discussed in Chapter 4.

Eleven key visual communication terms were used in the textbooks (chart, figure, graph, graphic, illustration, image, photograph, table, visual, visual argument, and visual element/image), and I employed these terms as coding labels. Similarly, nine pedagogical topics were found in the science-writing and composition textbooks.

Two topics were found in both fields’ textbooks:

1. Discussion of the purposes of visuals in written texts
2. Attention to the ethical use of visuals

Three topics were exclusive to science-writing textbooks:

3. Use of visuals to convey key information
4. Beginning the process of composing scientific documents with visuals
5. Understanding how, when, and why scientists read visuals

Four topics were exclusive to composition textbooks:

6. Use of visuals as invention processes
7. Creation of visuals as alternatives to written texts
8. Addition of visuals to enhance written texts that were lacking
9. Emphasis on analysis of visuals
Interview Data Analysis

Because the lists of terms from the textbook analysis included only the most used visual communication terms in the textbooks I examined, I also used open coding to locate additional terms used by participants. However, since the participants were situated in two disciplines, and because language can be used differently based on the disciplinary context, an additional layer of microanalysis was used to delineate moments when a term was used in distinct ways or when two terms were used in a manner that demonstrated the same meaning.

As with the terms, each of the topics from the textbook analysis list became a coding label for the interview recordings to identify instances where the participants discussed practices that fit within specific visual communication pedagogical topics. Because the interview questions I asked the six participants included their practices of reading and composing visuals, I realized that the participants discussed more topics than those covered by the textbooks. Some of these topics were entirely new, but others were basically the pedagogical topics relating to the participants’ own composing and reading practices rather than in connection with their teaching. Because I had already coded for these nine topics, I went back through all of the comments and relabeled those that dealt with the participants’ communication practices rather than pedagogical content and added these topics to the list. I once again employed open coding to discover additional topics discussed by the participants. These practices yielded an unwieldy number of topics that were combined and cut. Topics discussed by only one participant or that were indirectly related to visual communication (e.g.: “how new technology affects the creation of visuals”) were not included in the final list. Topics that were nearly identical or were subsets of other topics were combined (e.g.: “visuals grabbing the interest of an audience” was merged with “the purposes of visuals in written texts”). After these adjustments were made, a finalized list was generated with eight topics that fall within two categories:
Six topics describe the participants’ composing and reading processes:

1. How the participants learned their discipline’s conventions
2. The purposes of visuals in the participants’ written texts
3. Use of visuals to convey key information in participants’ work or others’ scholarly work
4. Participants’ processes of composing scholarly documents with visuals
5. How, when, and why the participants read visuals
6. Participants’ addition of visuals to enhance written texts that are lacking

Two topics describe participants’ concerns with visual communication instruction practices:

7. Student difficulty reading/interpreting visuals
8. Textbooks lacking discussions of visuals

As with the pedagogical topics, I observed instances in which participants in the same discipline or across disciplines discussed the topics similarly or differently to discover what visual communication practices and conventions seemed to be endorsed by the discipline and which seemed to be particular to the individual.

**Conclusion**

In this chapter, I have detailed the methods I used to collect and analyze data. The process of generating codes constituted the grounded theory that guided my pilot study: that instructors in these disciplines use terminology to describe visual communication practices and teach specific visual communication conventions because of the values placed on visual communication by the discipline in which they teach. And while some of these practices, conventions, values, and expectations are specific to one individual discipline, there are certain
instances where one or more of these processes cross over the boundary between biological sciences and composition.

In the next chapter, I will share the primary data analysis results from the textbook analysis portion of the research project. I will detail more specifically the terms and topics gathered during the textbook analysis phase as well as examine the similarities and differences presented across the two disciplines in order to discuss how visual communication conventions and practices are situated in these fields.
In order to discover visual communication conventions and practices valued in the composition and natural sciences fields, I first looked to popular textbooks that help to introduce new members to their respective fields. As pedagogical tools typically designed by members of the discipline and that convey disciplinary knowledge to students, presumably textbooks also articulate at least inexplicitly the communication conventions valued by the particular discipline. Thus this chapter analyzes the similarities and differences of the visual communication topics addressed in composition textbooks and science-writing textbooks with the goal of enhancing the understanding of practices and conventions of visual communication in these textbook traditions and potentially the disciplines at large. Specifically, visual communication terminology will be located and examined within the textbooks in order to discover the key pedagogical topics that express disciplinary visual communication conventions to students.

Textbooks are worth examining because they are “the most frequent kind of text that students read in school” (Geisler 32), and they “preserve and transmit cultural norms, beliefs, and value orientations over time and space” (de Castell 86). When examining how high school biology teachers use textbooks, Lori Lyman Digisi and John B. Willett found that textbooks were used for four reasons, the last three of which are applicable to my research: “b) to preview the lesson, c) to reinforce the lesson, and d) to have students learn information independently” (129). Since textbooks provide a considerable amount of guidance for students as they learn course content, they are a useful starting point for examining what knowledge gets conveyed to students as they enter a discipline.
This chapter details findings from a project analyzing composition and science-writing textbooks. I have organized this chapter by methods, results, discussion, and conclusions. Within each of these sections I have labeled subsections considering the visual communication terms and pedagogical topics discussed in the examined textbooks. The purpose of this analysis is to make clear that disciplinary conventions and good practices not only exist but also are at times specific to the disciplinary context. By examining differences in communication practices, students might begin to recognize that the expectations and values of one discipline might not be the same as another’s and critically consider how best to analyze and begin composing in each situation. Essentially, composition instructors who take a WAC/WID approach can help students be informed about composition’s visual communication conventions by simultaneously offering them some awareness of the communication expectations in the scientific disciplines.

**Methods**

For this study, nine composition textbooks were gathered in order to determine the ways they teach visual communication. To gain ecological validity, these textbooks were chosen from a short list of textbooks approved for use by composition instructors at a large Midwest research university with a Communication Across the Curriculum program that specifically emphasizes written, oral, visual, and electronic communication. These nine were chosen because they had sections devoted to visual communication. Each of the major composition textbook publishing houses are included here. Table 3 catalogs all of the composition textbooks examined.

Science-writing textbooks and handbooks were similarly gathered to examine visual communication instruction in science. These texts were chosen on the basis of Library of Congress subject headings, specifically “technical writing,” “technical writing—handbooks, manuals, etc” and “communication in science,” and I eliminated books published before 2004.
Table 3: Composition Textbooks Examined

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Year</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aims of Argument</em></td>
<td>Crusius &amp; Channell</td>
<td>2014</td>
<td>McGraw-Hill</td>
</tr>
<tr>
<td><em>The Call to Write</em></td>
<td>Trimbur</td>
<td>2014</td>
<td>Wadsworth-Cengage</td>
</tr>
<tr>
<td><em>Compose Design Advocate</em></td>
<td>Wysocki &amp; Lynch</td>
<td>2012</td>
<td>Pearson</td>
</tr>
<tr>
<td><em>Envision</em></td>
<td>Alfano &amp; O’Brien</td>
<td>2014</td>
<td>Pearson</td>
</tr>
<tr>
<td><em>Everything’s an Argument</em></td>
<td>Lunsford, Ruszkiewicz &amp; Walters</td>
<td>2013</td>
<td>Bedford/St. Martin’s</td>
</tr>
<tr>
<td><em>Joining the Conversation</em></td>
<td>Palmquist</td>
<td>2014</td>
<td>Bedford/St. Martin’s</td>
</tr>
<tr>
<td><em>The Norton Field Guide to Writing</em></td>
<td>Bullock &amp; Groggin</td>
<td>2013</td>
<td>Norton</td>
</tr>
<tr>
<td><em>Write Now</em></td>
<td>Anderson</td>
<td>2011</td>
<td>Prentice Hall</td>
</tr>
<tr>
<td><em>Writing</em></td>
<td>Faigley</td>
<td>2011</td>
<td>Pearson</td>
</tr>
</tbody>
</table>

(10 years earlier). I then chose books in these LC subject headings by a) removing those that treated only a single discipline (e.g., chemistry) and b) finding those that contained sections on visuals, indicated in their tables of contents (as I had with the composition textbooks). That resulted in eight books. Table 4 lists all of the science-writing textbooks examined.

Table 4: Science-writing Textbooks and Handbooks Examined

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Year</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Communicating Science: A Practical Guide</em></td>
<td>Lazlo</td>
<td>2006</td>
<td>Springer</td>
</tr>
<tr>
<td><em>How to Write and Illustrate Scientific Papers</em></td>
<td>Gustavii</td>
<td>2008</td>
<td>Cambridge University Press</td>
</tr>
<tr>
<td><em>Mastering Scientific Writing: Secrets for Success in the Agricultural, Biological, and Health Sciences</em></td>
<td>Kahrs</td>
<td>2008</td>
<td>Infinity</td>
</tr>
<tr>
<td><em>Successful Scientific Writing</em></td>
<td>Matthews &amp; Matthews</td>
<td>2008</td>
<td>Cambridge</td>
</tr>
<tr>
<td><em>Writing and Presenting Scientific Papers</em></td>
<td>Malmfors, Garnsworthy &amp; Grossman</td>
<td>2004</td>
<td>Nottingham University Press</td>
</tr>
<tr>
<td><em>Writing Scientific Research Articles: Strategy and Steps</em></td>
<td>Cargill &amp; O’Connor</td>
<td>2013</td>
<td>Wiley-Blackwell</td>
</tr>
</tbody>
</table>
A grounded theory approach was initially implemented to locate discussions of visual communication in each of these texts. The tables of contents and indexes of 50% of the collected texts were searched for terminology related to visuals to create an initial list of eleven key terms. I initially focused on the terms used in these textbooks because, as Eleftherios Klerides explains, “language in texts functions ideationally in representing experience and reality…. [A textbook] is a systematically organized group of statements that linguistically represents aspects of” the discipline (32). Thus, language seemed a logical starting point from which to discover the knowledge and communication conventions presented in disciplinary textbooks. These key terms I located were then searched for in the tables of contents and indexes of all of the composition and science-writing texts. Finally, a list was created with all of the terms that appeared in at least 20% of the selected texts.

As the key terms found in each text were recorded, all of the pages on which one or more of these terms appear were also noted in order to discover where, how often, and in what ways these texts discussed visuals. An initial pass through the texts was made to find the common topics included in the composition textbooks and the scientific writing textbooks and handbooks to instruct students to use, analyze, and incorporate/create visuals. Nine topics were located, and then were listed and categorized in a recursive process.

It must be noted briefly that what will not be considered in this chapter are the methods by which textbooks teach visuals used in scientific posters or oral presentations, but will only look at the instruction of visuals in scientific articles.
Results

Terms

From the 17 composition and science-writing textbooks analyzed, 11 terms related to visual communication were found in at least 20% of the texts. Table 5 illustrates this list of key terms, noting which terms appeared in which type of text.

<table>
<thead>
<tr>
<th>Key Term</th>
<th>Composition Texts</th>
<th>Science-Writing Texts</th>
<th>Total Texts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
</tr>
<tr>
<td>Chart(s)</td>
<td>6</td>
<td>67%</td>
<td>4</td>
</tr>
<tr>
<td>Figure(s)</td>
<td>2</td>
<td>22%</td>
<td>6</td>
</tr>
<tr>
<td>Graph(s)</td>
<td>6</td>
<td>67%</td>
<td>6</td>
</tr>
<tr>
<td>Graphic(s)</td>
<td>4</td>
<td>44%</td>
<td>2</td>
</tr>
<tr>
<td>Illustration(s)</td>
<td>5</td>
<td>56%</td>
<td>2</td>
</tr>
<tr>
<td>Image(s)</td>
<td>5</td>
<td>56%</td>
<td>1</td>
</tr>
<tr>
<td>Photograph(s)</td>
<td>9</td>
<td>100%</td>
<td>3</td>
</tr>
<tr>
<td>Table(s)</td>
<td>4</td>
<td>44%</td>
<td>7</td>
</tr>
<tr>
<td>Visual(s)</td>
<td>2</td>
<td>22%</td>
<td>2</td>
</tr>
<tr>
<td>Visual argument(s)</td>
<td>4</td>
<td>44%</td>
<td>0</td>
</tr>
<tr>
<td>Visual element(s)/image(s)</td>
<td>4</td>
<td>44%</td>
<td>0</td>
</tr>
</tbody>
</table>

While certain terms, such as chart and graph, were used consistently in these composition and science-writing textbooks, other terms, such as figure, photograph, and visual argument, tended to be included more often in one discipline’s texts than the other. Also, “visual argument(s)” and “visual element(s)/image(s)” were found only in the composition textbooks. Though not examined specifically in this chapter, the differences in terminology might also provide insight into the conventions and expectations of the composing practices of each discipline.
**Topics**

Of the nine common topics of visual communication instruction generated from the 17 textbooks, two of them were utilized in both composition and science-writing texts, three were unique to science-writing texts, and four were only found in composition texts. Table 6 depicts these topics, illustrating how many of the texts included each.

**Table 6: Common Topics of Visual Communication Instruction in the Composition and Science-writing Texts**

<table>
<thead>
<tr>
<th>Topics in both Composition and Science-writing Texts</th>
<th># Texts Included</th>
<th>% Texts Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion of the purposes of visuals in written texts</td>
<td>16</td>
<td>94%</td>
</tr>
<tr>
<td>Attention to the ethical use of visuals</td>
<td>11</td>
<td>65%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topics Exclusive to Science-writing Texts</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of visuals to convey key information</td>
<td>7</td>
<td>88%</td>
</tr>
<tr>
<td>Beginning the process of composing scholarly documents with visuals</td>
<td>6</td>
<td>75%</td>
</tr>
<tr>
<td>Understanding how, when, and why the audience reads visuals</td>
<td>2</td>
<td>25%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topics Exclusive to Composition Textbooks</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of visuals as invention processes</td>
<td>6</td>
<td>67%</td>
</tr>
<tr>
<td>Creation of visuals as alternatives to written texts</td>
<td>5</td>
<td>56%</td>
</tr>
<tr>
<td>Addition of visuals to enhance written texts that are lacking</td>
<td>5</td>
<td>56%</td>
</tr>
<tr>
<td>Emphasis on the analysis of visuals</td>
<td>8*</td>
<td>80%*</td>
</tr>
</tbody>
</table>

* Topic 9 includes Penrose and Katz’s *Writing in the Sciences: Exploring Conventions of Scientific Discourse*, making the % Texts Included out of a total of 10 texts

Several of the topics clearly presented themselves, such how almost all of the texts examined offered some explanation of the rationale for including visual communication in academic documents (Topic 1 below) or that many texts gave direction on ethical practices of using visuals (Topic 2), such as how to cite visuals and ensure the visuals are not misleading. Other topics appeared solely in sample activities and assignments in composition textbooks (Topics 6-8). The topics apparent in the science textbooks differed from those offered in the
composition textbooks mainly in that they focused on the practices of science rather than the analysis of those practices (Topics 3-4).

The analysis of visuals (Topic 9) was the topic most difficult to categorize. In keeping with their individual discipline’s values, composition textbooks focus on explaining the process of visual rhetorical analysis while the science-writing textbooks focus on how to implement that analysis into the creation and reading of the visuals. Thus, in science texts, the analysis of visuals is typically hinted at but not actually explicitly discussed, or the analysis is discussed in relation to the purposes of visuals in written texts. For these reasons, analysis of visuals was categorized as exclusive to composition textbooks because the science textbooks do not directly address the process of visual analysis but only the practical outcomes.

The one outlier for the analysis of visuals category is Ann M. Penrose and Steven B. Katz’s *Writing in the Sciences: Exploring Conventions of Scientific Discourse*. Though writing for a scientific audience, the authors of this textbook are composition and technical communication instructors. Thus, the information provided in their text, at times, crosses the boundaries of certain common topics, such as how visuals are analyzed, and this will be discussed briefly in the Discussion section.

**Discussion**

What follows is a discussion of each of the nine topics and descriptions of how the texts demonstrate the topics.

**Topics Found in both Composition and Science-writing Texts**

1. Discussion of the Purposes of Visuals in Written Texts

   All of the composition textbooks and all but one of the science-writing texts explain the purpose of visuals in written texts; however, composition textbooks focus students to think about
which visuals work best for presenting different types of data while science-writing textbooks expand this discussion to explain how the contexts and audiences of the discipline reinforce the disciplinary expectations of using visuals to convey large amounts of information in a short space. These distinctions possibly stem from the fact that composition instructors, and thus the textbooks and resources, only have so much time within one course to cover all the types of communication necessary to prepare students for composing in a variety of academic contexts, while natural sciences textbooks can be more focused on conveying the communication conventions utilized in a more definite set of fields.

For instance, composition textbooks overview the purposes of using certain visuals in texts in general ways, as Lester Faigley in Writing states, “Photographs and other images can work in combination with words to enhance observations” (113), and in technical ways, as Mike Palmquist in Joining the Conversation notes how figures help readers “see trends,” images help readers “better understand the subject,” captions are “a necessary complement to figures and images,” photographs “strengthen (or serve as) emotional appeal,” and tables, charts, and graphs “present statistical data” (255; 419). Several of the science-writing textbooks offer these same sorts of advice, as is illustrated by Margaret Cargill and Patrick O’Connor in Writing Scientific Research Articles: “Pie charts are effective at highlighting proportions of a total or whole….Line charts allow the display of a sequence of variables in time or space” (27). These instructions help students make informed decisions about the types of visuals to use.

One distinction between the two disciplines’ textbooks is the value placed on the purpose of visuals presenting key information. At times, composition textbook authors perhaps inadvertently downgrade the importance of visual communication, making it seem secondary to the written text; for example, John Trimbur, in The Call to Write, notes, “Photographs, drawings,
and other illustrations enable readers to visualize the content of the written text” (511). Since traditionally composition scholars begin composing documents with written language, it makes sense that composition textbook authors like Trimbur convey the view that written text comes first and visuals are added later for usability and persuasion. However, scientists do not typically compose documents in this same order. Cargill and O’Connor explain how crucial visuals are to presenting scientific data clearly and concisely, something difficult to do in written form:

The data presentation in a scientific article aims to illustrate the story, present evidence to support or reject a hypothesis, and record important data and metadata. We verify, analyse, and display data to share, build, and legitimize new knowledge. To do this effectively, we must present all necessary data in ways which make the most important points most prominent. (25)

Essentially, a key purpose of visuals in scientific documents is to reduce large amounts of data and represent them so that researchers and readers better recognize important patterns in the information. In Guide to Publishing a Scientific Paper, Ann M. Körner reinforces this practice when she writes, “Photographs and photomicrographs provide instantly assimilable information, while graphs and histograms allow the easy interpretation of results” (57). The purpose of these visuals seems to stem from two characteristics: First, the nature of scientific data often comprises large amounts of quantitative, statistical information that is difficult to discuss succinctly in written language or denotes descriptive characteristics about an organism, plant, or animal that must be illustrated for the audience to fully understand the particulars. Second, the context of the document and the needs of the audience often influence the disciplinary conventions; as Ann M. Penrose and Stephen B. Katz in Writing in the Sciences explain, “Journals do not allow room” for scientists to relate data from a long-term study or large sample design, “nor would readers
want to spend the time to read these raw data” (105). By stating these factors, the science-writing textbooks are presenting to students the discipline’s rhetorical situations to emphasize the importance and purpose of good visual communication.

2. Attention to the Ethical Use of Visuals

Many of the composition textbooks and science-writing texts examined are keenly concerned with the ethical use of visuals: expressing the need for students and researchers to follow the appropriate conventions for designing visuals and conveying information, to be consistent, and to not skew data. The composition textbooks *Envision, Writing, Joining the Conversation*, *Everything’s an Argument*, and *Write Now* all include information about how to appropriately cite pictures, cartoons, and other visuals in a written text using MLA format. The authors of *The Norton Field Guide to Writing* and *The Call to Write* include the most about the ethical use of charts and data, as when Trimbur reminds students that these visuals “often misrepresent or exaggerate the meaning of the data” (515). The need for students to be aware of conventions, like plagiarism and skewing data, is instruction that is important to composition courses as well as discipline-specific courses.

While documentation style is not discussed in any of the examined science-writing textbooks, many do mention the need for a writer to obtain permissions for and to properly cite original works. The ethical issue more prominent in these textbooks is the concern of the writer skewing data through bad visual design. For example, Janet R. Matthews and Robert W. Matthews, in *Successful Scientific Writing*, advise researchers that while they should “produce visually dynamic illustrations,” they must remember “that legibility and comprehensibility should remain the most important criteria” (66). Implied in this statement is that it is more important for a visual to be neat and convey a clear message than to be beautiful but not present
accurate data. The amount of information being presented can affect accuracy too; for example, in *Guide to Publishing a Scientific Paper*, Körnerreminds writers that visuals “should not contain so much information that your results are indecipherable and your point is lost” (74). Even the type of visual used to present data becomes an ethical decision, as Björn Gustavii, in *How to Write and Illustrate Scientific Papers*, notes, “Column charts are said in certain cases to exaggerate differences between individual measurements. If this is so, it could be a reason for not using column charts in such cases” (25). These examples illustrate that science writers’ attention to the organization and amount of information and the design of their visuals can affect accuracy of the key points.

Overall, the textbooks examined in this study have general similarities in that they provide discussions of the purposes of visuals in written texts and attention to the ethical use of visuals. On the whole, however, the composition textbooks’ guidance tends to be more generalized when compared with specifics given in science-writing texts. This is to be expected as composition textbooks are used in courses that are designed to introduce students from a wide variety of majors to composing in academia. Perhaps the more noteworthy contrast is that composition textbooks value written communication more heavily than science-writing textbooks, even when presenting aspects of visual communication: The visuals rarely, if ever, stand on their own to convey the researcher’s main ideas. Meanwhile, science-writing texts discuss how written and visual communication work together but also the reasons for visual communication to perform on its own. These distinctions in disciplinary conventions possibly stem from the distinctions between the processes for studying, organizing, and presenting numerical, quantitative data or visual data used regularly in the natural sciences and discursive, qualitative data used regularly in composition.
**Topics Exclusive to Science-writing Texts**

Of the nine topics of visual communication observed in the texts, three topics are specific to science-writing textbooks: Use of visuals to convey key information, Beginning the process of composing academic documents with visuals, and Understanding how, when, and why the audience reads visuals.

### 3. Use of Visuals to Convey Key Information

The first of the topics specific to science-writing texts is the recognition that visuals play a significant role in the practices and conventions of science writing. As mentioned previously, one fundamental purpose of visuals in scientific articles is for presenting essential data. Because visual communication is so highly valued, seven of the writing guides for the sciences include substantial instruction on how to incorporate visuals into written texts. For example, segments in Cargill and O’Connor’s *Writing Scientific Research Articles: Strategy and Steps* and Matthews and Matthews’s *Successful Scientific Writing* explain how to effectively choose and use visual aids like tables and figures in written texts. The ability for a writer to use effective visuals is crucial because of the natures of quantitative and statistical data: Visuals aid the researcher’s understanding of the data, the writer’s presentation of patterns in the data, and the reader’s recognition of the knowledge being presented by the data.

Cargill and O’Connor explain how researchers use visuals to make sense of large amounts of data by writing that data presentation is a way to “verify, analyse, and display data to share, build, and legitimize new knowledge…. [and] also an exercise in deciding which datasets or details to leave out of the article” (25). In this way visuals work to convey information to the audience, but also as an organization exercise, helping the writer to determine what data should be presented and why. These authors also advise writers to consider their audience’s practices
when they note, “One overarching guideline is that tables and figures should ‘stand alone’: that is, the reader should not need to consult the text or the article to understand the data presented in the table or figure” (25). Birgitta Malmfors, Phil Garnsworthy, and Michael Grossman in *Writing and Presenting Scientific Papers* agree, noting, “Figures should be understood independently (stand alone), without reference to the text, to tables or to other figures” (20). They go on to indicate that the text plays the supporting role to the visuals, that the accompanying text is used to “summarize and characterize the data, to help readers see what [the researchers] see” in the data (106). These instructions imply that if the visuals do not convey key points, likely the audience will not take the time to read the document. In fact Matthews and Matthews reinforce this value by stating, “Scientists often scan graphics such as tables and figures to see whether the rest of the paper is worth reading” (56). Thus, visuals must convey meaning on their own as well as in relation to the written text of scientific documents.

These conventions of using visuals to organize and convey key information differs from the conventions of visual communication in composition, in which visuals support key ideas discussed in the written text but do not usually stand on their own. While some composition textbooks have sections on visuals that convey arguments, they are speaking of visuals more generally (posters, commercials, advertisements, etc.), not as visuals working within a scholarly article conveying key research and messages in conjunction with written text. Thus, it makes sense for science-writing textbooks to describe specific practices for using visuals. While some composition textbooks include explanations of when to use charts, graphs, or other visuals to display data, the infrequent use of statistical data does not encourage composition textbook authors to spend much time detailing how visuals can be used in these ways.
4. Beginning the Process of Composing Academic Documents with Visuals

As mentioned in the previous section, science writers often use visuals as a way to locate and arrange data. Six of the eight science-writing textbooks explain how creating a visual is an effective way for scientists to determine if there are significant data and to ensure that those ideas and patterns are clearly presented. Malmfors, et al. in *Writing and Presenting Scientific Papers* explain, “Before starting to write about your results, it is best to prepare them in the form of tables or figures. From among the tables and figures that you would like to report, select those that are the most important or the most representative—the ones that best tell your story” (13). This practice of examining the data visually helps scientists ensure they are following ethical practices by demonstrating that their research is credible and noteworthy.

This point of telling a story with the results is one that comes up often in the discussion of visuals. In *Writing Scientific Research Articles* Cargill and O’Connor claim that beginning with the visuals is a way for researchers to identify “a clearly connected story which leads to one or more ‘take-home messages’” (23). They argue that it is important for the researcher to discover and articulate the main points of the research results early in the composing process. To do so, they suggest to “focus on your tables and figures first” and bullet point the key messages (23). These notes can then be used to determine where in the paper the data in the visuals should be located and perhaps even “may stimulate thoughts for inclusion” in the written portions of the document (23). Matthews and Matthews in *Successful Science Writing* reinforce the idea that visuals need to be prepared as soon as possible by explaining, “Figures and tables present data in condensed form and help clarify and support ideas, they make writing easier” (56). Because so much of the key data are presented in the visuals, these textbook authors are explicit in their instruction of using visuals to begin composing documents. Since the key information often
resides in the visuals, the writer must start there in order to determine what written discussions are necessary to tell the audience the story of the data.

Interestingly, many composition textbooks offer visual invention (sometimes called brainstorming or prewriting) techniques that are reminiscent of some suggestions included in the science-writing textbooks for locating and arranging information. However, the visuals produced in composition invention activities are rarely included in the finished document. In science, though, these visuals act as a vehicle for learning, for understanding what the data say or reveal, and for conveying information; thus, they are essential components to the finalized document. Because composition instruction is often centered on the writing process (helping students invent their ideas, draft those ideas on paper, revise their ideas into coherent arguments, etc.), it is perhaps surprising that composition textbooks do not expand upon the use of visuals as tools for defining, arranging, and displaying information—tasks that seem to be for science textbooks part of the composing process.

5. Understanding How, When, and Why the Audience Reads Visuals

As many of the online guides to reading scientific writing discussed at the beginning of this chapter noted, often scientists will begin reading scientific papers by looking at the visuals. In Guide to Publishing a Scientific Paper Körner explains that since reading scientific writing is often a lengthy affair, “readers may scan your paper and look at your Figures before they invest the time required to read the text of your paper” (74). Penrose and Katz in Writing in the Sciences agree with Körner by remarking that scientists reading articles are highly unlikely to “take the time to read a paper from start to finish” (124). Instead, they will read the title and abstract, and then go straight to the visuals since that’s where the significant numeric data lie. The authors support these claims by explaining that among their surveyed participants, “only
after examining the data [in the visuals and figures] themselves did these scientists read the results section provided by the authors” (124).

What becomes clear is that writers of science documents need to be aware of the purpose the visuals as well as the needs of the audience. Körner accentuates this idea, writing, “The material that you display in your Figures should be so clear and so convincing that the reader can easily draw the same conclusions from each Figure as you yourself have done” (74). Thus, visuals in scientific communication typically act to succinctly convey the key points of the research being discussed. In order to create visuals (as well as written text) that successfully achieve these goals, the writer must consider the expectations of the scientific audience and understand how scientific writing will be read by that audience.

The central theme running through the topics exclusive to science-writing texts is that the purpose of using visuals (to convey key points and significant evidence) is directly related to the practices of composing and reading visuals (starting with the visuals before moving on to the written text). Interestingly, though they do not use the term, the science-writing textbook authors seem to be very conscious of the rhetorical situation of science communication. Often the authors are justifying certain composing practices by discussing the context or the needs of the audience or writer. These instructional topics differ from those in composition because the act of learning these skills seems to occur during real-world practice. Science-writing textbooks focus on learning communication conventions during the act of communicating real data to real audiences within specific contexts; meanwhile, as will be discussed in the next section, composition textbooks often separate context from the composing process because one goal of the discipline is to teach individual composing skills and to help students be prepared to consider the conventions of a variety of rhetorical situations. Yet, it seems surprising that as part of the
awareness of a variety of rhetorical situations, the composition textbooks include little discussion of the ways in which an audience might interact with visuals in a document. If, as Alfano and O’Brien explain in *Envision*, one of the jobs of a writer is to “think about how readers will interact with your writing,” and many scientific audiences are examining visuals early in their reading processes, composition textbooks might find value in discussing How, when, and why the audience reads visuals (268).

**Topics Exclusive to Composition Textbooks**

Of the nine topics of visual communication observed in the texts, four topics are specific to composition textbooks: Use of visuals as invention processes, Creation of visuals as alternatives to written texts, Addition of visuals to enhance written texts that are lacking, and Emphasis on the analysis of visuals.

6. **Use of Visuals as Invention Processes**

The idea of pre-writing, invention, or brainstorming, is discussed in all of the composition textbooks examined, and often these pre-writing strategies take the form of visuals. Six of the nine examined composition textbooks include clustering (also called mapping or bubble webs) as a technique for generating ideas to help students visually connect ideas. Textbook authors, such as Anne Wysocki and Dennis Lynch in *Compose Design Advocate*, suggest that students draw a picture: “Sometimes making your ideas into a picture opens up new ideas and directions” (95). In *Envision* Alfano and O’Brien also mention how in “graphic flowcharts, you list one idea and then draw an arrow to suggest cause and effect and to show relationships among ideas” (178). Each of these tasks are suggested as ways for students to create a topic for a paper or to organize ideas to be included in a paper. In discussing these visual invention tasks, the textbook authors imply that this work often occurs prior to any composing of
the final document, and possibly prior to any research since these invention techniques can be used to select or narrow the topic to be discussed in a paper.

Even though it has been mentioned that scientists might create a visual in order to determine if their research is yielding significant data—and in reality the goal of all scientific research is to invent or discover new knowledge—the term “invention” does not appear in any of the science-writing textbooks’ table of contents or indexes. Based on the language used in these texts, such as “discovery,” “search,” and “research” (Matthews and Matthews 1), scientists seem to view invention as occurring through the practice of science research, not as a task occurring before any other work has started. While some similarities might be seen in the ways visuals are used as planning and organizing methods in both disciplines, the terminology, the timing, and the purposes of the practices illustrate distinct disciplinary differences.

7. Creation of Visuals as Alternatives to Written Texts

Many visual communication activities in composition classes are designed as remixing activities in which visuals take the place of written texts or as tasks to promote reflection on composing processes. For example, *Compose Design Advocate, Joining the Conversation, Write Now* and *Writing* all include assignments that ask students to transform written texts into visual texts or create new texts using mostly visuals. Wysocki and Lynch include several of these tasks: “Take a short paper you’ve already produced and re-produce it as best you can using photographs” (282), “compose your own photographic essay about an issue that matters to you” (376), and “choose a text you’ve already produced…[to] reproduce the text as a paper or online comic book” (496). *Envision, Joining the Conversation, Write Now* and *Writing* all also include photo essay assignments. While the visual text is the larger component within these assignments, all but one of these photo essay activities do call for students to write a reflective piece that
corresponds with the visual texts they create. The addition of the reflective pieces imply that the purpose of these visual activities is about helping students build their own authority and ethos within their work, which is actually done, at least in part, through the written piece. These activities indicate that composition courses are concerned with process-oriented goals.

However, there is one instance in which composition textbook authors articulate the importance of adapting written text to visuals in ways similar to science-writing textbooks. Andrea A. Lunsford, John J. Ruszkiewicz, and Keith Walters in *Everything's and Argument* note, “Words are powerful and capable of precision and subtlety. But some information is conveyed more efficiently by charts, graphs, drawings, maps, or photos” (341). Statements like these do not explicitly demonstrate how important illustrating statistical data might be for other disciplines, but they do enlighten students to the idea that thinking about and presenting information in a visual manner can be useful and expedient.

8. Addition of Visuals to Enhance Written Texts that are Lacking

Like the science-writing textbooks, several of the composition texts examined do explicitly discuss the incorporation of visuals into written text; however, they do so in a way that assumes the visuals are subordinate or secondary to written portions of documents. For example, in *Write Now* Daniel Anderson lists methods for adding visual components to already-written texts: When writing a position argument, a student might “use images to create visual appeals that complement the logic of your argument,” or for an explanatory research essay, students could “include informational graphics to help readers make sense of the topic” (478). In a similar way, in *Joining the Conversation* Palmquist claims that illustrations “can expand on or demonstrate points made in the text of your document” (549). Additionally, in the index entry of *The Call to Write* Trimbur insinuates that visuals are simply augmenting written text by listing,
“Tables, as document enhancement.” The wording in these texts (“complement,” “help,” “expand on,” “demonstrate points” that are already made, and “document enhancement”) suggests that visuals are generally subordinate to written text, that visuals are added-on rather than crucial elements of a document that convey arguments.

Science writing typically does not view visuals as simply additions or enhancements to the text; in fact, visuals are seen as crucial components to the document. For example, Pierre Lazlo notes six functions of visuals in science writing, including to “serve as a piece of evidence,” “depict an experimental set-up,” and “communicate to the viewer the quality of the work done,” qualities essential to writing up experimental research (20). So this distinction is one that is vast between composing conventions in composition and the natural sciences.

9. Emphasis on the Analysis of Visuals

Lastly, a task discussed in all but two of the composition textbooks is visual rhetorical analysis. Timothy W. Crucius and Carolyn E. Channell in The Aims of Argument argue that visual rhetorical analyses are vital skills for 21st c. students to have, writing, “Like language, visual images are rhetorical. They persuade us in obvious and not-so-obvious ways. As both readers and writers of arguments, we need to understand the power of visual rhetoric and learn to use it effectively and responsibly” (73). Thus, all but two of the composition textbooks examined include some discussion of visual rhetorical analysis.

Composition textbook authors speak generally on the topic as well as use specific rhetorical terminology to discuss how to analyze images. In Writing Faigley examines the questions “What do visuals do best?” and “What do words do best?” (531). He notes that these questions help students recognize that to “deliver spatial information,” a visual would be helpful, whereas words are best suited to “communicate abstract ideas” (531). Faigley also asks students
to think about “readers’ expectations for the medium,” “about the purpose of an image,” and “about the placement of an image” when deciding whether and how to use visuals (532).

*Compose Design Advocate, Envision and Everything’s an Argument* explore the purposes, audiences, and contexts of visuals, as well as the ways ethos, pathos, and logos can be identified in visuals. *Compose Design Advocate* and *The Aims of Argument* also offer visual rhetorical analysis activities and assignments in which students are asked to put their rhetorical understanding to use. In sum, these texts, to varying degrees, ask students to consider the author/creator’s purposes, the needs and expectations of the audience, and the information being presented in order to make rhetorical decisions about when to add visuals to a written text. These rhetorical analysis skills are likely useful for students as they learn to negotiate new conventions as they move into other academic writing contexts.

In fact, disciplines like the natural sciences expect students to recognize how the purpose, subject, context, and audience affect their methods of communicating, and a few of the science-writing textbooks address the rhetorical situation without using that term. For example, Malmfors, et al. in *Writing and Presenting Scientific Papers* note that the writer should ask themselves “Who are you addressing?….Why is your message important?….What are your main findings or ‘take-home’ messages?….[and] How can you best deliver your message and satisfy audience’s needs?” (3). However, only one of the science-writing textbooks includes specific rhetorical terminology and offers practice with rhetorically analyzing documents. As mentioned previously, Penrose and Katz, authors of *Writing in the Sciences*, have backgrounds in composition and technical communication, so they integrate visual pedagogy practices endorsed in their home disciplines with those in the natural sciences. For example, the authors discuss several scholars of visual rhetoric and digital literacy and claim that visual technologies “serve a
number of rhetorical functions” (44). And in the section “The Role of Persuasion in Scientific Communication,” the authors rhetorically analyze several scientific texts, noting how logic, evidence, beliefs, presentation, and style each affect the persuasiveness of the writers’ arguments (16-17). Typically the science-writing textbooks discuss the rhetorical situation in general terms as a task to be done when composing while the composition textbooks instruct students how to analyze documents in order to later consider the rhetorical situations when they compose. Penrose and Katz, however, bridge the conventions and goals of composition and science communication in ways that other science-writing texts do not, possibly because of their interdisciplinary backgrounds.

The central theme running through the topics exclusive to composition texts is that visuals are used to aid students’ thinking and learning about academic writing. Therefore, using visuals as invention processes, creating visuals as alternatives to written text, and adding visuals to written texts are useful tasks to help students meet those goals. Similarly, composition textbooks instruct students to consider the rhetorical situations of diverse genres and composing contexts. This knowledge prepares students for their own future composing tasks, both within composition classes and beyond. However, as mentioned, composition textbooks do not often specifically discuss the ways in which audiences might read visuals early in the reading process in order to glean an article’s main ideas. They also rarely explain the ways in which visuals might be used at different points during the writing process to help convey key data. Even though the textbooks subscribe to the instruction of rhetorical analysis and writing process, it seems that there is room for improvement when it comes to discussing the ways visual communication can work in both process and product.
So while the communication goals and assigned tasks in composition classes are likely different from the goals and tasks of natural sciences classes and disciplinary conventions, some of the individual skills and knowledge presented in composition is also valued in the natural sciences though still in distinctive ways. For example, even though science-writing textbooks typically do not present instruction on rhetorical analysis, they do expect students to be able to consider the audience expectations, key data to be displayed, and genre conventions in order to organize and present new knowledge through both visual and written communication. In sum, both of these disciplines have valid reasons for the practices of composing and reading with visuals; however, these disciplinary distinctions could pose difficulties for students trying to transfer and apply knowledge and skills learned in one disciplinary context to the other.

Conclusion

The results of the textbook analysis presented here show that the majority of the visual communication topics included in the examined composition and science-writing textbooks are different. While some of the topics are mentioned by both composition and science-writing textbooks, such as understanding the purposes of visuals and ethical uses of images, differences remain in the ways the topics are conveyed. These differences seem to stem from the goals of the classes themselves and of the types of research valued by the disciplines. Specifically, the outcomes of composition classes are often writing process-oriented: Students in a composition class are learning to be authoritative, develop useful composing processes, and consider a variety of genres and methods of communicating. Often the data being examined or evidence being supplied is discursive and more efficient to convey in written language. Meanwhile, natural sciences classes are designed with the purpose of teaching students the best practices of doing science; learning to communicate in the natural sciences is not separated from the context of
researching and experimenting. And the research being done is often quantitative, yielding large amounts of numerical data that are more efficiently presented in visual form, or needs to be presented in visual form because distinguishing features of habitats or species must be seen by the audience to comprehend the knowledge being presented.

It must be mentioned briefly that the methods used here for analyzing these disciplinary textbooks limit the scope of understanding of what the textbook authors’ goals are and are limited in that they cannot take into consideration other classroom factors of student learning. For instance, examining only certain segments of the textbooks based on locating key terms misses some of the nuance of the authors’ design and scaffolding of materials through chapters, units, and the textbooks as a whole. This decontextualization of the terms and topics tends to oversimplify the holistic purposes and goals set by the textbook authors and might miss some of the explicit rationale being provided about the disciplines’ communication conventions. This examination also does not consider how individual instructors make use of the textbooks and supplement those materials with their own. Like most instructors, WAC/WID-focused instructors are apt to selectively choose, modify, and augment the textbooks’ content based on what they and their institutional program consider important to teach.

However, what this focused textbook examination does offer is access to some of the generalizations and particulars of different disciplines’ communication conventions through fairly simple methods. Often a central goal of WAC/WID-focused instructors is to help students appreciate that communication conventions are not one-size-fits-all. For instructors who are interested in helping students consider a variety of disciplinary composing situations or who emphasize transfer of learning, these visual communication disciplinary distinctions might be worth considering during instructional activities. However, because few composition instructors
have backgrounds in disciplines beyond literature or rhetoric and composition—disciplines that value written communication above visuals—they may not recognize the roles visual communication may play in other disciplines. Specifically, they might not realize that many of the composing practices in disciplines around the university campus, most notably the scientific ones, use visuals to convey key research data because their experiments are grounded in numeric rather than discursive evidence.

The analysis in this chapter of the common topics and terms in composition and science-writing textbooks helps provide understanding of these domains’ practices and conventions of visual communication in a way that gives instructors tools for promoting discussions that might aid students’ transfer of learning of visual communication. This understanding, in turn, offers an opportunity for composition instructors to remind themselves of their own discipline’s conventions. As with all knowledge, instructors often forget that the conventions they work within are not the same as everyone’s conventions; thus, being reminded of the values of the discipline and purposes of genres of communication can be helpful to consider tacit knowledge in more deliberate ways. Thus, they might better be able to inform students that visual and written communication are used in various ways and for different purposes both in their own discipline and across disciplines.

A particular challenge for examining writing textbooks in this manner is that written communication is traditionally valued more than visual communication, especially in composition textbooks (as indicated by there only being 11 visual communication terms and 9 visual communication pedagogical topics located in these textbooks). Thus, textbooks are limited in the ways they help students learn about visuals. As Ken Hyland explains in his book *Disciplinary Discourses: Social Interactions in Academic Writing*, “Textbook authors, whether
knowingly or unconsciously, draw on the genres and beliefs of current and previous disciplinary vocabularies in constructing their material, representing their field of reality in terms of understandings and set of relations that are familiar to co-professionals” (108). Hence, this textbook analysis creates a solid foundation for research on visual communication practices and instruction, but it is also important to also examine how members of these disciplines communicate using visuals and teach that knowledge to students who are entering the field. The next chapter of my dissertation begins this examination. I build upon the pedagogical topics found in the textbook analysis to discover how instructors clarify, complicate, or contradict the textbooks’ instruction.
CHAPTER 5

HOW COMPOSITION AND BIOLOGICAL SCIENCES INTERVIEW PARTICIPANTS TEACH VISUAL COMMUNICATION: AN INTERVIEW ANALYSIS

As I examined the results and implications of the textbook analysis research project, I began questioning whether instructors use the same visual communication terms and pedagogical topics as the textbooks do. Each of the textbooks examined have different methods for considering and instructing visual communication. Likewise, members of a field have different styles of teaching or interests, so the ways in which they teach visual communication could differ widely as well. As Cheryl Glenn and Melissa A. Goldthwaite instruct new composition instructors in *The St. Martin’s Guide to Teaching Writing*, “The textbook you use will underpin a number of important elements in your course,” implying that it is only one factor in a classroom that influences a student’s knowledge (6). As Lori Lyman Digisi and John B. Willett find in their study of 184 high school biology teachers that those interviewed “modified their use of textbooks” (123). So to enhance my understanding of visual communication instruction in the natural sciences and composition fields, my research should not end with only an examination of textbooks. I needed to speak with instructors in composition and a natural science field to gain insight into how the terms and topics in the textbooks aligned with those used by instructors and in what ways the instructors use textbooks in their courses.

This chapter details my findings from interviews with three composition and three biological sciences instructor participants. It should be noted that throughout this chapter I describe the three participants from the CAC Program as composition participants even though one of these participants, Brenda, primarily discusses her experiences teaching the Biological Communication course. I do this because all three of the participants’ higher education degrees
are in composition and communication pedagogy, theory, and practice and because the Biological Communication course is housed within the CAC Program and not one of the biological sciences programs. That being said, at times, Brenda’s comments align more with those of the biological sciences participants, making her a unique outlier.

I have organized the chapter in four parts: methods, results, discussion, and conclusions. Within each of these sections I have clearly labeled subsections considering visual communication terms and visual communication pedagogical topics. The examinations in these sections point to similarities and differences between the terms and topics found and discussed in the textbooks and by the interview participants, specifically how the terms and topics discussed in textbooks were used, left out, or augmented by instructors in their classroom teaching.

**Methods**

Six participants, three from composition and three from biological sciences, each took part in a 90-minute interview to discuss their teaching of visual communication conventions. Because, as Anne J. Herrington writes, “Teachers do have a good deal of influence over the nature of the community that is created in a given class,” instructors are a key source of information about the practices and expectations of a discipline (120). This chapter describes information gleaned from the interviews about the participants’ processes of teaching disciplinary visual communication practices to students.

**Participants**

All three of the composition instructors interviewed are or were recently advanced PhD students who regularly taught courses in the CAC Program and were noted by graduate faculty to be strong teachers and researchers of pedagogy. All three also had backgrounds, to varying degrees, with teaching biological sciences students.
1. Brenda has a Bachelor of Arts in Biology and has done extensive curricular design on the Biological Communication course to engage students in public science communication. Her focus on public science communication makes her an outlier because she does not view herself as firmly grounded in the composition discipline, but is actually bridging composition and biological sciences.

2. Kasey has taught general composition courses as well as the Biological Communication course. All of the research she participates in deals with the scholarship of teaching and learning, specifically with helping students think critically about the decisions that they make in each composing situation and how to transfer skills across contexts.

3. Lauren worked as a nurse for many years before returning to school for her PhD. She has worked to update the curriculum for the biological sciences Learning Community composition course and sees herself as “a communication specialist with a nursing/healthcare background.”

All three of the biological sciences instructors were recommended to me by CAC Program faculty or by the Program Coordinators of the university’s Center for Excellence in Teaching and Learning (CELT). The biological sciences instructors each have distinctive backgrounds and positions in the university.

1. Lyann is a professor in the Department of Ecology, Evolution, and Organismal Biology, with a specialty in Plant Systematics and Evolution. She teaches undergraduate and graduate courses in plant anatomy and plant systematics and works closely with instructors in the Biological/Pre-Medical Illustration Program. She has participated in a variety of CELT pedagogy workshops.
2. Mike is a professor in the Department of Plant Pathology and Microbiology. He teaches graduate students in a scientific speaking skills class and mentors them in their individual research projects. He has also worked extensively with farmers and master gardeners through the university’s Extension and Outreach program.

3. Natalie is a senior lecturer in the Microbiology Undergraduate Program. She teaches mainly the general biology, general genetics, and general microbiology courses for first- and second-year undergraduates and a microbiology seminar for seniors. She was also integral in the creation of the original curriculum for the biological sciences Learning Community composition course.

I met individually with all six of the participants for the 90-minute interviews in their offices or locations of their choosing. During the interviews, each participant was specifically asked about the visual communication terms used in their discipline and the visual communication topics that are covered in their textbooks and teaching practices. The methods for asking these questions and analyzing their responses are detailed through the rest of this section.

**Terms**

In order to compare disciplinary instructors’ perceptions of teaching visual communication in their classes with the findings in the textbook analysis research project, I first needed to discover and examine the terms used by interview participants. The language used by a discipline is important to study because, as Mark Waldo writes, “The arena (and reality) of [colleges and universities] is disciplinization and development of expertise. They must, through the teaching and research of their faculty, ritualize the word” (3). And that disciplinization of language affects instruction and learning because, as Toby Fulwiler discusses in his study of 22 instructors from across disciplines in *Teaching with Writing*, “The extent to which teachers use
different language to describe similar problems [is] a probably cause of some confusion among students” (125).

To create a precursory list of visual communication terms the participants use and hear used in their disciplines, to locate and examine instances where language might be used in discipline-specific ways, each participant was asked the following questions during the preliminary interviews:

1. What visual communication terms are used in your discipline?

2. [They were shown a list of the key terms that appeared in the textbook analysis component of my research.] Are any of these terms used in your discipline? Are any never used?

3. [If the participants had not already addressed general terms they use to encompass multiple visual terms] Do you use any of these terms interchangeably or to mean the same thing?

When coding the interview recordings in Atlas.ti, I initially focused on the responses given to these questions to gain an approximate awareness of the terms used by the participants in response to the questions. I was interested to discover which terms the interview participants used from the textbook analysis list of key terms and what additional terms the participants used.

This precursory list included all of the terms from the textbook analysis as well as additional terms that appeared to be discipline specific (e.g.: map, pedigree), to have general design connotations (e.g.: color, caption/label), or to describe visually-prevalent documents (e.g.: poster/presentation). This expanded comprehension of visuals from the interview participants forced me to broaden my scope of visual communication terms for listing and coding the terms located in the interviews.
With this new perspective, I made several more passes through the entire content of the interviews, searching for visual communication terms used by participants responding to all questions. I again coded these in Atlas.ti, and ended up with 45 total terms. This list included all 11 of the key visual terms found in the textbook analysis research and an additional 12 visual terms that were used regularly by the participants. 22 terms were recorded but were not included in this final list because they did not get used at least 10 times and by more than one participant in the preliminary interview analysis. Table 7 lists the key terms found the textbook analysis research and the key terms that appeared regularly in the participants’ responses.

<table>
<thead>
<tr>
<th>Key Terms from Textbook Analysis (also appearing in interviews)</th>
<th>Key Terms from Interview Analysis (not appearing in textbooks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart(s)</td>
<td>Poster</td>
</tr>
<tr>
<td>Figure(s)</td>
<td>Caption(ed/ing)/Label(ed/ing)</td>
</tr>
<tr>
<td>Graph(s)</td>
<td>Picture</td>
</tr>
<tr>
<td>Graphic(s)</td>
<td>Presentation</td>
</tr>
<tr>
<td>Illustration(s)</td>
<td>Color</td>
</tr>
<tr>
<td>Image(s)</td>
<td>Art(ist/work)</td>
</tr>
<tr>
<td>Photograph(s)</td>
<td>(Line) Drawing(s)</td>
</tr>
<tr>
<td>Table(s)</td>
<td>Map(s)</td>
</tr>
<tr>
<td>Visual(s)</td>
<td>Document/Visual design (principles)</td>
</tr>
<tr>
<td>Visual argument(s)</td>
<td>Diagram(s)</td>
</tr>
<tr>
<td>Visual element(s)/image(s)</td>
<td>Visual communication</td>
</tr>
<tr>
<td></td>
<td>Type(faces)/Fonts</td>
</tr>
</tbody>
</table>

After this list was finalized, I transcribed all six interviews. I used Microsoft Word’s “Find and Replace” function to scan through the interview text to locate the total number of times each of the terms were used by each of the interviewees. This action resulted in a more precise count of how often terms were used and by whom than the Atlas.ti coding attempt and these data are illustrated in Table 9 in the Results section of this chapter.
Topics

Similar to the process of locating visual communication terms, during the preliminary interviews, each of the six participants was specifically asked about the visual communication topics covered in their textbooks and teaching. They were asked the following questions:

1. [They were shown a list of the topics that appeared in the textbook analysis component of my research.] Which, if any, of these topics is covered in textbooks in your field?

2. Which, if any, of these topics not included in your discipline’s textbooks is covered in your teaching of visual communication?

In Atlas.ti, I initially coded the participants’ specific responses to these questions to record which of the nine topics from the textbook analysis (see Table 8) were mentioned as occurring in the participants’ textbooks and teaching. Next, I made several more passes through the entire content of the interviews to locate instances in which the participants discussed these pedagogical topics when responding to all the other interview questions. Each of these instances was coded in the same manner as the previous ones.

<table>
<thead>
<tr>
<th>Table 8: Visual Communication Topics Created in the Textbook Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topics in both Composition and Science-writing Texts</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td><strong>Topics Exclusive to Science-writing Texts</strong></td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td><strong>Topics Exclusive to Composition Textbooks</strong></td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>
When coding the full preliminary interviews for these nine topics, I noticed two important distinctions: First, I realized that topics other than the original nine from the textbook analysis were recurring in the participants’ interviews. Second, at times interviewees discussed topics in relation to their own composing or reading rather than in the context of their teaching conventions to students. Thus, I had to expand my list of codes and review all of the previously coded comments to divide them into pedagogical topic codes and communication topic codes.

These topics dealt with the use of visuals in composing, reading, learning and teaching practices and with general difficulties the interviewees had using visuals. Further passes were then completed to locate these additional visual communication topics discussed by the interview participants, and an all-inclusive list was created and categorized in a recursive process. Upon closer examination, many of the topics were very similar (e.g.: Visuals used to practice science is like Teaching disciplinary content through visuals) or were subcategories of another topic (e.g.: Visuals being used to persuade/grab attention is a component of Purposes of visuals) and could be combined to streamline a finalized list.

This list included the nine original pedagogical topics from the textbook analysis, as well as 8 new topics that fall within two new categories:

1. Category 1: Participants’ composing and reading processes (e.g.: Discussion of the purposes of visuals in written texts and How, when, and why the participants read visuals)

2. Category 2: Participants’ concerns of visual communication in current instructional practices (e.g.: Student difficulty reading/interpreting visuals and Textbooks lacking visuals and instruction of visual communication).
Only the results of the first of these categories will be discussed in this chapter because these topics also address pedagogical issues. The remaining three topics, as well as the methods for coding and analyzing them, will be discussed more fully in Chapter 6.

**Results**

**Terms**

During the 6 initial participant interviews, 45 terms related to visual communication were used. Of those, 23 were used at least 10 times and by more than one interviewee. It must be noted that, at times, participants probably used certain terms because they appeared in interview questions or in the list of terms and topics from the textbook analysis research component. Thus, I deleted the terms used when participants read them from the interviewer’s documents or repeated them from interview questions. This process did not affect the number of terms included in the finalized list of 23 terms, but disciplinary distinctions of terms used by participants can be more clearly seen. Table 9 illustrates this adjusted list of terms in order of use, noting how often each of the terms were used by participants in each discipline and the percentage of use of the terms by each discipline’s participants. Even so, it should be mentioned that I was using the term “visual” as a generic term in my questions, and likely that correlates to the high use of that term by participants.

However, while coding the term “visual,” I realized that the word was being used in two distinct ways. First, as a noun, meaning an item appearing within a text; second, as an adjective, meaning a visual way of thinking, seeing, or learning. Table 9 indicates the participants’ use of this term based on this functional distinction. Interestingly, the biological sciences participants more often used “visual” as an adjective while the composition participants more often used “visual” as a noun. For instance, Lyann mentioned plant systematics as “a highly visual field”
Table 9: List of Visual Communication Terms Used by Disciplinary Participants

<table>
<thead>
<tr>
<th>Key Term</th>
<th>Composition Participants</th>
<th>Biology Participants</th>
<th>Total Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># Use</td>
<td>% Use</td>
<td># Use</td>
</tr>
<tr>
<td>Visual(s) [noun]</td>
<td>134</td>
<td>79%</td>
<td>36</td>
</tr>
<tr>
<td>Visual [adjective]</td>
<td>30</td>
<td>41%</td>
<td>44</td>
</tr>
<tr>
<td>Poster</td>
<td>44</td>
<td>76%</td>
<td>14</td>
</tr>
<tr>
<td>Graph(s)</td>
<td>26</td>
<td>54%</td>
<td>22</td>
</tr>
<tr>
<td>Figure(s)</td>
<td>13</td>
<td>29%</td>
<td>27</td>
</tr>
<tr>
<td>Table(s)</td>
<td>13</td>
<td>34%</td>
<td>25</td>
</tr>
<tr>
<td>Caption(ed/ing)/Label (ed/ing)</td>
<td>17</td>
<td>46%</td>
<td>20</td>
</tr>
<tr>
<td>Image(s)</td>
<td>11</td>
<td>31%</td>
<td>25</td>
</tr>
<tr>
<td>Picture</td>
<td>5</td>
<td>15%</td>
<td>28</td>
</tr>
<tr>
<td>Presentation</td>
<td>15</td>
<td>48%</td>
<td>16</td>
</tr>
<tr>
<td>Color</td>
<td>13</td>
<td>46%</td>
<td>15</td>
</tr>
<tr>
<td>Chart(s)</td>
<td>10</td>
<td>42%</td>
<td>14</td>
</tr>
<tr>
<td>Graphic(s)</td>
<td>15</td>
<td>65%</td>
<td>8</td>
</tr>
<tr>
<td>Art(ist/work)</td>
<td>13</td>
<td>57%</td>
<td>10</td>
</tr>
<tr>
<td>(Line) Drawing(s)</td>
<td>2</td>
<td>9%</td>
<td>21</td>
</tr>
<tr>
<td>Illustration(s)</td>
<td>2</td>
<td>10%</td>
<td>18</td>
</tr>
<tr>
<td>Photograph(s)</td>
<td>8</td>
<td>47%</td>
<td>9</td>
</tr>
<tr>
<td>Map(s)</td>
<td>3</td>
<td>19%</td>
<td>13</td>
</tr>
<tr>
<td>Document/Visual design (principles)</td>
<td>13</td>
<td>100%</td>
<td>0</td>
</tr>
<tr>
<td>Diagram(s)</td>
<td>6</td>
<td>46%</td>
<td>7</td>
</tr>
<tr>
<td>Visual communication</td>
<td>10</td>
<td>83%</td>
<td>2</td>
</tr>
<tr>
<td>Type(faces)/Fonts</td>
<td>9</td>
<td>82%</td>
<td>2</td>
</tr>
<tr>
<td>Visual element(s)/image(s)</td>
<td>6</td>
<td>86%</td>
<td>1</td>
</tr>
<tr>
<td>Visual argument(s)</td>
<td>6</td>
<td>100%</td>
<td>0</td>
</tr>
</tbody>
</table>

and that she thinks of communicating in her field as “visual storytelling,” while Mike noted that scholarly articles in his discipline are “moderately visual.” Meanwhile, Brenda, Kasey, and Lauren each tended to use the noun “visual” as a generic term to talk about all types of visuals (tables, charts, figures, etc.). For example, Lauren specifically stated, “we use that kind of generic term of ‘visuals’ that could mean anything that's not a written text” and Brenda also insinuated “visual” as a catch-all term when she refers to terminology associated with “genres of
visuals, like bar graphs, and line graphs, and scatterplots.” The use of this term might also stem from the language used in the CAC Program, which focuses on WOVE modes of communication (written, oral, visual, and electronic).

In fact, participants were asked to consider what words they or others in their discipline would use as general or catchall terms for describing visuals. Table 10 illustrates the generic terms noted by participants. “Visual” was referred to by all three of the composition participants and by only one of the biological sciences participants as being a general term used. Thus, it makes sense for the composition participants to be using the noun form of “visual” so much more frequently than the biological sciences participants. And in actuality, the participants seem to have their own preferred terms that fall along disciplinary lines: while “visual,” “graphic,” and “image” were used most frequently by composition participants to discuss all types of visuals, “figure” is used by all three of the biological sciences participants. Few of the general terms used crossed disciplines: only “graphic” and “visual” were referred to by both composition and biological sciences participants.

Table 10: Generic Visual Communication Terms Used by Participants

<table>
<thead>
<tr>
<th>Key Term</th>
<th>Composition Participant</th>
<th>Biology Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual(s)</td>
<td>Brenda, Kasey, Lauren</td>
<td>Lyann</td>
</tr>
<tr>
<td>Figure(s)</td>
<td></td>
<td>Lyann, Mike, Natalie</td>
</tr>
<tr>
<td>Graphic(s)</td>
<td>Brenda, Kasey</td>
<td>Lyann</td>
</tr>
<tr>
<td>Image(s)</td>
<td>Brenda, Kasey</td>
<td>Lyann</td>
</tr>
<tr>
<td>Table(s)</td>
<td></td>
<td>Mike</td>
</tr>
</tbody>
</table>

Table 9 also helps to illustrate that some terms (e.g.: “graph,” “caption/label,” and “color”) were used consistently by participants in both disciplines and other terms (e.g.: “(line) drawing,” “document/visual design (principles)” and “visual communication”) tended to be used more often by interviewees in one discipline than the other. Distinctions in the use of these terms
yielded a key observation: All but one of the terms taken from the textbook analysis deals with genres or types of visuals (“figures,” “tables,” etc.). However, some of the terms used by participants in the interviews did not fit within that categorization. Like “visual argument,” the only term found in the textbook analysis research that does not describe a type of visual, “visual communication” and “visual [adjective]” are general visual terms or visual rhetoric terms. They describe the state of the visual or the way the visual is working within a text rather than the type of visual itself. Similarly, terms like “poster,” “caption/label,” “color,” “document/visual design (principles),” and “type(face)/font” are neither types of visuals nor general visual or visual rhetoric terms. These terms are all either larger texts in which visuals appear or components of a visual within a text. Essentially, these terms deal with documents or document design.

Likewise, Table 11 divides the list of updated terms into the three categories of Types of Visuals, Visual Terminology, and Design Terminology. It also demonstrates precisely which participants used each of the updated terms, which helps to illustrate instances in which one participant’s use of a term influenced the overall numerical total. For example, even though “illustration” was used a total of 20 times during the interviews, Lyann mentioned the term 18 times and was the only biological sciences participant to use that term. Similarly, “poster” was used 58 times, of which Brenda used it 41 times because she was describing a particular class assignment. These two examples help indicate that calculating the overall use of the terms does not provide all the information necessary to totally understand how visual communication terms are used in composition and biological sciences; however, it does give a starting point from which to measure significance that will be discussed more fully in the Discussion.
Table 11: Categorized List of Visual Communication Terms Used by Individual Participants

<table>
<thead>
<tr>
<th>Types of Visuals</th>
<th>Composition Participants</th>
<th>Biology Participants</th>
<th>Adjusted Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brenda</td>
<td>Kasey</td>
<td>Lauren</td>
</tr>
<tr>
<td>Visual(s) [noun]</td>
<td>68</td>
<td>25</td>
<td>41</td>
</tr>
<tr>
<td>Graph(s)</td>
<td>19</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Figure(s)</td>
<td>1</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Table(s)</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Image(s)</td>
<td>6</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Picture</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chart(s)</td>
<td>3</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Art(ist/work)</td>
<td>12</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Graphic(s)</td>
<td>7</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>(Line) Drawing(s)</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Illustration(s)</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Photograph(s)</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Maps</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Diagram</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Visual element(s)/image(s)</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

Visual (Rhetoric) Terminology

| Visual [adjective]          | 15     | 9     | 6      | 14    | 24   | 6       | 74   |
| Visual communication        | 4      | 1     | 5      | 2     | 0    | 0       | 12   |
| Visual argument(s)          | 2      | 2     | 2      | 0     | 0    | 0       | 6    |

Document (Design) Terminology

| Poster                      | 41     | 1     | 2      | 3     | 11   | 0       | 58   |
| Caption/Label               | 10     | 6     | 1      | 20    | 0    | 0       | 37   |
| Presentation                | 7      | 3     | 5      | 3     | 13   | 0       | 31   |
| Color                       | 11     | 2     | 0      | 7     | 6    | 2       | 28   |
| Document/Visual design (principles) | 5  | 6     | 2      | 0     | 0    | 0       | 13   |
| Type(faces)/Fonts           | 3      | 3     | 3      | 0     | 1    | 1       | 11   |

Topics

All 6 interview participants were asked about the list of visual communication pedagogy topics from the textbook analysis research project. Mike was the only participant who did not
specifically answer the question; instead, he gathered a textbook and a public education text to compare the ways visuals are used between the two. As the 90-minute mark of the interview was fast approaching, I chose not to re-ask the question.

The other five participants each considered the list of visual communication pedagogy topics and discussed which they saw in their textbooks and/or used in their teaching. As mentioned, I noted each of these instances; however, at times, the remaining content of the participants’ interviews yielded different or expanded results to these original notations. Thus I examined all six interview recordings in their entirety to uncover the participants’ use of these topics. In one instance, Natalie said she does not specifically teach students to understand how, when, and why the audience reads visuals, but she later described an in-class activity in which she details the purposes of and conventions for pedigree charts and how to read the information conveyed in that particular type of visual. Table 12 details which of the visual communication pedagogy topics each of the participants specifically discuss or teach. A ✓ indicates that the participant articulates that s/he does teach this topic or at some point describes an instance in which the topic is taught; a ✗ indicates an instance in which the participant claims s/he does not teach that topic; and a blank indicates that the participant did not mention the topic at all. As mentioned, there are instances when participants’ responses conflicted or they noted that a topic might be covered in their teaching but not in a textbook or vice versa or might only be covered in a singular context; thus, several of the topics in Table 12 denote both a ✓ and a ✗.

The data in Table 12 tend to contradict the findings from the textbook analysis research. Some of the composition participants teach the Topics exclusive to science-writing texts and some of the biological sciences participants teach the Topics exclusive to composition textbooks. For example, Brenda, Kasey, Lauren, Lyann, and Natalie all stated that they emphasize the fact
Table 12: Pedagogical Topics Discussed by Participants

<table>
<thead>
<tr>
<th>Topic</th>
<th>Composition Participants</th>
<th>Biology Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brenda</td>
<td>Kasey</td>
</tr>
<tr>
<td>Topics in both Composition and Science-writing Texts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion of the purposes of visuals in written texts</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Attention to the ethical use of visuals</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Topics Exclusive to Science-writing Texts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of visuals to convey key information</td>
<td>✓</td>
<td>✓✗</td>
</tr>
<tr>
<td>Beginning the process of composing scholarly documents with visuals</td>
<td>✓✗</td>
<td>✓</td>
</tr>
<tr>
<td>Understanding how, when, and why the audience reads visuals</td>
<td>✓</td>
<td>✓✗</td>
</tr>
<tr>
<td>Topics Exclusive to Composition Textbooks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of visuals as invention processes</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Creation of visuals as alternatives to written texts</td>
<td>✓✗</td>
<td>✓✗</td>
</tr>
<tr>
<td>Addition of visuals to enhance written texts that are lacking</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Emphasis on the analysis of visuals</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

that visuals can be used to convey key information even though that topic is typically only covered in science-writing texts. This emphasis is a positive indication that these pedagogical topics are important for instructors to convey in both of these disciplines, and these particular instructors are thinking about how to share that knowledge with students. However, some of the positive responses yielded above come only from the participants acknowledging that they do teach a topic; they were not asked to provide a specific example for each. So there is a possibility that the participants interpreted some of the topics differently from me. That possibility may stem from the limited timeframe in which the interviews took place; 90 minutes is not enough time for the interview participants to fully describe teaching on all of these topics. However, these interviews did reveal useful information, including details that describe different interpretations and pedagogical topics from those covered in the textbook analysis research.
Discussion

This section describes the interview participants’ use of visual communication terms and discussions of visual communication pedagogical topics and how they relate to the terms and topics found in the disciplinary textbook analysis research. This section will be divided into two sections, terms and topics, and then subsequently divided by discipline, similar to the organization of the Discussion section in Chapter 4.

Terms

When interpreting the use of the terms used by the participants, I found three key questions that need to be addressed:

1. How do participants in composition use visual communication terms similarly or differently from those in biology?
2. How are the visual communication terms in the textbooks used similarly or differently than in the participant interviews?
3. How do participants within composition and/or within the biological sciences use visual communication terms similarly or differently?

These questions will be addressed in the upcoming three subsections that examine the participants’ use of terms.

Terms: Composition Participants vs. Biological Sciences Participants

Through my analysis of the terms used by the six interview participants, I found several terms used by participants from both disciplines to teach students the conventions of reading and composing visuals. However, within that overarching similarity, two significant distinctions came to light that specifically relate to visual communication pedagogy: Biological sciences participants used more specific terms for describing types of visuals than composition
participants, and participants from both disciplines teach students to analyze visuals but define that term differently. These two peculiarities will be discussed through this section.

How specific are the terms used?

As illustrated in the Results, 15 of the terms used by the interview participants dealt with types of visuals. Of these, Table 9 (see p. 102) illustrates that five were used more often by composition participants than biological sciences participants (“visual(s) [noun],” “graph(s),” “graphic(s),” “art(ist/work),” and “visual element(s)/image(s)”). Two of these terms (“visual(s) [noun]” and “graphic(s)”) were noted by composition participants as being general terms for discussing visuals and appear more often in their speech. Also, “art(ist/work)” and “visual element(s)/image(s)” might be considered general terms since they describe a range of visuals. Lyann’s comments described “visual element(s)/image(s)” as “kind of general terms” and mention “artwork” as referring to both photographs and line drawings. Thus, only “graph(s)” is a term used more frequently by composition participants (54% of the total usage) that designates a specific type of visual, one that’s purpose is to “promote understanding of results and suggest interpretations of their meaning and relationships” (Matthews & Matthews 65).

Interestingly, Kasey and Lauren used “graph(s)” less frequently and in less specific ways than Brenda. For instance, Kasey mentioned, “I guess there's a really distinct difference between figure and graph but I don't—I should know that and I recognize that but I don't often teach that [in composition classes].” This comment indicates that she recognizes the distinctions among the visual genres but does not discuss any particular attributes of these individual types. On the other hand, Brenda used the term when discussing visuals necessary in students’ composing, saying, “It's not just bar graphs and line graphs and then the dreaded pie chart. There's also other things [students] can do that are relevant like maps and diagrams and cross sections and photographs.”
Brenda’s use of terms to describe specific types of visuals rather than using more generic terms more closely aligns with the language used by the biological sciences participants.

In fact, the majority of terms used to describe specific types of visuals (10 of the 15) were used by biological sciences participants. As the discussions in many of the analyzed textbooks note, “table(s),” “illustration(s),” “map(s),” and “diagram(s),” among others, signify specific genres of visuals that have their own conventions: They each display certain types of information and there are general guidelines for how to best display data within each type of visual. The differences between the composition and biological sciences participants’ usage seem to stem from the goals of their classes. Since composition courses are typically made up of students from a wide variety of majors, the communication practices being taught are broader; thus, general visual communication terms easily meet the instructors’ needs. For example, based on Kasey’s comment, she does not speak about visuals in specific ways because she does not teach them in her classes. Meanwhile, biological sciences courses focus on teaching students how to work with data that is often communicated visually, so more specific uses of terms to describe types of visuals would best match that goal. Brenda, then, is an outlier, bridging these two disciplines by teaching visual genres in her Biological Communication class and making sure she uses specific terms that illustrate her awareness of the different purposes of these types of visuals.

It should be mentioned briefly that another factor possibly influencing the participants’ language is the difference in the quantity of visuals used in biological sciences scholarship and composition scholarship; we will see in participants’ responses through the Discussion section that visuals are used more prominently in biological sciences articles than in composition scholarship. The greater use of visuals likely corresponds to the need for more and more specific terms to discuss the visual presentation of data.
"Analysis" means what?

As previously mentioned, instances in which instructors use different language to mean the same things or the same terms with different meanings “can be especially confusing to students writers who are not confident about writing skills in the first place; they soon come to believe that all writing instruction is arbitrary and subjective” (Fulwiler 125). The participants’ use of the term “analysis” is one instance where different definitions might cause some confusion, and, in fact, did as I was conducting the interviews.

All of the participants except Mike used “analysis” when discussing visuals; however, I realized that the meaning of the term differed among the interviewees. Kasey, Brenda, and Lauren discussed visual rhetorical analysis; they discussed “analysis” in relation to “general principles of visual design principles” (Brenda), “impact on audience” (Kasey), “making specific decisions” (Lauren), and “what would appeal” (Lauren). On the other hand, when Lyann and Natalie used analysis, the definition was similar to that of interpretation. Natalie specifically discussed “data analysis” as “the ability to read charts and interpret graphs” and Lyann described analysis as a component of “data collection.” The difference in meanings for this word appears to stem directly from disciplinary practices. Again, composition classes are usually writing process-oriented, so considering the choices that go into creating or integrating a visual in a document fits within that goal. Meanwhile, biological sciences classes are usually science process-oriented, so students would be using visuals to comprehend information being displayed within them.

What becomes important to note about this distinction is that the multiple meanings of the same term in two disciplinary contexts might be a significant barrier for some students’ learning. Gerald Nelms and Rhonda Dively argue that if distinctions like these are not made explicit for students, they may “overlook cues that might signal the potential application of concepts, strategies, and skills learned in first-year composition” (227). While the use of the
same term to mean different things may cause confusion for the student, at the root of that confusion is the fact that the ways visuals are analyzed differs between these two disciplines. Charles Bazerman, in “Writing, Cognition, and Affect from the Perspectives of Sociocultural and Historical Studies of Writing,” reinforces these discrepancies when he writes, “Even within the same language and the same levels of schooling, we have developed differentiated forms of writing that travel in differentiated social networks to serve different tasks, evaluated by different standards” (92-93). That members of these disciplines used the term “analysis” differently indicates that they think about and examine visuals differently. Difficulties students might have applying previous knowledge to a new analysis situation may stem from lack of recognition that the meaning of the term differs because the disciplinary expectations and practices are different.

That complication is what makes Brenda’s situation teaching the Biological Communication course so interesting. She used visual communication terms in distinct ways from Kasey and Lauren. Chiefly, she used certain terms that are rarely mentioned by the other two composition instructors: “graph(s),” “art(ist/work),” “photograph(s),” “poster,” “caption/label,” and “color” as well as both the noun and adjective forms of “visual.” Each of these terms except “visual [noun]” were used far more by the biological sciences participants than by Kasey and Lauren. It seems that Brenda’s background in biology and her emphasis on teaching the Biological Communication course impact the terms she uses to describe visuals. If we, like Bohr and Rhoades, are “concerned that our disparate ways of talking about writing instruction prevented students from making connections,” having an instructor in composition courses discuss how terms may be used differently because of disciplinary conventions could be beneficial for students to consider ways that their learning in general composition or Biological Communication courses could be applied to their biological sciences work.
Terms: Science-writing Texts vs. Biological Sciences Participants

Table 13 illustrates the 11 key visual communication terms found in the science-writing textbooks from the textbook analysis research component as well as the 11 most used terms by biological sciences participants in their preliminary interviews. Of the terms found in more than half of the science-writing textbooks ("table(s)," "figure(s)," graph(s)," and "chart(s)"), only "chart(s)" is not listed in the most often used terms during the biological sciences participants’ interviews. This parallel indicates the language of the textbooks likely originates from the language of the members of the discipline.

<table>
<thead>
<tr>
<th>Key Term</th>
<th>Science-Writing Texts</th>
<th>Biology Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td># of textbooks in which the term appeared</td>
<td># of times term used in interviews</td>
<td># of participants using the term</td>
</tr>
<tr>
<td>Table(s)</td>
<td>7</td>
<td>Visual [adjective] 44</td>
</tr>
<tr>
<td>Figure(s)</td>
<td>6</td>
<td>Visual(s) [noun] 30</td>
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</tr>
<tr>
<td>Chart(s)</td>
<td>4</td>
<td>Figure(s) 27</td>
</tr>
<tr>
<td>Photograph(s)</td>
<td>3</td>
<td>Image(s) 25</td>
</tr>
<tr>
<td>Graphic(s)</td>
<td>2</td>
<td>Table(s) 25</td>
</tr>
<tr>
<td>Illustration(s)</td>
<td>2</td>
<td>Graph(s) 22</td>
</tr>
<tr>
<td>Visual(s)</td>
<td>2</td>
<td>(Line) Drawing(s) 21</td>
</tr>
<tr>
<td>Image(s)</td>
<td>1</td>
<td>Caption/Label 20</td>
</tr>
<tr>
<td>Visual argument(s)</td>
<td>0</td>
<td>Illustration 18</td>
</tr>
<tr>
<td>Visual element(s)/image(s)</td>
<td>0</td>
<td>Color 15</td>
</tr>
</tbody>
</table>

And yet there are distinctions between numbers of times the terms are used and the number of interviewees using the terms. Three of the key terms used by biological sciences participants listed in Table 13 were used by only one or two participants ("(line) drawing(s)," "caption/label" and "illustration"). These discrepancies likely speak to the variety of courses the
biological sciences participants teach and the distinct specializations from which they hail. For example, Mike only teaches at the graduate level, and he commented that his students recognize the importance of the types of communication being taught in his class, saying, “They have a different view; even 23-year olds have a different view of their future than a 19 or 20-year old. Nothing wrong with that younger person but…to try to get them to focus on these skills is a lot easier sell for graduate students.” Thus, some of the terms he was using likely were impacted by the content of his courses, which naturally differ from Lyann’s and Natalie’s courses simply because he is teaching graduate rather than undergraduate students.

Of course the content of the courses, stemming from the biological specialization, also plays a role in the terms used. For instance, Lyann noted differences in the types of visuals used in her field, saying, “[In plant anatomy], we don’t use graphs as much as some other fields.” In Successful Scientific Writing, Matthews & Matthews include a table that illustrates what type of information different visuals convey; for example, it explains, “To dramatize differences or draw comparisons – Bar graph” or “To describe relationships – Table, line graph, block diagram” (57). So if in plant anatomy, scholars often use photographs, which Matthews and Matthews describe as being used “to describe a process, organization, or model” or “to describe an entire object,” and if this is information often being conveyed, then this type of visual would logically be created to display it, and thus the term would often be used in a class. So it becomes clear that the terms being used by the interview participants sometimes differ because of the content and students in their classes; likewise, since the textbooks analyzed were general science-writing texts, they tend to discuss visuals using more generic terms (“table(s)” and “figure(s)”), not knowing the specific types of information that the reader needs to convey in certain visuals.
Terms: composition textbooks vs. composition participants

Table 14 illustrates the 11 key visual communication terms found in the composition textbooks from the textbook analysis research component as well as the 11 most used terms by composition participants in their initial interviews. Notably, “visual(s)” is a term that was only used in two of the nine composition textbooks yet has the highest use by the composition participants. As previously mentioned, the extreme use of this term might be due to the fact that it is the term most used during interview questions; however, all three of the composition participants listed “visual(s)” as general term that would be used to describe all types of visuals. Lauren specifically addressed this in her interview, saying, “We just say visuals, we don't specifically go into more detail and say things like images, charts, tables, graphs, photographs, we just kind of use the broad category.” And yet it seems that the textbooks do go into more

<table>
<thead>
<tr>
<th>Key Term</th>
<th>Composition Texts</th>
<th>Composition Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of textbooks in which the term appeared</td>
<td># of times term used in interviews</td>
</tr>
<tr>
<td>Photograph(s)</td>
<td>9</td>
<td>134</td>
</tr>
<tr>
<td>Chart(s)</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Graph(s)</td>
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<tr>
<td>Graphic(s)</td>
<td>4</td>
<td>13</td>
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<tr>
<td>Table(s)</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Visual argument(s)</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Visual element(s)/image(s)</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Figure(s)</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Visual(s)</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Visual(s) [noun]              | 134 | 3 |
Visual [adjective]             | 30  | 3 |
Poster                        | 44  | 3 |
Graph(s)                      | 26  | 3 |
Caption/Label                 | 17  | 3 |
Figure(s)                     | 13  | 3 |
Table(s)                      | 13  | 3 |
Color                         | 13  | 2 |
Document/Visual design (principles) | 13  | 3 |
Image(s)                      | 10  | 3 |
Visual communication          | 10  | 3 |
detail by using the specific terms rather than the broad categorical term. Of course, the creation of the list of terms in the textbook analysis research was limited to the table of contents and indexes; the term “visual(s)” might have been used more regularly through the textbooks but did not appear in these reference sections.

Another significant observation is that out of the terms found in more than half of the composition textbooks (“photograph(s),” “chart(s),” “graph(s),” “illustration(s),” and “image(s)”), only “graph(s)” and “image(s)” show up in the most often used terms during the composition participants’ interviews. This might have to do with the trend of the composition participants using more general terms for discussing visuals. In fact, “image(s)” was categorized as general by two of the three composition participants. As previously mentioned, Kasey used graph(s) in a general way. For example, when asked what she wishes students knew how to do before they arrive in her course, she noted, “I wish they knew how to create and manipulate graphs and things like that” (emphasis mine). Her language here implies that “graphs” is a placeholder term that includes all other visuals “like that.” She doesn’t only want students to be able to create and manipulate graphs, but to create and manipulate a variety of visuals based on the context, content, and audience.

Lastly, there is one term noticeably lacking from both the science-writing textbooks and the biological sciences participants’ interviews: “visual argument(s).” Even though none of the biological sciences participants note direct familiarity with “visual argument” as a term, two of the biological sciences participants comment that they could see uses for it. Lyann noted that because of her work with Biological and Premedical Illustration instructors and students, she does hear the term “visual problem solving,” which might be related to “visual argument(s),” and Mike commented that he could assume the meaning of “visual argument(s)” as “talking about
some process or some concept and I’m backing it up with photos or images.” Meanwhile, all three of the composition participants used “visual argument(s)” during their interviews, demonstrating that it is a term they are distinctly aware of and use at least occasionally. Crusius & Channell, in *the Aims of Argument*, define visual rhetoric as “the use of images…to make an argument or persuade us to act as the image-maker would have us act” (74). Thus, in composition, the emphasis on visual rhetorical analysis asks audience members to consider how visuals can make particular arguments; however, in the biological sciences, the visuals are used to summarize data: they “provide strong support for your arguments” (Knisely 56).

The textbook analysis research corresponds to these extreme findings in the participants’ comments, as “visual argument(s)” was only used in the composition textbooks. In fact, even though science-writing textbooks expected students to consider how visuals support the research arguments, communicate information, or need to be designed well, they did not use the terms that were used in composition to describe those expectations. So we see here with the interview participants that this trend is not specific to the textbooks, and might be a direct dissimilarity between these two fields.

**Topics**

In the textbook analysis research, I discovered a total of nine visual communication pedagogical topics discussed in the analyzed textbooks. Two were found in both the composition and science-writing textbooks (Discussion of the purposes of visuals in written texts and Attention to the ethical use of visuals), three exclusive to science-writing textbooks (Use of visuals to convey key information, Beginning the process of composing scholarly documents with visuals, and Understanding how, when, and why the audience reads visuals), and four specific to composition textbooks (Use of visuals as invention processes, Creation of visuals as
alternatives to written texts, Addition of visuals to enhance written texts that are lacking, and Emphasis on the analysis of visuals). However, when asked specifically about whether these same topics are covered in their own teaching or use of textbooks, the six interview participants’ responses ranged widely.

Thus, all nine of the pedagogical topics will be discussed more fully here, again addressing three key questions:

1. How do participants in composition describe visual communication pedagogical topics similarly or differently from those in biological sciences?
2. How are the visual communication pedagogical topics in the textbooks covered similarly or differently than in the participant interviews?
3. How do participants within biological sciences and/or within composition describe visual communication pedagogical topics similarly or differently?

The first and second of these questions will be discussed throughout all three sections below; and the third question will be addressed in the Topics exclusive to biological sciences and the Topics exclusive to composition sections.

Topics in both Composition and Science-writing Textbooks: What do the Participants Say?

As Gunther Kress and Theo Van Leeuwen write, “In a multimodal text using images and writing, the writing may carry out one set of meanings and the images another” (18). Already it has been shown how composition textbooks and biological science textbooks offer sometimes similar and sometimes different uses for visuals in the classroom and in research. Here I examine whether or not the interview participants recognize the same purposes as the textbooks do, and why those distinctions might matter. The textbook analysis research demonstrated two pedagogical topics discussed in both composition and science-writing textbooks: Discussion of
the purposes of visuals in written texts and Attention to the ethical use of visuals. Similarly, interview participants from both disciplines discussed how they broach these visual communication topics in their classes, especially discussions of the purposes of visuals.

1. Discussion of the purposes of visuals in written texts

Authors like Jean Trumbo have noted the purposes of visuals in science communication, making claims that they vary “in purpose from data sharing among scientists to entertainment for the public” (266). Since the purposes of visuals can range so widely in one discipline, it is not surprising then that all six of the interview participants stated that they talk about the purposes of visuals in written texts with their students but that the purposes they discussed differed. For instance, one major way the textbooks discussed the purpose of visuals was to convey the role that certain types/genres of visuals play in documents; some of the interview participants focused on this as well. For example, Natalie has her students consider which types of visuals best display certain data, having students think about, “Why would we do a chart over a table? Why would we do a bar graph over a scatterplot?” Similarly, Lauren explains to her students that she wants them to understand the purposes of different types of visuals so that they can convey information correctly in their own visuals, saying, “If they're using a pie chart to describe parts of a whole, that would be appropriate. If they're using a diagram to show how pieces fit together, that would be appropriate.” And Lyann described field-specific visuals, noting that scientists in plant systematics often create evolutionary trees because they illustrate “the evolutionary relationships in that group of organisms.” So she teaches students the conventions of that type of visual so that they can best read the data in it.

A second way Brenda, Lauren, and Lyann all discussed the purpose of visuals is that they convey important information to the audience, and the author must consider how best to do that.
Lauren said that she has conversations with her students about how generally “a visual should represent something or in some way contribute to the overall message that you're trying to convey.” Lyann made a comparable comment when explaining that the visuals are vital for “telling the story” of the data, and goes a step farther, explaining that as part of telling the story, visuals must be incredibly clear. The visual at times shows the readers exactly what the researcher has done and seen, which is important because the results have “to be replicable and verifiable.” Lyann’s comment aligns with Michael Lynch’s definition of visual displays, which he articulates are “documents that enable objects of study to be perceived and analyzed initially. Such displays systematically transform specimen materials into observable and mathematically analyzable data” (195). Thus, the visual acts as a guide for readers and researchers.

Likewise, Brenda, because her course is devoted to science communication, has the most specific conversations with her students about how to best represent an idea or tell the story. She has conversations with her students, explaining that they must think critically about why and how they are creating and incorporating visuals in a document, saying things like:

This isn't just a photo of a cell that I'm talking about in the paper. How do you make this photo of this cell under this slide a certain magnification with these certain parts labeled? How is that relevant? How is that something that's meaningful to your poster? How does that help me understand the science that you did? The research that you did?

She also highlighted how visuals are part of the bigger message being conveyed to an audience that includes the need for the author to present herself and her research in the best light. She tells her students, “You want to represent yourself the best you can professionally both to your peers and to people outside your discipline. You want to be representing [your science] well.” So to
various degrees each of these participants ask their students to think about the choices they make when using visuals, whether it be about the type of visual used to convey data or how to ensure that the visual conveys what is most useful to the audience.

2. Attention to the ethical use of visuals

Five of the interview participants mentioned that they discuss with their students how to use visuals ethically. For the most part, proper labeling and citing of sources is what participants discussed as ethical practices. Brenda, Kasey, Lauren, Lyann and Natalie each mentioned teaching one or both of these conventions. Lyann went into the most detail about how important attention to ethics is when she says, “That's where that labeling comes in because as you could see in that, the source, you'd better give the source, you’d better not rip that one off.” And even though the other participants would agree with Lyann’s assessment of the importance of ethics, Kasey mentioned how difficult it is to find time to teach and assess these expectations. She said, “We talk a little bit about how to make sure you're being ethical, but I can't hold them to a standard of production that I don't have time to properly scaffold and then give them feedback about, and then let them revise and try again with everything else that we're trying to do.”

Similarly, Natalie mentioned that discussions of creating ethical visuals does not typically happen at all in her lower-level classes. Not until a 400-level class does she broach the topic and use a textbook that talks about “how to make the visuals and how to not be unethical about it.”

Clearly the ethical use of visuals is an important topic, but it seems to be one that does not get integrated into many of these participants’ classroom pedagogy until the students are creating their own research documents that need visuals included. That distinction is interesting because the 11 textbooks examined that discuss the ethical use of visuals do generally explain how organization, content, and design can all affect whether or not the data are presented
ethically. And, in fact, even though Natalie said she does not mention this topic in many of her classes, an assignment she showed me included several graphs displaying the same information with different labels (See Appendix I). In that activity she has students consider why certain presentations of the data could be misleading. So perhaps this is a topic understood in a unique way by members in the biological sciences: that the expectation of ethical practices is woven into the need for scientists to convey their research in the best manner possible.

Topics Exclusive to Science-writing Textbooks: What Do the Participants Say?

The textbook analysis research demonstrated three pedagogical topics discussed exclusively by science-writing textbooks: Use of visuals to convey key information, Beginning the process of composing scholarly documents with visuals, and Understanding how, when, and why the audience reads visuals. Interestingly, interview participants from both disciplines discussed how they broach these visual communication topics in their classes, so in this section I will discuss how all of the participants cover these pedagogical topics in their courses and if there are any notable distinctions across or within disciplines.

3. Use of visuals to convey key information

Similar to the findings of the science-writing textbook analysis, Mya Poe, et al. write, “In scientific research articles, visual representations of data are the workhorses of argument” (115). Interestingly, though, when asked whether they or their textbooks explicitly discuss how visuals convey key information, the biological sciences participants were not the only ones to respond in the affirmative. Brenda, Kasey, Lauren, Lyann, and Natalie all responded that they and/or their textbooks cover this topic. Of the composition participants, Kasey’s and Lauren’s instruction of this topic seem much more general than the biological sciences participants’; meanwhile,
because Brenda’s course is designed for biological sciences majors, it is not surprising that she would include this topic that is perhaps more science communication-focused.

Lauren stated that of all of the pedagogical topics found in the textbook analysis research, Use of visuals to convey key information is the only one she has noticed explicitly discussed in composition textbooks. And even then she finds those entries lacking, remarking, “It's more of a general discussion that visuals can be used to convey key information, but again, not how.” And perhaps as a result, class time is spent asking students what is being conveyed in the visuals rather than how that information is necessary or best conveyed in visual form.

On the other hand, Brenda, in her Biological Communications course, and the biological sciences instructors are more detailed in their discussions of how visuals communicate data. Brenda reminds her students pay attention to scientists visually representing key research and data, saying, “You get a sense more from the results by looking at the visuals that [the author has] provided because those are the ones that are most important.” Natalie highlighted this idea by describing a pedigree chart that she shows her students, which demonstrates key genetic markers within an ancestral line. The visual illustrates a number of genetic markers within a family tree; something that could be described in writing, but not nearly as succinctly. Similarly, Lyann noted that one of the central goals of her plant systematics class is for students to be able to “look at something, interpret it, analyze it … to actually key out that plant and figure out what it is. It’s [about] them using information to get to an identification.” So, again, the visual is what is important because the students have to be able to literally see the specimen in order to recognize features for identifying the plant. Like the textbook analysis research, where only the science-writing texts included this topic, the biological sciences participants are much more accustomed to working with key data in visuals; whereas, the composition participants (except
for Brenda, who is teaching science students) consider visuals as a mode of conveying key information, but only discuss that concept in general forms with their students.

4. Beginning the process of composing scholarly documents with visuals

Of all of the topics gleaned in the textbook analysis research, Beginning the process of composing scholarly documents with visuals yielded the most dramatically different responses from the interview participants. While six of the eight science-writing textbooks specifically articulate how creating/incorporating visuals early in the composing process is a useful task, only three of the participants mentioned any sort of instruction on it.

Brenda’s response was the most hesitant; she talks with her students about how “there is [sic] quite a number of scientists performing research where a lot of their research is giving them visual results”; however, she does not think the textbooks she has used in the Biological Communication course address starting the composing process with visuals. Since a goal of foundation and advanced composition courses is to consider composing processes—invention, drafting, revision, etc.—it is perhaps surprising, especially in a Biological Communication class, to not include instruction on how visuals can be used to invent and organize research arguments. Yet it seems that neither these composition textbooks nor instructors do.

On the other hand, two of the biological sciences participants address this topic, though they do so for upper-level undergraduate and graduate students. Mike stated that he advises his graduate students to “start in the middle and build out” when composing. He suggests they start with the materials and methods section and then move to the results section, and “there are your tables and graphs there, and you work on those before you maybe even talk about the context, which is introduction, and what it meant, which is discussion.” So it seems that his recommended process does not begin immediately with the visuals, but they come toward the beginning.
Natalie’s response was the most akin to the textbooks’ suggestions. She said, “We do begin the process of composing scholarly documents with visuals. That's part of their lab write-ups.” This activity is relative low-stakes in which students must create some sort of visual representation of data; however, likely because her students are not yet required to do their own research, she does not have strict guidelines about the type of visual or how the visual is integrated into the documents. Her assignment is simply an activity for students to practice conveying their knowledge.

Thus it seems this topic is one that is taught to students only at certain points in their academic careers: like Natalie who does not require students to do research that needs to be communicated, Lyann specifically said she does not have students compose with visuals because she does not teach labs; meanwhile, Mike is teaching graduate students, who are more likely to be composing articles for publication than the undergraduate students in Natalie’s general education courses. So even though researchers such as Lynda Walsh and Andrew B. Ross, who conducted a survey of 144 STEM researchers about their composing processes, contend, “The overwhelming majority (85%) reported that they began composing a research article section by inventing the graphics for it” and the analyzed textbooks insinuate the significance of this topic, based on the responses of these participants, teaching students to compose documents by starting with the visual remains a less significant aspect of communication instruction because often undergraduate students are composing for classroom learning purposes rather than to communicate research as experts in the field would do (130).

5. Understanding how, when, and why the audience reads visuals

Many of the science-writing textbooks discussed the importance of reading the visuals in scientific articles. In “Making Science Visible,” Jean Trumbo emphasizes why the ability to read
visuals is so integral to communicating and understanding science when she writes, “[An image’s] correspondence to the actual science behind the representation may be strictly conceptual. Learning to interpret these images is essential for both the scientist and science communicator” (276). The participants also suggested the distinctiveness of science visuals when they were asked whether they discuss Understanding how, when, and why the audience reads visuals with students. Yet the composition participants rarely see this topic in textbooks, and only Brenda includes it in her teaching. This absence is intriguing because most composition courses include guidance on audience analysis as an objective; knowing how, when, and why the audience reads visuals would potentially help students understand disciplinary composing conventions and direct them as they begin to compose in a variety of academic contexts.

In her Biological Communication course, Brenda does talk with her students about how they can be effective and efficient readers, telling them, “Look at the title and the abstract. That's going to help you pretty quickly discern whether it's applicable to you or not. And then if you decide if it's a ‘yes’ or a ‘maybe’ to scan through the headings and subheadings if there is [sic] any, and then visuals, and captions and then read the introduction.” Natalie goes a step farther, specifically teaching her students how to read a variety of visuals. She also insinuated the complexity of visual communication asking her students to consider how visuals can be created in such a way as to present distorted information, warning them that “they need to be careful when they're reading figures in primary literature.” In fact, she described giving students a Test of Scientific Literacy Skills to ensure that they have “the ability to read, analyze data that's given in graphical form and tell you what the conclusions should be.” She is dismayed at the low results, which again indicates both the difficulty students have reading and interpreting visuals and the importance of that skill to the biological sciences field.
It seems that having these discussions in biological sciences classes teach students two important lessons about communication in the field: First, reading visuals immediately or early in the process is helpful for giving an overall picture of the research, and second, the visuals must be read closely and critically because they convey information in ways that are not always simplistic and easily understood. This instruction contradicts the learning experiences of STEM researchers surveyed by Lynda Walsh and Andrew B. Ross who found, “Participants did not report having been taught much visual argument at all; rather, they reported learning principles of usability and design that treat STEM graphics somewhat like a transparent lens that just needs to be focused properly to remove distortions and give viewers a ‘clear’ view of data” (132). Hence, it seems that the interview participants explain to their students the role visuals play to help a reader engage with and understand information in a way that not all science instructors do.

Pedagogical Topics Exclusive to Composition Textbooks: What Do the Participants Say?

The textbook analysis research demonstrated four pedagogical topics discussed exclusively by composition textbooks: Use of visuals as invention processes, Creation of visuals as alternatives to written texts, Addition of visuals to enhance written texts that are lacking, and Emphasis on the analysis of visuals. However, again we find that interview participants from both disciplines consider these visual communication topics in their classes, so in this section I will discuss how all of the participants cover these pedagogical topics in their courses and if there are any notable distinctions across or within disciplines.

6. Use of visuals as invention processes

Six of the nine composition textbooks analyzed included discussions of visuals, like concept maps, being used for invention or prewriting purposes. Eric Hobson explains why
visuals make strong invention tools in “Drawing Students into Writing,” when he writes, “For the artist and the writer, invention is an essential activity. Verbal texts, like pictures and other types of visual texts, do not spring fully formed into the world. Rather, a time and a place for exploration, play, and invention help verbal and visual artists alike discover what they are trying to say and explore their options for saying it” (140). Hence, it perhaps surprising that only one of the three composition interview participants noted using visuals in the invention process in her teaching. Kasey found visual communication tasks to be an important component to her teaching, and thinks students should do more invention activities, specially visual ones, saying, “I wish they felt more comfortable making a mess of their paper with visuals in the invention process because I feel like that can be a very liberating [process].” Meanwhile, Brenda and Lauren not only do not teach students to use visuals in the invention process, they also both claimed that none of the textbooks they have used suggest visual invention strategies. Of course, Brenda’s textbooks in the Biological Communication course are likely different from ones typically used in composition courses because the goal of the course is to link communication skills with biological sciences. Thus, it is not terribly surprising when she said that she finds her textbooks do not “at all talk about invention as a part of the composing process.”

However, even though none of the science-writing textbooks include visual invention activities, two of the biological sciences interview participants use these techniques in their classes. Natalie mentioned concept maps as ways for students to better learn information and Mike talked about storyboarding as a method for organizing information for oral presentations. Of course, because Natalie’s undergraduate students do not do much of their own research, they do not do much composing either. So it seems that the content of these courses affects whether or not this topic is covered in a class; since Mike’s graduate students are composing scholarly
articles and Brenda, Kasey, and Lauren’s students are learning a variety of processes for composing academic texts, they each emphasize invention. Yet, according to the participants, visuals do not seem to be a primary technique for doing so.

7. Creation of visuals as alternatives to written texts

Even though five of the nine composition textbooks analyzed included activities for remixing written text into visuals, such as photo essays or comic strips, none of the composition interview participants gave completely positive responses to this question. Lauren said that in her experience this topic did not get covered in undergraduate-level composition classes at all. Kasey mentioned that even though her textbook did include some remixing activities, she did not cover them in her teaching. She expanded on this idea when she later said, “I don't often talk about using them as alternatives as written texts because we're all about writing.”

Brenda’s response borders on the most positive, as she said, “[Textbooks] do talk about visuals as alternatives to written texts sometimes, but I think it's never without written text.” Her view was that while it is possible for visuals to convey some of the same information that written text could, in her work with scientific communication the visual would never stand completely on its own without written text to help explain or support it. And Lyann agreed with Brenda’s assessment, remarking, “Mainly [visuals as alternatives to written texts] would come up when like we're doing a website design or something because virtually everything else is a combination. We integrate the visuals with text. It's almost never do we completely replace the text.” It seems that Alan G. Gross’s observation that “scientific prose and its accompanying tables and figures work together toward a single metaphysical end” could be adapted here to include a wider variety of prose and range of visuals (79); in fact, it seems that the participants in
both fields would agree that the written text and the visuals work together to convey a meaning, and it is rare for a visual to do so on its own.

Because of these neutral responses by the participants, it seems surprising that many of the analyzed composition textbooks focus on this aspect of visual communication. It appears that textbook authors are taking to heart Diana George’s call for composition instructors to think of “students as producers” of visual texts (13), especially with the influence of the WPA Outcomes Statement’s publication in 2014 that reminds composition instructors that “writers also attend to elements of design, incorporating images and graphical elements into texts intended for screens as well as printed pages.” So visuals are supposed to be included in the composition classroom; yet, as Odell and Katz probably correctly assess, “This sort of work leads them into what for most will seem unfamiliar territory, especially as they try to assess students’ work” (W198).

Thus, remixing activities might be a simple way for writing instructors to assign and assess visuals: They stem from a previous writing assignment and they could even be minor, in-class or ungraded activities. In many ways, this type of assignment makes for a happy balance of asking students to practice visual communication production skills while not putting too much strain on the instructor’s own visual communication skills. The interview participants, however, do not seem to respond to this particular practice, perhaps because they recognize the interconnectedness of visuals and written text in many real-world communication contexts.

8. Addition of visuals to enhance written texts that are lacking

Five of the nine composition textbooks analyzed talked about visuals as ways to “complement,” “help,” “expand on,” and “demonstrate points” that are being made in the written text of documents. The textbooks tended to use language that elevates the function of written text, insinuating that the written text comes first and visuals should only be applied if necessary
to aid the transmission of the argument. However, on the whole, several of the interview participants did not have this same perspective; instead, they mentioned how the interconnectedness of the visuals and written text is essential to being engaged with a document and getting real meaning out of it.

Both Kasey and Lauren argued that visuals do enhance written text, but because they can convey key information in meaningful ways. For example, Kasey claimed that visuals and written text “go hand in hand,” and Lauren talks with students about the usefulness of visuals, asking, “How could we improve this [written text] by adding something visually [sic]? How will that enrich it?” Kasey and Lauren implied that visuals are not simple add-ons, but rather play a pertinent role in conveying information that writing cannot do alone.

And Mike mentioned that he spends a significant amount of time talking with students in a presentation skills class about the importance of visuals in scientific presentations, saying, “To me…the well-designed graphs, the visuals, the animations if they're well chosen are like in the desert of this unfamiliar science that you're crawling through, here's a little waterhole so you can have a drink and momentarily feel better, and your attention span goes up, and so you're ready to go back into the desert again.” Though he was discussing a different genre of communicating, like the other participants Mike indicated that the visuals are working to enhance the written text, but in such a way that they are not somehow lesser than the writing.

9. Emphasis on the analysis of visuals

As previously mentioned, “analysis” was a term used by both composition and biological sciences interview participants, but only the composition participants used the term to mean rhetorical analysis. All three of the biological sciences participants discussed at length the importance of teaching students how to analyze (i.e.: interpret) visuals. Natalie summed this
point up best when she stated, “The ability to read charts and interpret graphs is part of science literacy,” so students must learn to do it.

Since, however, rhetorical analysis was examined in the textbook analysis chapter, I will spend most of this section considering how all three of the composition participants describe visual rhetorical analysis activities in their classes. Lauren includes an in-class activity (see Appendix F) in which she shows two posters that contain the same information but have different visual designs. She has students dissect the rhetorical choices the creator made in each version and the effectiveness of those choices. Similarly, Kasey asks students to write a visual rhetorical analysis essay (see Appendix E). She is very clear about the goals:

I want them to develop their skills of analysis: I want them to understand design principles. I want them to understand how the visual and verbal elements of these things work together to impact the audience. I want them to understand how the creator of the visual has a specific object in mind as far as what audience they are appealing to and what strategies will work on that audience.

Kasey, like Lauren, spends time in class having students discuss visual rhetorical analysis terminology and skills in order to prepare them for this major assignment. Likewise, Brenda assigns a scientific poster project (see Appendix D), for which she will first have students visually rhetorically analyze a variety of sample posters and then have them apply that knowledge when designing their own posters. She commented why this practice was extremely important for biological sciences students:

I think a lot of scientists don't necessarily talk about things like typography and color and visual appeal, like what is visually appealing and a lot of science students are like, “I don't know what looks good!” They act [clueless]...
start to show them different examples and they start to realize that they do realize what looks good versus what doesn't just kind of as an immediate gut reaction and then you can help them break down why….They start to realize that they have a lot of that intuitively, they just don't have the language to talk about it or the understanding to know why it's not right or why it's good or effective.

Clearly all three of these participants value teaching students how to rhetorically analyze visuals. Kasey explained why this skill is so important to her teaching when she says, “I'm hoping that those [analysis skills] do transfer because they aren't specific to, ‘Hey, I have to get this assignment done.’ Those are specific to reading visuals on a larger level.” She and the other composition participants acknowledged that this skill is valuable because of its usefulness in a variety of contexts—it helps students consider how others are communicating well and how they too might communicate well across genres and disciplines.

As mentioned in the previous chapter, several of the science-writing textbooks indicated that students should be able to generally rhetorically analyze scientific texts and composing contexts. If nothing else, they should be able to consider their audiences needs. In fact, Luc Pauwels, in “A Theoretical Framework for Assessing Visual Representational Practices in Knowledge Building and Science Communications,” writes, “A real set of skills is needed in order to be able to assess the usability of given representations based on a thorough knowledge of their generic processes, and to be able to produce visual representations with the required representational and expressive properties in relation to their purpose(s)” (21-2). Likewise, Christina Haas in “Learning to Read Biology” argues that science students need to be aware of rhetorical situation, that rhetorical skills can provide them with “a metaunderstanding of the motives of science and scientists and the history of scientific concepts” (45). And it is clear that
the composition participants expect, or at least hope, that the rhetorical analysis skills they teach will be useful for students moving into other disciplines in the way Pauwels articulates.

**Conclusions**

The results of this interview analysis demonstrate that there are a variety of similarities and differences in the pedagogical topics covered by composition instructors and biological sciences instructors as well as between instructors and textbooks. Of course, it must be mentioned that the six interview participants included here is a very small sampling, so I cannot make completely definitive judgments about the processes of teaching biological sciences and composition. It is also important to note that the composition participants are current or recent PhD students who are grounded in composition pedagogies and the biological sciences participants are a senior lecturer and full professors who are more aware of pedagogy than typical because of the courses they teach and their engagement with the university’s Center for Excellence in Learning and Teaching. Because advanced lecturers and professors rarely teach composition courses and graduate students rarely teach full sections in the biological sciences, there is a lack of symmetry between the disciplinary participants, which might influence some of their perspectives about visual communication in their disciplines. Likewise, the enhanced awareness of pedagogy of the participants might also impact the results of this dissertation because all six of the participants are already engaged with the consideration of communication conventions.

However, as previously mentioned, textbooks are only one tool utilized in classrooms to convey disciplinary knowledge to students. Thus, the interview results present an additional factor affecting the instruction practices of visual communication in composition and the biological sciences. An analysis of their observations are useful for my research because it yields
an expanded awareness of the influences of visual communication pedagogical topics covered in composition and biological sciences classrooms.

Many of the observations of the participants, similar to the textbook analysis findings, indicate that the goals of their classes and types of research valued by the discipline influence the visual communication terms they used and their methods for instructing students about visuals. Specifically, the more general use of visual communication terms and the discussions of the purposes of visuals and the notion that visuals have the ability to convey key information illustrate how composition classes are more focused on the composing process and how visuals might fit within that; whereas, since the biological sciences classes are focused on science-as-content, the instructors use more specific terms (like pedigree “chart(s),” “maps,” and “(line) drawing(s)”) to describe the visuals used by researchers to convey new scientific knowledge as they teach students about the ways visuals convey information in their discipline.

Some of the participants’ observations, however, contradict the perspectives displayed in the textbooks. Some of these contradictions are consistent across the participants in each discipline. For instance, even though five of the nine composition textbooks present activities in which visuals completely take the place of written text, none of the composition participants teach the idea that visuals can be alternatives to written text. In another case, only the composition textbooks discussed how visuals can enhance written texts that are lacking, and did so in a way that ranked the visuals as less critical to the message being presented than the written text. The participants, on the other hand, agreed across disciplines that the visuals should not simply be considered add-ons to the written text, and the biological sciences participants spent more time describing how useful visuals can be to enhance documents by representing information that the writing cannot clearly convey. In these two instances, the composition
participants all seem to be unified in their perspectives and the biological sciences participants also appear to agree on these uses of visuals in their respective disciplines.

Other contradictions occurred that were not so clearly defined as disciplinary, though. Sometimes one of the biological sciences participants would use a specific term more often than the others; for example, Lyann uses “illustration(s)” regularly, but neither Mike nor Natalie use that term and only two of the eight science-writing textbooks did. The reason for Lyann’s use of this term stems from the type of research she does with plant anatomy and plant systematics. Her research yields certain types of data that are best illustrated in a certain type of visual. As Lyann noted, members of her specialization do not use graphs as often as other scientists might. So, the inconsistencies across the participants’ comments highlight how within the broad discipline of the biological sciences, there are a variety of specializations in which the members of the community have constructed and adhere to specific communication conventions that might differ from those in other biological sciences specializations. Furthermore, it seems clear that the science-writing textbooks, which present a very broad perspective of visual communication conventions across the natural sciences, simply cannot cover all of the communication aspects particular to individual specializations.

Finally, certain contradictions occurred that did not seem to be suggestive of disciplinary, specialization, or course contexts; instead, they appeared to be idiosyncratic moves that the participants were making because of their own perceptions or experiences with visual communication. For example, when discussing how to use visuals in the invention process, Kasey was the only composition participant who mentioned teaching this, and she did so because she felt it was “liberating” for students to be able to visually make a mess of their composing process. On the other hand, Mike asks his students to storyboard when they are creating
presentations because his daughter, an MFA student in acting, suggested that it would be a helpful task. He tried it, and found that doing so helped the students consider the story they want to tell about their research before jumping into the creation of the first slide. While these comments might seem minute, they illustrate at a local level how knowledge is constructed within a particular course context by members of that context.

Thus, the analysis presented here offers awareness of visual communication conventions that are specific to disciplines, to specializations within disciplines, and to courses located within disciplines. These findings support Herrington’s observations when she observed the writing contexts of two chemical engineering classes in “Writing in Academic Settings” and found, “Even within one discipline…different courses may represent distinct forums where different issues are addressed, different lines of reasoning used, different writer and audience roles assumed, and different social purposes served by writing” (119). What seems to be reinforced is the concept that disciplines, and even specializations or courses within a discipline, are socially constructed communities that influence the communication practices and conventions. And yet, even though these practices and conventions (and terms and pedagogical topics) have been constructed through the history of the discipline, students still receive mixed messages because the textbooks and the instructors each have particular methods for teaching, language used to teach, and/or topics deemed important to teach.

The analysis in this chapter of terms and topics used by the interview participants again helps remind instructors of both disciplines that the conventions they work within are not the same as conventions in all contexts. Being reminded of the values of their disciplines and purposes of communication can be helpful for instructors to consider both tacit communication knowledge and communication particularities of a discipline, specialization, or context in more
deliberate ways. And this understanding reinforces WAC/WID pedagogies, for instructors who are interested in helping students consider composing situations across disciplines or who emphasize transfer of learning, that these disciplinary distinctions of visual communication conventions and practices might be worth considering when instructing students about academic writing.

Since composition courses often include activities for students to examine and gain practice with the writing process and consider an audience’s needs when writing, what seems especially useful for composition instructors to consider is that in the biological sciences writers often start their composing processes with visuals and readers often look to visuals early in their reading practice. Even though some composition textbooks include visual invention practices, two of the three composition participants did not integrate these activities into their instruction. Similarly, Brenda was the only composition participant who discussed the rationale for reading visuals early in the reading process with her students. Yet if composition classes are designed with the goal of preparing students to compose in a variety of academic fields, and considering a variety of writing processes, purposes, and audiences for what is being written are integral to that instruction, more awareness of the ways visual communication is practiced in other disciplines like the biological sciences could be beneficial. It is possibly difficult for students to transfer their learning from composition into disciplines like the biological sciences when they are not prepared to see and use visuals in their final products or their composing processes.

While this chapter has detailed the visual communication pedagogical topics used by the interview participants in their classrooms, what have not yet been covered are the actual methods by which the participants use visuals in their academic work. Therefore, the next chapter examines the ways in which the participants learned their disciplines’ communication
conventions and work within those conventions as they read and compose visuals. They also share their concerns about the ways in which visual communication is currently taught in their fields. Their observations about these actions and issues work to reinforce the disciplinary and specialization communication conventions displayed in this chapter and to shed some light on some of the individualized methods of teaching and communicating visually that were beginning to be demonstrated here.
CHAPTER 6

COMPOSITION AND BIOLOGICAL SCIENCES INTERVIEW PARTICIPANTS’ PERSPECTIVES OF USING VISUALS IN PROFESSIONAL WORK: AN INTERVIEW ANALYSIS CONTINUED

While examining interview participants’ responses associated with the visual communication terms and pedagogical topics from the textbook analysis research, I realized the participants touched on a wider variety of visual communication subjects. The textbooks deal only with conveying disciplinary communication conventions to their audience of students, but the interview participants also discuss topics related to the ways in which they learned how to communicate with visuals, their processes for reading and composing with visuals, and concerns they have teaching visual communication. As individuals who have learned to become a member of their discipline, continue to produce knowledge within the expectations of the discipline, and teach incoming members of the discipline, the interview participants have a much wider breadth of interaction with visual communication than the textbooks. Thus, it is sensible to investigate their processes of learning, reading, composing, and preparing to teach visual communication.

In this chapter I display the visual communication topics discussed by the interview participants that extended beyond the pedagogical topics covered in the textbooks previously analyzed. I have organized the chapter in the same way as previous chapters, in four parts: methods, results, discussion, and conclusions. Within the first three of those sections, the information is divided up to look at a term and topics covered in the participants’ interviews. The examinations in this chapter point to the importance visuals play in the participants’ composing, reading, learning, and teaching practices, and the concerns they have when teaching their discipline’s visual communication conventions.
Methods

My methods for locating, listing, and analyzing these topics stem from the methods I used in the textbook analysis and interview analysis research processes in the previous two chapters. During the interviews, I asked the six interview participants questions about topics that extended beyond the ways in which they teach visual communication to their students. Those questions centered around their experiences learning the discipline’s communication conventions, using visuals in composing and reading scholarly articles, and general perspectives of using and teaching with visuals. (See Appendix C for the complete list of questions). As with the pedagogical topics, I initially coded the participants’ specific responses to these questions in Atlas.ti based on the categories of questions listed above. Next, I made several passes to locate any additional visual communication topics and to divide topics that were discussed often in a variety of significant ways by the interview participants.

As mentioned in Chapter 5, I realized during coding of the original nine pedagogical topics from the textbook analysis that the participants were discussing several of those topics in relation to their own composing and reading practices rather than in connection with their teaching. Of those nine topics, five were used by participants during the interviews in this way. Because I had already coded for these nine topics, I went back through all of the comments and relabeled each one that dealt with the participants’ communication practices rather than their pedagogical content and added these topics to the list. This list was created and categorized in a recursive process, and the final list includes eight topics that fall within two categories:

1. Category 1: Participants’ composing and reading processes (e.g.: The purposes of visuals in the participants’ written texts and How, when, and why the participants read visuals)
2. Category 2: Participants’ visual communication concerns of current instructional practices (e.g.: Student difficulty reading/interpreting visuals and Textbooks lacking visuals and instruction of visual communication).

The complete list of topics is presented in Table 16 in the Results.

Finally, further passes were made through the interviews to locate instances in which the participants discussed the premises of these eight topics in response to questions other than the ones mentioned on previous pages. These instances were coded in the same manner as the previous comments, and display compelling similarities and distinctions both across and within the composition and biological sciences disciplines. These findings will be displayed in the Results and Discussion.

**Results**

**Term**

The previous chapter described several terms that the biological sciences and composition participants used that primarily dealt with visual communication pedagogy—they were terms that might be used in the classroom to teach students about the conventions of reading and composing visuals in disciplinary scholarship. There was one additional term that participants in both disciplines used but discussed in strikingly dissimilar ways. This term, “art(ist/work)” was only peripherally used when teaching students about visual communication conventions; more often the participants mentioned it in relation to their own composing processes. Thus, it is sensible to discuss the use of that term in this chapter.

“Art(ist/work)” appears to be a frequently used term to discuss visuals because it was used 23 times by four participants during the interviews (see Table 15). However, Lauren and Mike each only used the term once, and the time Lauren used it as well as nine of the times
Table 15: Interview Participants’ Use of the Term “Art(ist/work)”

<table>
<thead>
<tr>
<th>Composition Participants</th>
<th>Biology Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brenda</td>
<td>Kasey</td>
</tr>
<tr>
<td>Art(ist/work)</td>
<td>12</td>
</tr>
</tbody>
</table>

Brenda used it were when discussing a specific “Art on Campus” assignment prominent in the CAC Program’s curriculum. That leaves Lyann as the participant who used the term most frequently, and her use of language like this likely is a result of her involvement with the Biological and Pre-Medical Illustration program in which students are prepared to become visual communicators of scientific artwork. This association of science and art becomes an interesting one as the biological sciences participants struggle with their own identities as scientists but not as artists. This discrepancy will be examined more fully in the Discussion.

**Topics**

All six of the interview participants were asked to describe how they learned their discipline’s visual communication conventions, how they read and compose scholarly articles with visuals, and what other general thoughts they have about how visuals are valued in their disciplines, the competency with which visual communication conventions are taught to students, and the difficulties they see expert or novice members of the discipline have with visual communication. Table 16 denotes these topics and categories, as well as which participants discussed them. A ✓ indicates that a participant discussed a topic and a blank indicates that a participant neither confirmed nor rejected the topic, usually by not discussing it at all.

In the first category of topics illustrated in Table 16, all topics except the first one directly relate to the pedagogical topics examined in the previous two chapters. Here, however, the topics specifically describe the reading and composing processes of the interview participants rather
Table 16: Visual Communication Topics of Interview Participants’ Composing, Reading and Learning

<table>
<thead>
<tr>
<th>Category &amp; Topic</th>
<th>Composition Participants</th>
<th>Biology Participants</th>
<th>Total # of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brenda</td>
<td>Kasey</td>
<td>Lauren</td>
</tr>
<tr>
<td>Category 1: Participants’ Composing and Reading Processes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How the participants learned to compose and read in their disciplines</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>The purposes of visuals in the participants’ written texts</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Use of visuals to convey key information in participants’ work or others’ scholarly work</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Participants’ processes of composing scholarly documents with visuals</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>How, when, and why the participants read visuals</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Addition of visuals to enhance written texts that are lacking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Category 2: Participants’ Visual Communication Concerns of Current Instructional Practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student difficulty reading and interpreting visuals</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Textbooks lacking visuals and instruction of visual communication</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

than their practices of teaching those concepts to students. Since they focus on the participants themselves, the first topic has been included because it relates the participants’ experiences learning their discipline’s visual communication conventions. Of the other five topics presented, there are two notable variances. While all of the topics have shifted to focus on the participants’ practices, one also shifted to more specifically address the participants’ actions: While the participants were asked whether they teach students to begin the process of composing with visuals, here participants were simply asked to describe their composing processes. All six of the
participants did discuss using visuals as they compose, but they do not in fact all begin the process with those visuals.

Another significant outlier in this list of topics is Addition of visuals to enhance written texts that are lacking. As Table 16 illustrates, most of the topics presented here were discussed in some way by all or most of the interview participants, except for this one. Interestingly, in the textbook analysis research, Addition of visuals to enhance written texts that are lacking was a topic specific to composition textbooks; however, it is not the composition participants but those from the biological sciences who use visuals in this way in their composing and reading. Reasons triggering these distinctions will be considered more fully in the Discussion.

**Discussion**

**Term**

As mentioned in the Results, Lyann, with her Biological and Premedical Illustration (BPMI) influences, most frequently used the term “art(ist)/work” during her interview. Often she does so to talk about how scientists sometimes are not adept at visually displaying data. For instance, she described how rarely she has been given feedback on her visuals, saying “Nobody really critiqued it…people who review journal manuscripts mostly are other people like me, they aren't artists, they don't have an in-house artist to do the critiquing.” And in fact, she does not do much of her artwork anymore, describing students in the BPMI program who do that work now. Mike made a similar comment to describe how a graduate student he mentors worked with a commercial artist to create a particular visual because it was so important for conveying information. He said, “This [visual] is the kind of thing that teachers will borrow from this [article] and use to understand what's happening here. And people who have never worked with
this bacteria before, they have never worked with squash and pumpkin and cucumber beetles before, can extract a lot of the article by reading no more than this [visual].”

Here the use of the term “art(ist/work)” signifies much more about the ways the participants think about themselves as communicators, their discipline’s lack of emphasis on teaching visual composing, and their processes for communicating research. First, even though the biologists are clearly communicating their data in visual ways, they do not think of themselves as “artists.” Lyann even acknowledged that she thinks she has “become a pretty good photographer” but that drawing is a different story.

But what is interesting is that even though these biological sciences participants downplay their artistic abilities, such as when Natalie says about a particular visual, “There is no world where I could do this,” and describe how they rarely were explicitly taught how to create useful visuals, they overcome these challenges in their scholarship: The scientists hire artists to convey the research meaningfully. Mike did acknowledge, “20 years ago I wouldn’t have [hired an artist]…I had to be a convert to recognize the power of that.” He went on to explain the significance of having impactful visuals, saying, “It’s worth it to pay somebody who does it and does a good job because the thing could have a 20-year life just from simply being attractive and simple and well thought out.”

The composition participants do not articulate their identities in the same way as the scientists, but they too struggle to create meaningful visuals. A key difficulty they have creating visuals is, as Lauren recognized, what is being visualized in composition is often not “tangible”; “words or communication or theory” are difficult to represent visually. Though perhaps this challenge is precisely the reason why composition scholars might want to consider the tack the scientists take and work with artists to better represent their research; doing so might aid readers
like Lauren who at times read the written text of an article, thinking, “[I] don’t understand what is said,” and then read the visual, thinking, “[I] still don’t understand what is said.”

**Topics**

Through the interviews, the six participants discussed 8 topics that dealt with a variety of visual communication issues. These topics ranged from the processes they used to compose and read visuals in scholarly articles, experiences they had learning visual communication conventions, and general concerns they have had teaching visuals. Because of the range of topics, they have been organized into two categories: Participants’ composing and reading processes and Participants’ visual communication concerns of current instructional practices. Each of these topics will be discussed more fully in the following sections.

**Category 1: Participants’ Composing and Reading Processes**

The topics contained in this category are all ones similar to the original nine pedagogical topics located in the textbook analysis research except for the first topic (How the participants’ learned their discipline’s conventions). This first topic is important to include here because it demonstrates how the participants came to learn the ways in which they were expected to communicate in their disciplines using visuals. As individuals who work within their discipline’s conventions to read and compose visuals the methods they use to do so and they ways in which they learned these conventions might speak to certain idiosyncratic language, topics, or methods used in their current activities. The remaining five topics differ from the topics discussed in the previous chapter because rather than focusing on the ways they conveying this information to students, the participants were articulating their own or other disciplinary members’ practices of reading or composing visuals. Whether or not this content is directly conveyed to students is
unclear from these individual passages, but they illustrate how the participants perceive visual communication conventions being enacted by themselves or others in the field.

Six topics will be discussed in this section: How the participants’ learned their discipline’s conventions; The purposes of visuals in the participants’ written texts; Use of visuals to convey key information in participants’ work or others’ scholarly work; Participants’ processes of composing scholarly documents with visuals; How, when, and why the participants read visuals; and Participants’ addition of visuals to enhance written texts that are lacking.

1. How the participants learned to compose and read in their disciplines

The American university education model is built on the premise that students learn to become members of a field from experts, the instructors. Joseph M. Williams and Gregory G. Columb, composition instructors at University of Chicago, explain:

To join a disciplinary community is, in part, to master a body of knowledge. But that knowledge does not exist ‘out there,’ independent of those who control it, just waiting to be acquired. Knowledge belongs to groups of people who have some shared stake in exploring, preserving, and expanding it. The outsider must acquire knowledge from insiders ….While the novice is committed to mastering the knowledge that the community thinks is important, the novice is equally committed to acquiring the ways of thinking that characterize that community, the tone of voice that identifies one member to another, the required silences whose violation instantly identifies the outsider. (101)

In essence, communication conventions must be learned alongside the ways of thinking, learning, and researching in the field. And when asked how they learned to communicate well in their disciplines, the participants noted that their classes provided far more guidance on written
communication skills and they learned visual communication conventions by participating in disciplinary activities: reading scholarship, composing their own research articles, or teaching others to compose.

Because the question I asked let the interview participants consider all modes of communication, most talked about their experiences learning written communication conventions. As previously mentioned, the composition participants did not mention spending a lot of time discussing visuals in their own classes or considering visuals in their own reading and especially composing processes, and they also said little here about learning the ways visuals fit within their discipline’s communication conventions. Specifically, Brenda mentioned that visuals were rarely expected in her graduate-level course work. She described how she did not have the opportunity “to learn or talk about visuals a whole lot.…I didn't feel like I was ever really encouraged all that often to put visuals into texts for seminar papers.”

Likewise, the biological sciences participants on the whole also felt like their training in visual communication was lacking. For example, Lyann and Natalie mentioned learning some of the basic “silly picayune details” (Natalie) about reading and creating visuals in classes. But they could only remember a handful of instances in which more complex types of interactions with visuals were dealt with in their education. Most notably lacking was feedback from their teachers on their use of visuals in their submissions. Natalie remembered having papers returned from her major professor that were “dripping blood,” and Lyann being handed a manuscript draft “covered with red ink. Just absolutely covered.” However, it is important to note that while these two participants were given good feedback from their professors, the feedback focus was not on the visuals. Lyann said, “So the drawing part wasn't—he didn't really critique that, he was critiquing the writing part.” Again, we find an instance in which instructors find themselves
unequipped to critique the visuals, which probably relates back to earlier points discussed regarding both science and composition instructors’ belief that because they are not artists, they are not equipped to evaluate anything visual.

And that point of view possibly affects the participants’ feelings that their classes lacked visual communication training opportunities. On the whole, participants were “absorbing all of the [visual] stuff” (Lyann) through their own reading of scholarship or through the “trial and error” (Natalie) of composing their own documents. For instance, Natalie explained that the one event that influenced her knowledge of her field’s communication conventions was co-authoring a textbook. Lyann reached out to a personal friend who was an artist at the Smithsonian Institution to help her the first time she tried to publish an article with line drawings. And Mike believed that teaching was one of the major experiences that influenced his knowledge of conventions. He explained, “Probably I didn't systematize [ideas about simplification, slide design, and visuals] until I started teaching it, which requires you to admit what do I know? What do I need to know? When should I tell them this? When should I tell them that?”

Though the biological sciences participants seemed comfortable working within their individual discipline’s communication conventions, based on their responses, it seems they often had to seek out professional opportunities in order to gain practice communicating effectively using visuals. Though from a different discipline, Lauren perfectly articulated how her learning of visual communication conventions was “more caught than taught.” And these experiences possibly influence how these individuals read and compose visuals even in their current work.

2. The purposes of visuals in the participants’ written texts

Until recently, scholars sustained the view that visuals are literal, essentialist representations of truth—they mean the same things to all readers at all times and are “solely
meant to generate and present objective data or to facilitate pure cognition” (19). Researchers like today have come to contest that perspective (see Gross, Lemke, Pauwels, Trumbo, Woolgar, and others), and as Luc Pauwels explains, visuals have a variety of intents and purposes (18-19). The previous chapter indicated that all of the participants discuss with their students the purposes of visuals in written texts. In this section, it is clear the participants also consider these purposes when they are reading or composing scholarship in their fields. While they talk with students about how different types of visuals convey information and that important information is communicated in visual form, here they speak more specifically about how they interact with visuals when reading scholarly articles and when composing their own texts. The participants tended to discuss the purposes of visuals in three ways: inviting readers, highlighting pertinent information, and teaching science content.

1. **Visuals inviting readers**

   Luc Pawels writes that one purpose of visuals is to “perform the function of an eye catcher, a means to arouse and maintain attention and interest, or even to entertain the reader/spectator” (19). And the participants likewise perceived visuals as attracting the readers, inviting them to consider reading the rest of the article. Kasey noted that when she reads, she “looks at [the visuals] first because they jump off the page and sometimes pinpoint important points.” Likewise, Brenda said, “I feel like if there are visuals they always catch my attention, and I at least give them a look to see what's going on here….and then I'd want to know a little more about the article itself.” These two participants describe this use of visuals as what Mike called “eye candy,” something designed to feed the eye. And based on the participants’ comments and the science-writing textbooks, scientists look at the visuals before reading much of the written text, and that perusal can influence whether or not they read more. And Mike
argued that those visuals are especially important for “people who aren't specialists in your field” because the visuals often help to communicate findings more simply.

Natalie also described using visuals to become engaged with information in an article, saying that the visuals act as the “idiot's guide to reading this paper to see what they were trying to display.” She expands upon her view of how visuals are used by noting that she returns to the visuals later to examine the findings more closely. Doing so helps her to practice scientific inquiry: “Then I go back because that gives you the, ‘Oh, this is what they got.’ And leads to some of your more interesting questions of, ‘I wonder why they got that? And I wonder if—what the next questions would be? And how could I use this for my own research?’” Natalie’s description of visuals indicated that they invite her to join the discussion within the article but also in the larger scientific questions that stem from the research. This perception of visuals was not discussed by the composition participants possibly because it seems that visuals in the biological sciences more often highlight key data than those in composition.

2. Visuals highlighting data

Pauwels also notes that visuals “are often used to summarize or synthesize empirical findings or a theoretical line of thought” (18). Similarly, several of the participants found this to be a key purpose of visuals. Brenda was the only one of the composition participants to discuss how authors might use visuals to highlight critical data, and the reason for this is she is describing visuals in scientific articles. She commented, “You get a sense more from the results by looking at the visuals that they've provided because those are the ones that are most important. The one that the author has decided usually that, ‘Wow! I really need to visually represent this because it's a powerful representation of what I've accomplished.’” Natalie and Lyann expanded Brenda’s thought by discussing instances in which certain information is
displayed in order to help readers fully grasp the importance of the findings. For instance, Natalie noted, “Once in awhile if it's something where you've got a really interesting discovery, they'll have a concluding figure that basically explains all the data.” And Lyann stated, “If I'm describing three new species, and I want to summarize how they compare to each other, I make a table with the species and the characters that define them. You're highlighting what's different among them, not what's the same.” Essentially, these authors used visuals to point to specific information or relationships that written text might not be able to communicate clearly.

Lyann pointed to an example, saying, “In plant systematics if you're describing a new species it's very, very common to map their distributions and include that as part of the information.” She indicated the details of the specimen, noting, “I can start to say something if I'm mapping on this tree, these different characters that I'm looking at. This one evolved, it's really old and then it evolved in different ways so I can figure out what came first and what came later….It's a great example of what happens in nature all the time.” So Lyann described how this visual describes a natural process; the purpose of it is to inform the audience by highlighting the most relevant data. Thus, these participants’ observations align with most of the points on Jean Trumbo’s list of the purposes that visuals serve. She writes, “Images illustrate concepts, verify research, solve problems, clarify ideas, assist in theory development, serve as a source for comparison and contrast, correct misconceptions, or summarize a topic” (275). The participants’ reinforcement of Trumbo’s point again indicates that visuals are crucial elements for conveying science knowledge.

3. Visuals teaching science content

At times, the data being presented in visual form is done in order to teach students disciplinary content. When describing a research article one of his students had published, Mike
noted that she became frustrated when he told her that her attempts to design a disease cycle diagram. As mentioned in the previous section, he insisted that she work with a commercial artist to create the visual because he was certain it “is the kind of thing that teachers will borrow from [the article] and use to understand what's happening here.” So Mike was predicting how the audience might use this visual, conferring a purpose on it. And Lyann and Natalie supported his claim because they both discussed visuals that they have found in scholarly articles that they now use in class to teach students specific scientific information. In Natalie’s case, she found a visual that illustrates the process of B cells generating antibodies in the spleen in one diagram; whereas, textbooks illustrate each step of that process in individual visuals, so students never see a complete picture of the process, only parts. For Natalie, this visual is invaluable.

But interestingly, none of the composition interview participants made any mention to this particular purpose of visuals in their scholarly articles. Lauren did comment, “When I read things, I always have my eyes out for something that I could use to teach. But I don’t know that I think of it in reverse when I’m writing something.” This consideration for teachers as an audience relates to the biological sciences participants’ willingness to have artists step in and create visuals. In the biological sciences there is already significance being placed on visuals conveying key information, so the instructors seem to automatically look for these types of visuals to aid their teaching, and consider other instructors when they create visuals. This consideration becomes a cycle that does not seem to be occurring yet in composition even though, based on Lauren’s comment, it might be a useful act to consider. Especially because in the end, Mike was pleased with the result, saying, “No one's ever done this to make this visually clear at a glance. And that, to me, is worth the paper.”
3. Use of visuals to convey key information in participants' work or others' scholarly work

As mentioned in the previous chapter, the composition and biological sciences participants discussed how visuals are often an important method of communicating information in scholarly texts. However, during the interviews, Kasey and Lauren spoke in more general terms of how they teach this topic than the biological sciences participants and Brenda did. So when asked about their own composing processes, it does not seem surprising that the composition participants more generally talked of what information can be conveyed visually, while biological sciences participants spoke more specifically about how and why visuals are necessary for communicating findings.

For instance, Kasey simply noted, “The pictures sometimes convey what need to be conveyed in a better way than just the writing alone could” and Lauren said, “Some information just naturally is better visually.” And yet neither of them explored situations when this might be the case in their own composing or in articles they have recently read. This observation correlates to the findings in the previous section that discusses how the composition participants’ descriptions of the purposes of visuals were more general than the biological sciences participants’ examples.

This lack of description might stem from their perceptions of visuals in composition not often conveying key information clearly or at all. When asked if visuals convey enough information to grasp central concepts or relationships, Kasey responded, “In my discipline? No they do not cover enough. Even one with a heavy-duty results section that is full of statistics doesn't explain the picture that I'm looking for, doesn't explain the implications as well as me reading some analysis.” And both participants noted that they would have no problem skipping the visuals entirely if they were too complex or if the written text sufficiently explained them. Lauren examined this disciplinary visual communication challenge, articulating, “Well maybe
part of the challenge is when we are using visuals we’re usually talking about things like words or communication or theory which isn’t as tangible as saying, ‘Oh, let’s look at this corn plant.’” So it seems the actual content of the two disciplines might be a significant factor in whether key information is represented visually and in satisfactory ways.

For example, Natalie noted precisely why visuals are important in biological sciences scholarship, saying, “The visual gives you what [the process] actually looks like.” She went on to describe the progression of how a B cell makes an antibody, and points to a visual that illustrates that. She talked through the process, saying, “[This visual] shows how [the B cell] gets into the spleen, what happens in the spleen in the context of the spleen, what happens in another part of the spleen with a different cell type, which again both of these cell types are color-coded, it shows you interventions, and then it ends up with the [antibodies]. So all these steps happen here.” Natalie was certain that without such visuals, understanding the process would be difficult for any reader. Similarly, Lyann discussed how identifying a new plant species is inherently a visual task: Because scientific knowledge must be confirmed, the audience needs to be able to see “that specimen and verify the identification.”

We see from these participants’ responses a connection between the ways in which they compose and the topics that they cover in their teaching. There is a clear sense here that the practices that these individuals have for reading and composing, in general and with visuals, are influencing the content that they teach. All of this seems to stem from the disciplinary conventions—if visuals are not highly valued in composition, members of the field do not often read and compose visuals, and thus do not spend much time teaching visual communication to students. Likewise, if visuals are valued in specific ways in microbiology or plant anatomy, then instructors like Natalie and Lyann compose and read visuals in specific ways because of the
values and conventions of the field, and in turn, convey that more detailed knowledge to students.

4. Participants’ processes of composing scholarly documents with visuals

The participants were asked about their personal processes of composing with visuals, and the responses indicate a clear divide between the two disciplines. While the biological science participants do sometimes begin their composing with visuals, they do not always; and, the composition participants tend not to consider visuals until the last stages of their composing processes. Lauren was most clear about the timing of incorporating visuals, saying, “They're not kind of a driving factor in my process or in how I can explain information. I will sometimes think how can I use visuals with this or what might work here? But it's always secondary to the written. And usually at the very end, as kind of I'm revising and finishing things up.” Kasey mostly agreed, though left the possibility of incorporating visuals earlier in her composing, saying, “Generally they come at the end, when I realize I've got a dense chunk of text that would really best be explained in a table or a graph or a figure of some kind. Or when I'm analyzing something, and I want to put things side by side to see how they stack up next to each other.”

Brenda agreed with Kasey and Lauren’s perceptions, but noted that perhaps part of the reason visuals do not play a more prominent role is because composition classes, even at the graduate level, do not prioritize this type of communication. She claimed, “I didn't feel like I was ever really encouraged all that often to put visuals into texts for seminar papers and things….They're not as focused on as, ‘Well, get your argument down, and get your argument perfect, and then add visuals later if you have time or if you have the skill.’” This lack of emphasis in their instruction potentially affects these participants’ scholarship because, as Kasey
noted, “I don't use many visuals in my own personal work.” Thus, visuals are mostly absent, which directly contrasts with the biological sciences participants’ experiences.

Because of Lyann’s field, she often begins any scholarly project with the visuals, and the selection of which visuals to include in her texts is an important part of that task. As Mya Poe, et al. explain in *Learning to Communicate in Science and Engineering*, “Raw data can tell many stories, and it is up to the researcher to decide how to extract a meaningful story out of the data” (134). And Lyann described her process of selecting visuals to tell her story in more detail:

Typically if I'm illustrating species I will gather together all the specimens I have of it and I will go through…all of the specimens and made [*sic*] detailed notes and measurements and everything. And often as I'm doing that, I'll say, “This would be a really good illustration for this part.” So sometimes I've already selected the parts that need to be illustrated…. But if I'm working on photographs….First we are going to take data and we look at what are actually important features and kind of score them and ok, which ones are we actually going to show…. So you really have to have it clear in your mind, “What story am I telling?” And then pick the pictures that tell it the best. The rest of that variation that might be there you would actually describe it with words.

And she went on to explain that as she writes more of the article, she might come back to the visuals and make adjustments. However, since her data actually is these visuals, she must start her composing process with those.

Natalie’s process is similar, yet much of her research is funded by grants, so her composing process occurs in separate stages. She noted, “I've written the intro because oftentimes the intro is the beginning of whatever grant it came from. You have to explain what
you're doing and why you're doing it in order to get money for it.” So that written portion comes first, but once she has completed her research, then the visuals take precedence: “I gather the data, and then I make the visual, and then I explain the visual in the results section. And I do that for all the visuals so there's usually—…3 or 4 is pretty common—figures, and then I will explain them, and then I write the conclusions.” Because research in the biological sciences can be time and cost intensive, most researchers do apply for grants, which clearly impacts the composing process for scholarly articles.

Mike, however, described a somewhat different process for composing with visuals, depending on the type of document. He explained:

If I'm writing something like this, which is a review article, and I've written a number of them, I may assemble my pictures or 2/3 of them before I ever put a word down. If I'm writing a scientific paper, where there's data and so forth I may start with tables and graphs and then build around that. You always start with your data. In this case the data is really a lot of the visuals.

Thus, the purpose of the article and the audience of the article impact his composing process. He sees visuals as an instrument to aid non-specialists in their comprehension of specialists’ research, so creating visuals that consider that audience’s needs become crucial to the composing process. On the other hand, when crafting an article for a specialist audience, he might work with visuals early in the composing process, but the topic of the research directs what the data are and how they may best be portrayed. If the data do not need to be conveyed visually, then based on Mike’s comments, visuals will come later in the composing process, if at all.

So here we see that where visuals fall in the composing process depends on the discipline, the context in which the research is occurring, the data or topic being examined, as
well as the audience for the final document. The participants might alter their process of creating visuals for any of these criteria, and as shown in the previous chapter, the methods for biological sciences participants teaching students how to compose with visuals also differs, probably in direct relation to the instructor’s own experiences. Yet, the biological sciences participants made clear that visuals are integral to their processes of thinking about the data, brainstorming their arguments about the data, organizing the data, and displaying the data. Those practices differ greatly from the composition participants; their practices of visuals not being utilized until the very end of the composing process is possibly directly related to the types of data being gathered and analyzed, and potentially is affected by their lack of instruction on composing with visuals and might directly affect their omission of visuals when teaching their students about writing.

**How much time is spent composing visuals**

When asked how much time they spend composing visuals, participants’ answers ranged widely (see Table 17). Neither Brenda nor Mike gave concrete responses to the question, but based on the four participants who did respond, there is a clear difference between the percentage of composing time spent by composition participants and biological sciences participants. It must also be noted that Lauren was including “subheadings and things like that to be visual elements” in her 20% estimate. So on the whole, these numbers support the participants’ comments in the previous section that imply that the composing of visuals in the composition discipline is a significantly smaller emphasis on the total composing process than in the biological sciences. This observation also might relate to the fact that visuals in the biological sciences are often used to convey key information to readers and might be demonstrating complex processes or details, so the composers would need to spend more time creating them.
5. How, when, and why the participants read visuals

The previous chapter indicated that Brenda and the biological sciences participants teach their students how, when, and why audiences read visuals. They specifically discussed the practice of reading visuals as a way to glean the main ideas of an article and the importance of reading visuals closely to properly interpret the key messages. Charles Bazerman, in *Shaping Written Knowledge*, notes how readers often employ individualized strategies for reading scholarship. He writes, “Readers actively employ their structured background knowledge (or schemata) in order to understand a text…Furthermore, the reader’s purpose in reading helps the reader define a reading strategy and select what information to glean from the text” (236). And in fact, that is what is demonstrated by the interview participants. In this section, the participants also considered how, when, and why they read visuals; however, their practices of reading visuals do not always align with what they and their disciplines textbooks instruct students to do. The participants tended to discuss how, when, and why they read visuals in three ways: where visuals fall in the reading process, how much time they devote to visuals when reading, and how they read students’ texts.

**Where visuals fall in the reading process**

The science-writing textbooks examined in my study lead readers to believe that scientists often look at the visuals first in order to decide whether they will read more of the article or to glean key concepts. Brenda was the only participant to explicitly teach her students

**Table 17: Participants’ Time Spent Composing with Visuals**

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that process of reading. A possible reason for this exception might be the result of reading practices of the participants themselves, which range based on their own individual preferences as well as the contexts and content of the articles they read. When asked about their reading processes, the participants describe a variety of ways of reading, which correspond to Jay Lemke’s findings in “Multiplying Meaning: Visual and Verbal Semiotics in Scientific Text,” when he analyzes scientific print publications and discovers that “scientific text is not primarily linear, it is not meant to be read according to a unique implied sequence” (95).

Brenda’s and Mike’s comments most closely align with those from the textbooks; Mike said simply, “I like pictures. That helps me decide if I'm going to read the thing.” And Brenda explained, “At this point in my career I'm pretty good at being able to scan through a text and knowing whether or not it's applicable or interesting enough for me to pay attention to the middle meat parts or if I just want to skip to the ‘Here's why this is important’ section.” For these two readers, the visuals act as an aid to determine whether a text is worth reading more fully or not.

Natalie also described reading visuals early in her process as a way to best understand what the key findings of the researchers are. She said, “Oftentimes I read the intro and then I look straight to the figures and then I'll go to what they're interpreting because sometimes what they interpret and what I interpret when I look at their graphs aren't the same.” Kasey also mentioned reading visuals early to glean important information, saying, “I see it as something that a person skims through and looks at first because they jump off the page and sometimes pinpoint important points.” What is distinctive about her response is that she also noted, “If they're too heavy statistics I could skip them altogether a lot of times and just read the explanation.” This discrepancy is intriguing: It might insinuate that she was taught to read and interpret certain kinds of visual data. And this theory would be supported by the textbook
analysis research since none of the composition textbooks examined included instruction on how to interpret data that is presented visually beyond analyzing the visuals rhetorically.

Lastly, several of the participants note how their reading illustrates the interconnectedness of visuals and written text in scholarly documents. Kasey said, “Some [visuals] are interesting enough and intriguing enough that I would go back to them. Some of them show me what I need at a glance; some of them I need to read the text to decipher them or use them to decipher the text.” And Lyann and Lauren’s process of reading visuals in relationship to the written text matches Kasey’s. Lyann explained that typically she reads articles straight through, skipping only the materials and methods, until she gets to the images. At that point she will spend more time going “back and forth” between the visuals and text because “I really have to look at it and understand what I’m seeing.” As Mya Poe, et al. note, this back and forth process is typical of scientists because “the text accompanying the visual tells the reader what to see in the image” (115). Lauren, however, might not even stop to examine the visual until she has read all the text on each page. She explained, “If I'm reading something that has visuals in it I will just read the whole page, and when I get to the end of the page then I will go look at it...but I won't read, stop, look at the visual, and then go back to reading.”

According to the interview participants, the practice of reading scholarly texts does not denote a distinction across disciplines, even though the textbook analysis indicated that reading in the sciences takes special practice. What is notable about the interview participants’ methods of reading is that Mike said, “Watch how somebody eats an apple: Some people have an idiosyncratic way of doing that and other people just sort of bite into it.” Charles Bazerman’s research in *Shaping Written Knowledge* aligns with Mike’s comment as he describes the reading process of physicists, observing that they “read backwards, or jump back and forth,” reading
selectively by skipping sections and sometimes reading sequentially and other times not (243). Perhaps, unlike the science-writing textbooks would have us believe, and expanding Lemke’s observation of reading practices to non-scientists, all individuals need to find their own idiosyncratic ways of reading documents and visuals that best work for them.

**How much time is spent reading visuals**

I also specifically asked the participants how much time they spend reading visuals. The results range widely. Table 18 illustrates the total percentage of time each participant claims s/he spends on visuals; several of them offering a range of time. One universality across all six participants is their firm assertion that the amount of time they each spend differs depending on the article itself, which again reinforces the claim in the previous section that reading processes are at least somewhat idiosyncratic to each individual.

Five of the participants noted that the visuals themselves are the deciding factor in how much time gets spent on them. As Kasey explained, “It depends on how many visuals are in that text and what the purpose of that text is, whether it’s a really important part or just a supplemental added accessory.” Brenda was the only participant who articulated that the content of the article itself might affect how much time she spends on the visuals in scientific articles, saying, “That's hard to gauge because it has to do with me for the stuff that's in the middle of the article and whether I want to really go in depth in reading it or not.” And because of that, she would not commit to a specific percentage.

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<td>Percentage/Range of time spent reading visuals</td>
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</table>
An important feature to note in Table 18 is that Kasey was being generous with her 50% response. Her initial response when asked what percentage of time she would spend on the visuals was, “Not much.” Eventually she said that if the article was filled with visuals that were engaging to read, she “might go 50%.” Implied in her response is the perspective that very few composition articles would include such visuals, which was also insinuated in Lauren’s response that she would typically only spend 10% of her time reading an article on the visuals.

Meanwhile, Lyann and Natalie both might spend one-third to half of their time reading articles on the visuals. Lyann noted the idea that because the visuals convey pertinent information reading them might take a prolonged period to comprehend. She remarked, “If I were looking at [a visual] like the example I gave you, the percentage would be higher because it's so visually intensive.” Her comment was striking because Mike claimed he spends less time reading the visuals (5%-30%) because, as he argued, “It takes longer to absorb the text.” This discrepancy might have to do with the types of visuals these two participants regularly use and the contexts in which they use them. Roth and Bowen’s examination of the reasons readers have difficulty understanding the data in graphs might clarify; they write that graphs are “multimodal texts that are configured from a number of signs including topological (graphical, pictorial) and typological (mathematical, linguistic) elements....Even relatively simple graphs lend themselves to be perceptually structured in different ways” (“When are Graphs” 431). The same researchers note in a separate study also centered on difficulties of reading graphs that readers’ familiarity with the content displayed in and type of graph also affect their interpretation abilities (“Professionals Read Graphs” 159). Thus, the participants might take more or less time reading visuals depending on the types of visuals most often used in the discipline and how complex the data being conveyed is.
The distinction might also stem from the fact that Mike was talking about visuals occurring in oral presentations rather than scholarly articles. Since he teaches a course on scientific presentation skills, he often makes comments about visuals acting to “feeding the eye.” For instance, he said about creating visuals in oral presentations, “If I have data to present I want to simplify it as much as I can. I want to get away from tables as much as I can. I want to go to graphs or I want to go to drawings or animations, something that's more catchy.” Or, finally, it might correspond to Mike’s comment in the previous section: that each individual has his/her own idiosyncratic method for reading, and some will spend more time on the visuals than others. In fact, Charles Bazerman acknowledges, “The researcher’s own need to carry on research and his or her own understanding of the field clearly shape the reading process,” so it might be that the differences found among the participants are due to the context or content of the document and the participant’s prior experience or knowledge regarding it (237).

On the whole, though, it does seem that articles in biological sciences fields include more visuals than those in composition, but that individual journals, authors, and topics affect the number and complexity of visuals needed. Those factors, plus the individual’s unique reading processes seem to all influence the amount of time the participants spend on the visuals.

**How participants read students’ written and visual communication**

During the interviews, I specifically asked participants whether their process for reading scholarly texts were similar to or different from their reading of student texts. Natalie was the only participant who stated that since she only teaches undergraduates who do not do their own research, their writing does not match the expectations as those of experts. Meanwhile, Brenda, Kasey, and Lauren all claimed that they read students’ texts differently than scholarly texts. Brenda explained that her students do not have the same skills as experts do to convey
information in accordance with the disciplinary conventions, so this lack of experience automatically causes her to read students’ composing differently.

Kasey and Lauren did not mention students’ lack of experience as the reason why they read those texts differently. Instead, they both articulated that students’ texts serve different functions than scholarly texts. Kasey and Lauren noted that the students are completing assignments as a way to learn how to compose, so as teachers, they read with that purpose in mind. Thus, Lauren expanded on this idea, saying, “I always read them with the context of the assignment in my head and kind of the concept of the rubric as well. So I’m very much reading to assess. I don't really process the content.” So for these two instructors, the students’ purposes of creating documents affects the ways they read those texts. In fact, in their study of general education instructors, David R. Russell and Arturo Yañez found that like Kasey and Lauren, “some faculty in some moments separated form from content.” This action might stem out of the often-upheld view that composition instructors are teaching “general writing skills” (Beaufort 10) and that “writing can be independent of content” (Downs and Wardle 554).

Meanwhile, the scientists do not subscribe to this same theory. Mike and Lyann affirmed that they would read graduate students’ writing like that of experts. Lyann expanded on how her approach for reading graduate students’ work is similar to reading a scientific article, saying that her process matches how she previously described reading scholarly articles: that she goes “back and forth” between the visuals and the written text. Unlike her instructor, Lyann does comment on her students’ visuals, especially the clarity of the labeling. She explained that she believes instructors are better about teaching visuals than when she was a student, saying, “we so often use these phylogenies that people do pay more attention to them as far as how they're presented.” Mike also noted that he gives his students feedback on their visuals. So it is clear that at least
from these two particular participants’ perspectives, instruction on visual communication has changed in the biological sciences in the past two decades.

Again, though, distinctions exist between the participants in the two disciplines because those in the biological sciences read student writing as they read experts’ writing, while the composition participants adapt their practices. While some of this distinction is most likely due to the goals of the classes themselves (composition classes being geared toward teaching writing processes) and to the fact that Mike and Lyann’s students are typically upper-level undergraduate and graduate students rather than first-year undergraduates like Kasey and Lauren’s, there is a correlation between the fact that the composition participants spend less time on the visuals in both students’ and experts’ texts than the biological sciences participants. The composition instructors are checking to see if the visuals are used appropriately while the biological sciences instructors are examining more closely if and how clearly the visuals support the message, indicating how important both the visuals and written text are within a document.

6. Addition of visuals to enhance written texts that are lacking

Even though the Addition of visuals to enhance written texts that are lacking topic was unique to composition textbooks for teaching students visual communication practices, it is the biological sciences participants who discuss composing visuals in this way. Unlike the composition textbooks, the biological sciences participants do not identify visuals as somehow subordinate to written text, which also came across in their discussions of teaching this topic in the previous chapter. When asked about her own use of visuals, Lyann commented how visuals can sometimes portray data better than written text, saying, “Frequently you get through a draft of a manuscript, and you need a summary diagram, or it's just not going to be clear. So that's pretty common.” Mike agreed that visuals often enhance the written text by making certain ideas
come across more clearly. He clarified, saying, “It doesn't mean it's a guarantee. You can get confused with figures and photos too but you're highly likely to overrun the buffer of the audience brain with text.” Both of these biological sciences participants highlight instances in which written text cannot display information as well as a visual.

This articulation would match Jay Lemke’s perspective of science communication in “Multiplying Meaning: Visual and Verbal Semiotics in Scientific Text.” In this article, Lemke expands previous semiotics research on the processes of communication to examine how visual and written communication work together in scientific texts. He claims, “The medium of printed scientific texts is first of all a visual one” (95), and supports that argument noting that when communicating, scientists “combine, interconnect, and integrate verbal text with mathematical expressions, quantitative graphs, information tables, abstract diagrams, maps, drawings, photographs and a host of unique specialised visual genres” (88). Lemke’s argument that visuals and written text are interconnected is illustrated by these three biological sciences participants who explain how an audience would not grasp the same take-away messages without visuals enhancing the written text. Alan Gross, in Rhetoric of Science, supports Lemke’s argument, writing that science visuals and text work together “to mobilize all the means of persuasion in the interest of a particular cause…. [Essentially,] tables and figures work together with text to win scientific arguments” (79-80). This particular perspective differs from the manner in which the composition textbooks discuss visuals emphasizing written text. The scientists articulate how written text might be lacking because, as noted in the Literature Review, language is inherently limited in what it can convey. Thus, visuals are necessary components of scholarly texts, especially those in the biological sciences, because visuals summarize complex information in ways that written text cannot.
By examining the interview participants own composing and reading processes, as discussed in these five topical sections, we see that the participants have a variety of methods for reading and composing with visuals, often related to the context and content of the texts as well as the value placed on certain visuals by each discipline. As a result of their own practices working, the participants convey knowledge in their teaching that essentially perpetuates certain knowledge and practices that sometimes corresponds to but at other times conflicts with information presented in textbooks. So we see here instances where members of a field might find their own processes that serve them better than the methods by which the textbooks suggested they work. Thus, analyzing a discipline’s textbooks does not give a complete depiction of the conventions that members of the field need to know in order to successfully communicate. As will soon be discussed, individuals often need to locate their own opportunities for practicing communication in their disciplines because they cannot learn it all in the classroom.

Category 2: Participants’ Concerns of Visual Communication in Current Instructional Practices

Throughout the participants’ interviews, a central theme that has emerged is how important visual communication is to effective scholarship in composition and the biological sciences. This view is demonstrated especially in scientific research, as Luc Pauwels, in *Visual Cultures of Science: Rethinking Representational Practices in Knowledge Building and Science Communication*, argues, “Visual representations are not to be considered mere *add-ons* or ways to popularize a complex reasoning; they are an essential part of scientific discourse” (vii). However, as the participants acknowledge the value of visuals in their professional work, they raised concerns that overall instruction of visual communication in their disciplines is lacking. They agreed that they were not well trained to use visuals, which hindered some of their
communication abilities early in their careers. They also agreed that they have concerns about current teaching instruction, that their students are lacking skills that they ought to have.

An overarching concern of this is that visual communication appears to be considered secondary to written communication. For instance, Brenda, Kasey, and Lauren each noted how the field of composition has traditionally focused on writing, so visuals are not valued in the same way as written text: “Visuals are oftentimes secondary” (Brenda), “the general perception is that writing is more important” (Kasey), and “[visual communication] does not seem to be highly valued” (Lauren). While the composition participants were more vocal about visuals being relegated to a lesser status than writing, the biological sciences participants also made comments about how visuals are not always as valued as written text. For instance, Mike said simply, “[Visuals] don't get the respect they should. That's for sure. And I wish students were thinking more visual [sic] when they were doing the work.”

This overarching perspective that visuals do not get the respect they should in the classroom is at the center of participants’ concerns about visual communication instruction. While the previous chapter discussed how the participants teach visual communication practices and conventions in their own classes, here they discuss two overarching problems they face as they try to teach visual communication in their courses. What they notice is that students do not have strong abilities to read and interpret visuals in textbooks or in scholarly writing, and the textbooks themselves are often lacking strong visuals or discussions of visual communication. The concern then is that if students do not have the skills to understand visuals when they arrive in their college classes and do not have strong visual models in their college-level textbooks, then they might continue to struggle in their academic and professional work reading scholarship and communicating their own research. Thus, two topics will be covered in this section: Student
difficulty reading and interpreting visuals and Textbooks lacking visuals and instruction of visual communication.

7. Student difficulty reading and interpreting visuals

Diana George writes that visual communication is “complicated and sophisticated,” and as such, many of the participants observed their students having difficulty reading and interpreting visuals (15). As several of the science textbooks analyzed in Chapter 4 demonstrate, visuals in a document have to be understood on their own without the aid of the written text, but they also must help to convey the overall message of the document and work in conjunction with the written text. Here, interview participants in both disciplines were concerned that students have difficulty understanding and interpreting the visuals, both on their own and in relation to the document as a whole.

For instance, Lauren commented, “I think [students struggle with] making meaning out of the visual.” Her explanation for this is that students do not spend enough time looking at the visual to fully examine it. Lyann would agree with this observation based on her comment, “What I usually see is that they mostly have read through it without spending the time and the effort to really understand what's there.” What they observe is similar to Christina Haas’s observations of a student moving through her science curriculum whose goals initially were simply “to learn, “to understand,” and “to memorize” the content (59-60). That is the extent to which she, and Lauren’s and Lyann’s students, can understand documents: as static texts, disconnected from authors and a larger scientific context.

In fact, Brenda also suggested that her students often are not familiar with the idea of visuals acting as arguments or communicating complex information. This view hearkens back to the now outdated essentialist view that visuals simply display reality in such a way that the
meaning is obvious. Yet, that perspective seems to linger, because Brenda finds that students have responses of, “‘Well visuals are just there to show something, right?’ Like it's [sic] some sort of representation-on-its-own-that-stands-alone kind of thing or something like that, and it's supposed to be self-evident.” And as previously examined, Mike noted of his own experience that “it takes longer to absorb the text” than it does to absorb visuals, so there does seem to be the perspective that visuals are somehow easy to comprehend, that they should not take much time to read. And because the assumption exists that reading visuals is a quick and easy task, the participants see students misconstruing their abilities of memorizing and interpreting visuals. For instance, Lyann described disagreements she has had with students, saying, “They think they're going to learn better if they have the exact images you show. I keep telling them, ‘You're not. You're going to memorize it, and I'm going to show you something different on the test, and then what are you going to do? I want you to be able to interpret what you're seeing.’”

And participants also noted concern about students’ difficulty finding meaning in the relationship between visuals and written text. Lauren observed that often the trouble students have stems from “just looking at the visual and not examining any of the text that goes with it. [The problem is that they are not] situating the visual within the larger argument or point being made.” Likewise, Lyann interpreted students’ perceptions, saying, “It's like, ‘Oh, this picture is all I need to see.’ And it's like, ‘I got it.’ But they haven't actually gone back and read and done that process of going back and forth between the figures and the text.” And while Charles Bazerman notes that this is typical of novices, saying, “In filling in one’s ignorance, one is likely to read trustingly and uncritically,” the instructors would like to see more critical thinking occurring (245).
The concern about students’ inability to read and interpret visuals stems from the fact that all of the participants recognize the importance of visual communication in their disciplines, especially the biological sciences. They questioned why students do not have these skills when they come to college. For example, Natalie explained that she has given the Test of Scientific Literacy Skills to incoming university students, remarking, “A large portion of that is reading, the ability to read, analyze data that's given in graphical form and tell you what the conclusions should be….And the percentages of getting some of those questions right is starkly frightening. Somewhere around the 30% range.” Lori Lyman Digisi and John B. Willett’s study of high school biology teachers’ use of textbooks speaks to possible responses to this question, as the researchers observed, “instruction tends to focus more on providing students with an additional means of getting the class content than on teaching students the process of how to actually construct new knowledge” (136). Or as Bowen, Wolff-Michael Roth and Michelle K. McGinn found in their research on biology students’ interpretations of graphs, “In the absence of concerns other than to do well in the course, students did not appear to develop any general interpretive skills for graphs, but learned instead to apply the professor’s interpretation” (1020). So perhaps students have not been trained to sufficiently read and interpret visuals or they do not recognize the instructor’s goal of having them think critically in the manner of scientists. Whatever the reason, the interview participants were frustrated by their students’ abilities to adequately read and interpret visuals and expect that this is a skill that students should have when arriving in their college-level classes.

8. Textbooks’ lack of visuals and instruction of visual communication

A second concern the participants have with trying to teach visual communication was that they have trouble finding textbooks that focus on visuals. In fact, five of the six participants
had highly negative things to say about the textbooks they use in their classes (none of which were examined in my textbook analysis) when it comes to the discussions of visuals. The participants had two overarching complaints: That the textbooks lack discussions of how to effectively design, analyze, and interpret visuals, and that the textbooks lack clear and informative visuals. Interestingly, the first of these complaints came from the composition participants and the second came from the biological sciences participants.

The composition participants’ perspectives ranged in intensity from only slightly irritated to incredibly frustrated. Seemingly least concerned, Kasey described using an excerpt from a supplemental text when teaching visuals because the class’s primary textbook doesn’t deal much with visual rhetorical analysis; and she whispered that the supplemental text is also not one that she really likes. Lauren was much more direct in her frustration with the textbook she is using in her classes. When asked what she finds useful about the discussion of visuals in this textbook, she responded:

I was disappointed in it. This is essentially one page in a 300-page textbook. One page. Visual design. There are 3 short paragraphs and then they basically give an example using different kinds of fonts, and that's it. And apparently that is visual design….really it doesn't do much, you know, saying, “Carefully crafted visual elements can help us compose arguments in clear, vivid and compelling ways.” But it doesn't say anything about how to do that or why to do that. It just says, “We have technology and you can choose different fonts.” Completely inadequate.

Here it is clear that Lauren finds the lack of discussion of visual design in her textbook an impediment to her pedagogy since visual design principles are a key component of her teaching.
Brenda is a bit of an outlier when it comes to her views on textbooks because she has the unique position of trying to find resources that bridge rhetoric with scientific communication as an instructor of Biological Communication, a writing course situated in the CAC Program but made up of biological sciences majors. This distinct context is perhaps what made her so outspoken about her irritation of the textbooks she has had the chance to use, saying:

I've hated every textbook I've ever used for teaching [this class]….A lot of the textbooks are really limiting….some of them lack chapters that actually talk about visuals of scientific information themselves….[or for] a lot of them it's reserved for one short chapter on ethics and how you have to be ethical and that's where they cover the visuals that are ethical as well as talking about your science and talking about journalists and all this stuff and they cram it all into one little chapter.

Her difficulty finding a textbook that she likes might result from the fact that she is teaching a course that is spanning across two distinct disciplines that have their own communication conventions and methods for teaching them.

And, in fact, the biological sciences participants were not nearly as frustrated as Brenda and the other composition participants about the use of visuals in their textbooks. For Natalie, her irritation stemmed from the issue that the visuals included in her textbooks are not always especially good at demonstrating the scientific processes that she is teaching her students. For example, she pointed to a visual in a recently published article, noting how that image illustrates a magnesium-binding site. She was thrilled to find this visual because she said, “In textbooks they just make it look like two squiggly lines which literally looks kind of silly.” And more than that, the textbook visual does not clearly represent the step-by-step process the protein goes
through to bind. So Natalie’s concern with textbooks is not directed at the way they teach students about visual communication in the field, but rather about how the visuals display the science that students need to learn. In *Critical Graphicacy*, Wolff-Michael Roth, et al. indicate a reason textbook visuals are not as useful at conveying science as visuals in articles.

In scientific publications, there is a recognizable relationship between “real” data and the theory that is expressed in [visuals]….This interaction between empirical data and relationships of theoretical nature is no longer available to the readers of science textbook. Here, graphs are detached from empirical situations to which they might relate. But textbook authors never make it clear that the featured line graphs are used to express currently accepted models (xvi-xvii)

Mike expanded Natalie’s concern of textbook visuals by projecting that students might have difficulty not only with understanding information but also with communicating their own research effectively with visuals. He commented that students see visuals that are not ideal and that influences their ability to create strong visuals. He argued that if “the diet that [students] get fed is oftentimes not nearly as visual as it needs to be,” then it should not be surprising that they do not always compose well visually too. In fact, Mya Poe, et al. argue that there are several reasons students have trouble considering the use of visuals in scientific arguments, two of which highlight the use of visuals by textbooks:

Science textbooks are filled with accepted visual models of science phenomena. Most of which are plotted using smooth curves with no error bars and a few data points…The collection and analysis of scientific data are presented as methodological choices that are the result of purely scientific best practices, not what methods will yield the kinds of data that most interest a particular scientist
and will persuade readers. [Also,] textbooks on scientific writing focus on the ‘correct’ presentation of tables, bar charts, and line graphs, truncating the process that yielded that visual evidence” (116).

These authors essentially argue that textbooks that include simplified visuals that do not demonstrate the rationale for the choices made about the visuals hinder students’ abilities to consider those choices and then make their own when the time comes.

Thus, the textbooks are frustrating for the participants in two distinct ways: First, they lack visual communication instruction. The participants themselves do not feel abundantly qualified to teach visual communication—the biological sciences participants do not consider themselves artists, and neither the composition nor biological sciences participants noted having significant visual communication instruction themselves from which to draw on to teach their own students.

Second, the textbooks, especially the biological sciences textbooks, do not always present the best visuals to help students learn scientific principles. The participants found this problem to be significant because poor visuals affect their success as teachers, and they limit students’ awareness of the ways in which visuals could present information, which could impact their creation of visuals when they begin doing their own research. And Lyann observed that this issue is pervasive because undergraduates are “not necessarily reading the primary literature, they're going to mostly be reading their textbook.” Hence, there seemed to be an implicit call (or explicit, in Brenda’s case) for textbook authors in both disciplines and in Biological Communications contexts to expand the use of visuals and instruction of visual communication to help instructors better convey disciplinary communication conventions and students better learn those conventions and content.
Conclusions

The results of the participant responses analyzed here indicate that there is a wide range of similarities and differences among the participants’ experiences composing and reading visuals and learning their discipline’s visual communication conventions. Some distinctions lie along disciplinary lines, such as the more general discussions composition participants make about the ways visuals can convey key information or how biological sciences participants note the importance of visuals for teaching course content. Other distinctions seem to stem from more singular elements, whether an individual’s idiosyncrasies, conventions specific to areas of specialization, or the uniqueness of context or content, such as how none of the participants were able to pinpoint one particular strategy or order for reading visuals in scholarly documents. Finally, there were similarities among many of the participants in the manners in which they learned visual communication conventions of their disciplines and the difficulties they have teaching visual communication because of students not having an appropriate foundation for reading visuals and textbooks not providing adequate guidance for both instructor and student on visuals.

Of course, it must be mentioned that these findings are based on research limited by sample size. As mentioned in the previous chapter, the interview participants included here is a very small sampling, from which it is impossible to make completely definitive judgments about how members of the composition and biological sciences fields read and compose visuals and perceive the uses for, difficulties of, and best learning practices of visual communication. The participants also have diverse backgrounds and are situated in different specializations. Hence, at times their comments might be nuanced to their own work rather than concepts that can be generalized across the entire discipline. However, what this analysis does present is the
perspective of six members from two academic disciplines who recognize the significance of visual communication within the work they do in their disciplines. These perspectives help to demonstrate distinctions of visual communication practices across disciplines and also within disciplines. That observation highlights the notion that visual communication practices and expectations might not be universally used and valued, they might also not be used or valued equally among all members and contexts within the same discipline. Hence, visual communication is a useful area of study for understanding if and how student learning might transfer across disciplines.

Another limitation of this interview research is that the analysis is based on memories, observations, and perceptions of individual participants trying to examine and articulate aspects of their discipline that might be tacitly known. As Robert S. Weiss mentions in *Learning from Strangers*, there are several factors that need to be taken into account when interviewing: “we cannot assume we will be told the whole truth nor the precise truth” (148). He explains, “There are some kinds of events that we are unlikely to hear about unless we have established an interviewing relationship in which there is extraordinary trust” and “The vagaries of respondent memory make for reports in which some observations are crystal clear while others are obscured or distorted or blocked” (149). Unlike in the previous chapter, the topics discussed in here cannot be evaluated against their coverage in disciplinary textbooks. Thus, we must allow some room for error; Weiss clarifies how the surroundings of the interview, the language I used as an interviewer, and the distance, both in space and time, that separated the participants’ comments from their work activities could all impact their responses. He writes, “Information is context dependent—that is, shaped in part by the interview situation—when it is free of anchors in observations of events” (149). However, as participants who value visual communication in their
teaching and professional work, what the interview process presents are the participants’ points of view that provide general insight into some of the practices and concerns of members of the biological sciences and composition disciplines.

One significant insight observed from the comments presented in this chapter is the belief that all six participants have that visual communication is an important component of their disciplines’ communication conventions. Situated alongside that observation are those that illustrate the participants’ concerns over the ways they were instructed to use visuals and how they still see significant issues surrounding current students’ learning of and abilities with visual communication. These concerns align with scholars who argue for more awareness, research, and teaching of visual communication practices in both composition and the sciences. While Michael Lynch notes that more research has been done of science visuals over the past few decades, writing, “The increased attention to visual images is part of a more general interest in the detailed contents of scientific texts, discourse, and practices,” more can be done to examine the processes for learning how to convey information in those ways (26). For example, in composition studies, Charles Hill calls for “a pedagogy that combines the visual and the verbal without subordinating either mode of rhetoric to the other” (127). In addition, Jean Trumbo argues, “Examples of visual representations in science communication are abundant, but relatively little attention has been directed toward the challenge of building visual literacy among scientists, communicators, and the public” (280). Hence, all of the participants note the need for visual communication conventions to be explicitly taught so that students and professionals can improve the work they do and the ways in which they communicate knowledge to disciplinary audiences (both expert and novice) and to the public. Plus, these insights provide an opening for
WAC/WID scholars and instructors to begin to gather resources for helping students better transfer their communication learning into other disciplines.

Again, these desires fortify the need for researchers and instructors to continue to observe, reveal, and assert visual communication conventions used and valued in disciplinary contexts. As Ken Hyland explains, “While disciplines are defined by their writing, it is how they write rather than simply what they write that makes the crucial difference between them” (3). And studying those methods for writing, or communicating more broadly, can help students, instructors, and professionals in the disciplines recognize what differentiates their own discipline from others as well as might provide some awareness of practices and conventions that can be transferred and applied in other disciplinary contexts. This call goes out particularly to WAC/WID researchers who might already be examining communication in a variety of disciplines, but might not be extending enough focus to the diverse ways in which visuals work within those disciplines to convey messages.

The next chapter of this dissertation discusses some of the implications of this call and provides practical applications for instructors and researchers, primarily those in composition and WAC/WID, who want to better understand and present disciplinary distinctions of visual communication conventions and practices.
CHAPTER 7
CONCLUSIONS AND IMPLICATIONS

In this chapter, I first explain the implications of this research project, showing how this study answers the research questions posed at the outset. Second, in order to expand disciplinary understanding of these issues and possibilities for enhancing student learning, I make suggestions for expanding awareness of visual communication practices and conventions in biological sciences and composition, specifically WAC/WID fields. Third, I describe the future research opportunities for scholars invested in expanding awareness of visual communication conventions in and across disciplines.

The three research questions that guided this dissertation project are as follows:

1. How do textbooks in the biological sciences and composition disciplines teach visuals?
   a. What terms are used to describe visuals and visual communication?
   b. What topics are covered when instructing the practices and conventions of visual communication?

2. How do disciplinary instructors conceptualize and use visuals in their own work and teach the practices and conventions of visual communication to students?

3. Where are the intersections and disconnects of the practices and conventions of visual communication between the two disciplines?

Using these questions to frame my research, I made preliminary discoveries of how individuals within these disciplines value visual communication, why visuals are used in disciplinary communication, how those values and practices are taught to students, and how current instructional practices in these disciplines support or encumber students’ learning of visual
communication conventions. There are, of course, limitations to my research methods, which are discussed in the Conclusion sections in the three preceding chapters. However, the work in this dissertation invites instructors and researchers in composition and the biological sciences to consider how and why members of these disciplines communicate using visuals and how to be explicit in their instruction of these practices to students entering the field and communicating in this particular disciplinary context for the first time.

**Research Questions Reviewed**

To recognize visual communication conventions and instructional practices in composition and the biological sciences, I analyzed the terms and the topics that were used in a selection of textbooks and were discussed by interview participants. In this section, I overview the distinctions in the ways the textbooks and participants used terms and pedagogical topics within each discipline and across disciplines. I will also outline the distinctions between the participants’ composing and reading processes between the two disciplines. Thus, I will explain what I have discovered in answer to all three of my research questions through these sections.

**Terms Used to Describe Visuals and Visual Communication**

First, I will discuss how textbooks and participants in the biological sciences and composition used visual communication terminology similarly and differently.

Terms Used by Science-writing Textbooks and Biological Sciences Participants

In Chapter 4, I described an analysis of nine composition textbooks and eight science-writing textbooks in which I located eleven terms used to describe visuals and visual communication. Using a grounded theory approach, I examined the tables of contents and indexes of the textbooks to create a list of terms that were found in at least 20% of the textbooks.
It is important to note that nine of these eleven terms were used by science-writing textbooks: “chart(s),” “figure(s),” “graph(s),” “graphic(s),” “illustration(s),” “image(s),” “photograph(s),” “table(s),” and “visual(s).” In Chapter 5, I then compared and contrasted the visual communication terms used in the textbooks and used by six interview participants in 90-minute interviews designed to invite the participants to discuss their methods for composing and reading visuals and consider how those practices influence their own teaching of visual communication practices and conventions. I asked the participants to list the terms they use regularly and then asked them specifically about the list of terms from the textbook research. The three biological sciences participants agreed that they used these nine terms and added the terms “art(ist/work),” “caption/label,” “color,” “diagram,” “(line) drawing(s),” “maps,” “picture,” “poster,” “presentation,” “type(faces)/fonts,” and “visual communication.”

The additional use of terms by the interview participants speaks to the fact that because the textbooks are meant to be used by students across natural sciences disciplines, the discussions of visuals have to be all encompassing; whereas, the participants could and did discuss the visuals used predominantly in the biological sciences discipline. In addition, some of the terms were only used by one of the participants. For instance, Lyann was the only biological sciences participant to discuss “illustrations,” perhaps because of the necessity within plant anatomy to show aspects of a plant or because of her work with the Biological and Premedical Illustration Program on campus. In sum, the visual communication terms found in the textbooks were used by all of the biological sciences participants, though the participants expanded the repertoire of terms and used more precise language to describe visuals because of the specific conventions of their specializations and/or because of certain training and experience.
Terms Used by Composition Textbooks and Participants

Of the eleven terms located in the textbook analysis project, all eleven were used by composition textbooks, including “visual argument(s)” and “visual element(s)/image(s),” the two terms not included in the science-writing textbooks. When asked about terms used in the composition discipline, participants agreed that all eleven of these terms were used, as well as all of the terms included above by the biological sciences participants, plus one more, “document/visual design (principles).” It must be noted that a handful of these terms were used primarily or solely by Brenda, the Biological Communication instructor, such as “maps” and “art(ist/work),” so might not be used as predominantly by general composition instructors.

While the composition participants used a wide range of terms to discuss visual communication, many of these terms were not used regularly. The ones most often used by at least two of the three participants are the terms that are the most general “visual(s),” “graphic(s),” and “image(s)” or ones that describe a type of visual document or element of document design: “poster” and “caption/label.” These findings indicate that both the textbooks and the participants discuss visuals in rather general ways and often do so in order to highlight rhetorical features of that method of communicating.

Significant Distinctions of Terms Used in Composition and the Biological Sciences

On the whole, visual communication terms used in biological sciences classes to discuss visuals is more specific than those used in composition classes, possibly because textbooks and instructors use a variety of visuals to teach students science content. Since different types of visuals present different types of data, members of that discipline would likely use more precise terms, such as “map(s)” and “chart(s).” Whereas, in composition classes, the instructors would more likely discuss visuals from a wide variety of media (television, Internet, billboards,
magazine articles, journal articles, etc.) as objects of a rhetorical analysis. Hence, less exact terms, such as “visual argument(s)” or “image(s),” would be used to describe how images communicate ideas that impact viewers. These rhetorical analysis tasks appear solely in composition contexts, as participants used the term “analysis” to denote a rhetorical analysis. When the biological sciences used “analysis,” they meant “interpretation.”

These two distinctions of participants’ and textbooks’ use of terms also indicate that composition courses are focused on guiding students’ writing processes. They invite students to consider rhetorical choices being made by composers, and visuals fall within that investigation. Instruction in that context is geared toward students considering why a visual might be used, how it is being presented effectively, and perhaps applying those observations to the creation of a visual; however, instruction of visuals in the biological sciences is focused on using a visual to learn a scientific process or relationship or using a visual to organize, interpret, and convey the results of research being performed. In this context, classes are designed to help students learn science content and to recognize how scientific research is performed and conveyed, and visuals are a key component of those two tasks.

**Pedagogical Topics Used to Describe Visuals and Visual Communication**

In this section, I will discuss how textbooks and participants in the biological sciences and composition employ visual communication pedagogical topics similarly and differently.

**Topics Used by Science-writing Textbooks and Biological Sciences Participants**

After creating the list of visual communication terms, I scoured the textbooks to locate where the terms appeared. I then abstracted how the terms were discussed and what pedagogical topics were covered to instruct students about visual communication and the use of visuals in the
discipline. And three of the topics were found to be exclusive to science-writing textbooks: Use of visuals to convey key information, Beginning the process of composing academic documents with visuals, and Understanding how, when, and why the audience reads visuals.

Essentially, these topics indicate that the purpose of using visuals in science writing is correlated to the practices of composing and reading visuals. Matthews and Matthews illustrate this point when they note that visuals “present data in condensed form and help clarify and support ideas, they make writing easier” (56). Because scientific visuals convey key research, readers look to visuals at certain intervals during the reading process to glean information and composers consider the visuals to be useful in the writing process.

I also asked the participants if they made use of the textbooks’ visual communication pedagogical topics in their classes. I showed the participants the list of nine topics, without the markers denoting which discipline’s textbooks included which topics. On the whole, the results from the biological sciences participant interviews largely corresponded to the results from the science-writing textbooks. Only Lyann did not teach students to begin the composing process with visuals, but merely because her students do not perform (and thus communicate) their own research. Hence, based on the analysis of these particular textbooks and the participants’ comments, the instruction of visuals by science-writing textbooks aligns with the instruction of visuals by biological sciences teachers in the classroom.

That being said, the biological sciences participants did note that they include in their teaching a few topics that were exclusive to the composition textbooks: Mike uses storyboarding as a visual invention technique, and Lyann describes how in plant anatomy visuals are often used to enhance scientific articles that otherwise would be lacking important information. So in this sense, the disciplinary divides are not quite as strict as the textbook analysis might suggest.
Topics Used by Composition Textbooks and Participants

Four of the topics examined in the textbook analysis project were found only in the composition textbooks: Use of visuals as invention processes, Creation of visuals as alternatives to written texts, Addition of visuals to enhance written texts that are lacking, and Emphasis on the analysis of visuals. The inclusion of these topics support the NCTE’s recommendation for writing instruction in the 2016 “Professional Knowledge for the Teaching of Writing” statement, which articulates, “Developing writers require support. This support can best come through carefully designed writing instruction oriented toward acquiring new strategies and skills.” These topics emphasize the goal of composition classes to aid students’ thinking and learning about academic writing, preparing them for future composing tasks, specifically visual communication tasks, in a variety of classes.

When showed the list of all nine topics, a few of the results from the participant interviews corresponded to the results from the textbooks: Participants indicated that, like the textbooks, they inform their students of the purposes and ethical uses of visuals, use visuals to enhance written texts, and emphasize the analysis of visuals. On the other hand, instructors did not teach some of the pedagogical topics as indicated by the textbooks. For example, only Kasey used visuals as invention processes, and none of the composition participants taught visuals as alternatives to written texts. It seems that the textbooks offer a wide variety of visual communication activities designed to help students brainstorm ideas and consider a variety of communication approaches. The instructors, however, prioritize what should be taught, and possibly include fewer visual communication activities because they do not coincide with the assigned projects or because the written products are often most valued.

That being said, there were instances in which the composition participants noted that they do discuss How visuals convey key information and How, when, and why the audience
reads visuals, two topics that were exclusive to science-writing textbooks. So while these participants might not have students create visuals in the same manners as the composition textbooks suggest, they do seem to recognize and convey to students a broader awareness of academic uses for visuals.

Significant Distinctions of Topics Used in Composition and the Biological Sciences

Overall the four pedagogical topics discussed in composition textbooks and three pedagogical topics discussed in biological sciences textbooks match the respective disciplines’ instructors’ methods of teaching. Two remaining topics were found in both disciplines’ textbooks: Discussion of the purposes of visuals in written texts and Attention to the ethics of visuals. As with the use of visual terms discussed previously, the composition participants’ use of pedagogical topics tends to be more general than those of the biological sciences participants. When discussing how visuals can convey key information, the composition participants often did not expand on how or what kind of information visuals can convey, stating simply that they can convey information. Only Brenda, because of teaching the Biological Communication course articulated the ways in which visuals in professional documents can tell stories or contribute messages as the biological participants did; though, the fact that the composition participants touched on this topic at all is interesting because the composition textbooks did not offer much, if any, discussion about visuals presenting the main information in scholarly articles.

Largely, the participants’ comments on the pedagogical topics did not appear as well defined as the disciplinary distinctions in the textbooks. The individuality in the interview participants’ responses appeared when communication occurred in a distinct context (as with Brenda teaching a Biological Communication course), about unique content (as with Lyann teaching students to read a pedigree chart), or because of an individual’s idiosyncrasies (as with
Kasey’s interest in classroom prewriting and invention activities). Yet generally, composition participants seemed to be more aware of widespread academic uses for visuals and spend less time on visual prewriting and writing-to-learn tasks, like remixing activities and using visuals as invention tools, that the textbooks suggest. And the biological sciences participants used some writing-process oriented tasks, like using visuals as invention tools and including visuals to enhance the written text, which were not topics covered by the textbooks. On the whole, the results from the textbook and the interview analyses indicated how composition courses tend to be more writing-process oriented and biological sciences classes more science-process oriented.

That being said, the composition textbooks and participants did not articulate much awareness of or instruction about how visuals sometimes work to help composers think through, arrange, and/or display information to meet the audience’s expectations—tasks that are part of the writing process. This observation seems to reinforce the composition participants’ articulations that visuals are not as highly valued as writing in their discipline.

**Topics Describing Participants’ Professional Visual Communication Practices**

Because all disciplines have their own communication conventions and individuals have idiosyncratic ways of working, I specifically asked the interview participants how they use visuals in their own professional writing and reading and how they learned these practices. In this section I will recount the findings from the interview participants’ discussions of composing and reading visuals found in Chapter 6.

Several of the interview participants’ comments discussed the pedagogical topics from the textbook analysis in relation to their own composing and reading practices. For example, all six of the participants consider the purposes of visuals and the ways in which visuals convey key information when they compose and read visuals. Other topics indicated strict disciplinary
distinctions, such as the composition participants who wait until the very end of the composing process to create visuals or the biological sciences participants discussing how visuals are used in the classroom to teach science content. And some topics demonstrate strategies that are completely unique to individuals or the content or context of the article. For example, each participant had their own processes for reading visuals in scholarly documents that sometimes overlapped with others’ practices and at other times did not.

Because there are so many disciplinary distinctions, it is interesting that the participants all agreed that they did not receive much visual communication instruction in their undergraduate-level or graduate-level classes and rarely received instructor feedback on their visuals. They all believed that visual communication is still not emphasized in instructional practices as much as it should be. The biological sciences participants in particular acknowledged how crucial good visuals are to science education and communication. That might be why the biological sciences participants located alternative methods (asking professionals for advice, writing textbooks, or teaching non-experts) to gain experience using visuals.

At the same time, the use of the term “art(ist/work)” illustrated that the biological sciences participants did not consider themselves to be artists, even though they regularly create visuals to convey their research. This perception seems to be a stumbling block for them; they believe that as a result of these feelings their own teachers felt unqualified to teach visuals, which is why they rarely got feedback on visuals in their coursework. And the participants themselves do not ask their students to create visuals very often either.

Likewise, the composition participants believed that visuals are often considered a secondary mode of communication to writing. According to the participants, visuals are discussed more generally in composition than in the biological sciences, and visuals are created...
late in the composing process in composition, unlike in the biological sciences. The composition participants noted that they, like the biological sciences participants, have to locate supplemental resources to teach visuals the way they deem appropriate, but their instruction is centered on design aspects of the visual while the biological sciences instructors look for visuals with enhanced displays of scientific content. Participants from both disciplines recognized that these issues are discipline-wide, that not enough research is being done on visual communication to help them consider how to use visuals in their own work (composition) and in their teaching (composition and the biological sciences).

In fact, participants in both disciplines noted two main concerns about current instruction practices. They found that students often have difficulty reading and interpreting visuals and that textbooks often do not present the best visuals for communicating necessary information. These concerns are important because they demonstrate the need for more research and instructional support for visual communication in both disciplines so that students will be better prepared as they integrate themselves into the fields. They will be expected to work with data and communicate their ideas in manners that are effective for the context and content and that will be accepted by their audiences. Yet, currently the participants worry that students are not getting enough preparation for those types of visual communication practices in the classroom.

Those observations bring us to the next section of this chapter, in which I will outline some suggestions for members of these disciplines to expand their understanding of their discipline’s and others’ visual communication conventions and practices.

**Suggestions for Instructors, Programs, and Researchers**

Throughout this dissertation, I have identified how examining the visual communication terms and topics used by textbooks and instructors located similarities and differences of visual
communication practices and conventions in the composition and biological sciences disciplines. These sources indicated that visuals help composers invent, organize, convey, and clarify ideas. In addition, visuals invite readers to interact with a document, summarize key points, and teach students important scientific content. And yet, according to the interview participants from both disciplines, visual communication instruction is often lacking: As students they were not often encouraged to use visuals or given feedback on the visuals they did use, and they currently notice students having a variety of difficulties reading and interpreting visuals. In sum, visual communication is an integral component of these two disciplines, but expanded research into these visual communication issues might help members of the disciplines more consciously participate in and instruct others of the visual communication conventions and practices.

In particular, WAC/WID researchers and instructors often examine the communication practices of various disciplines in order to help guide students’ awareness of the conventions of different disciplinary genres and contexts. Since the textbooks and interview analyses have indicated the importance of visuals to the composition and biological sciences disciplines, these scholars might be interested in learning more about the manners in which visual communication is used in reading and composing across disciplines.

I should mention that I am not arguing that composition teachers should learn to use visuals like scientists or to teach students how to compose within the conventions of another discipline; those are not the goals of composition or WAC/WID courses. However, conversations with students about disciplinary conventions and practices could still occur. Since composition textbooks and instructors often discuss the purposes of using visuals in composing and the rhetorical analysis of visuals, a discussion of the boundaries of visual communication in
composition and the similarities and differences between the conventions of that discipline and others like the biological sciences might aid students’ transfer of learning.

This discipline-specific information about visual communication may be important for biological sciences and general composition researchers and instructors also. The participants’ concerns laid out in Chapter 6 in particular indicate why expanded research and instruction on visual communication by members of these disciplines is useful: They observed that students have difficulty reading and interpreting visuals, and they find that textbooks often lack strong visual displays as well as instruction about the discipline’s communication conventions. These concerns impact the instructors’ perceptions of their teaching skills and of their students’ motivations and abilities to learn. The concerns also suggest that students might have difficulties using visuals in their own research activities in the future. Therefore, more explicit discussion in classes by textbooks and instructors might help students become more aware of how the social and historical influences of a discipline inform the visual communication conventions and practices therein and that they can analyze those conventions and practices to be better prepared when they approach new communication genres and contexts.

To help expand disciplinary awareness and possibilities for enhancing student learning, I ask that we consider what instructors, programs, and researchers in biological sciences and composition can do to better work with visual communication practices and conventions. While the following suggestions are not exhaustive, they are an appropriate place to begin.

**Classroom-level Recommendations**

During the interviews, two of the participants quoted the adage “A picture’s worth a thousand words,” and Natalie commented, “It’s probably more like two thousand in science.” Perhaps the most important consideration in addressing the use of visuals in a discipline is for its
members to be aware of the importance of and uses for visual communication in the discipline. So often experts make unconscious actions based on tacit knowledge of the discipline’s expectations and communication conventions, but students just entering a discipline do not yet have the awareness of those expectations and conventions so might not be certain when and why particular actions are taken. Hence, inviting instructors to consciously examine their disciplines’ visual communication conventions might be useful for expanding instructional practices to better integrate visual communication into classroom curricula.

Here I offer suggestions that focus on the classroom and the instructor. These ideas build upon other best practices that may already be in use in the biological sciences or composition classroom. It is important to note, however, that because individuals’ skills and practices of working with visuals differ and specializations within a discipline might value visual communication in unique ways, what may work in one classroom or for one instructor may not work in another classroom or for another instructor.

**Identify visual communication terms and conventions**

Reflective activities might help instructors consider the visual communication practices and conventions that would best help students’ learning. Interviews or surveys with questions like those asked in this interview project (e.g.: What visual communication terms are used in your discipline? When you create a scholarly document in your discipline, what is your composing process? Where do visuals fall within that process?) could be used as a starting point for drawing attention to the processes the instructors use when communicating with visuals. And documenting reading and composing activities for a brief period of time might help make individual instructors more conscious of their visual communication processes. Keeping a repository of effective visuals, research being done currently on visual communication in the
discipline, etc. could also help to remind and reinforce conventional methods of communicating with visuals. Asking individual instructors to reflect on disciplinary conventions in these ways may be useful at the classroom level to expand methods for discussing the ways visuals are used effectively in the discipline.

While it is important for instructors to consider their discipline’s visual communication conventions, a goal in the classroom is for students to learn how to meet those communication expectations. Thus, activities can be designed to help students actively discover the conventions, practices, and rationale for the use of visuals in composition and biological sciences communication. Like instructors, students might be asked to reflect on the communication skills they have and the contexts in which they have communicated. Students could also be asked to examine how various professionals have used visuals in textbooks and professional documents. The aims of such tasks include heightening students’ awareness of disciplinary conventions of visual communication to approach working within those conventions.

Activities like these put the onus of learning on the students; while the instructors can guide students’ awareness of these practices and conventions, the students can make their own observations to advance their individual knowledge and skills. And for instructors interested in guiding students’ awareness of disciplinary conventions and/or abilities to transfer their learning from a composition course into other disciplines’ classes, similar activities could be designed for students to examine similarities and differences among disciplines’ practices and conventions. Activities ranging from a brief compare/contrast assignment studying the ways visuals appear in composition and biological sciences articles to an in-depth analysis of common topics found in two or more disciplines’ textbooks would likely heighten students’ awareness of the conventions of visual communication in composition but also in other discipline. These activities could also
be broadened to examine a wider variety of communication expectations and practices as well, including those in STEM and Social Sciences fields.

The benefits of WAC/WID classroom activities like these are that they do not require a composition instructor to be an expert at science communication, nor do they expect students to become experts themselves or even attempt composing within another discipline’s conventions. Instead, they give students the opportunity to gain a rhetorical understanding of the purposes for conventions in composition as well as to help them build bridges for transferring visual communication knowledge across disciplinary contexts.

Select textbooks that focus on visuals

While there are dozens of composition and biological sciences textbooks in circulation, not all of them offer clear instruction of visual communication or even use effective visuals to convey disciplinary content. Brenda and other interview participants commented on textbooks that they disliked in part because of the lack of visual communication emphases. Since textbooks aid students as they acquire “an understanding of the field,” instructors might consider the textbooks’ manner for instructing the use of visuals when reviewing and selecting textbooks for their classes (Hyland 106). This process might also guide individuals’ search for supplemental texts that support visual communication instruction. In addition, comparing the terms used to describe visuals in the textbooks and supplemental texts to the terms they use might also invite discussions of the terms and the way(s) they are used in certain disciplinary contexts.

Provide feedback on visuals

None of the participants interviewed remembered instances where they were given useful feedback on visuals they created to convey their research. However, several of them noted that they do provide that type of feedback on their students’ visuals. Clearly they find this aspect of
instruction to be useful, especially for graduate students seeking to publish their work. So offering comments that are more useful than the comment Lyann received of “Oh yeah, you take good pictures” might help students better consider how best to present their data visually. Though it seems that just as instructors need training on how to provide constructive critiques on student writing, it is also needed to guide feedback practices of visuals. These sorts of faculty development opportunities will be discussed later in this chapter.

Consider backward-reaching and forward-reaching transfer of visual communication

During the interviews, I asked participants whether they discussed with students how they might apply previously learned knowledge or skills in their composition and biological sciences classes, or if they discuss how the knowledge or skills that students learn in these classes might be useful to them in future contexts. All six participants replied that they do the latter of these tasks. Evidently the participants recognize the value of considering what David N. Perkins and Gavriel Salomon term “forward-reaching transfer,” in which “one learns something and abstracts it in preparation for applications elsewhere” (26). The participants imply that explaining to students that they will likely draw on the skills taught in these particular classes helps to justify course content and motivate students to learn that content.

However, Perkins and Salomon argue that “backward-reaching transfer” is as important as forward-reaching transfer. They define it as an instance when “one finds oneself in a problem situation, abstracts key characteristics from the situation, and reaches backward into one’s experience for matches” (26). Only Brenda described asking students to consider their previous learning in relation to topics covered in her course. By explicitly helping students draw on previous experience, Perkins and Salomon predict that students will be more successful about the choices they make when composing in new situations. Doing so potentially limits occurrences of
“negative” transfer, when students draw on past experiences that do not effectively assist current communication situations. Being more conscious of the ways students could bring previous visual communication knowledge with them into current classes might impact the decisions they make and enhance the effectiveness of their communication practices.

Doing so might also help instructors understand how students interact with visuals in previous classes. Since the participants noted students’ difficulty reading and interpreting visuals, finding methods for helping students draw on those experiences might also enhance their reading and interpretation skills in these classes. This investigation might point researchers to the sources of students’ difficulty reading and interpreting visuals so as to expand their instruction of visual communication topics or work to make disciplinary changes to textbooks or curricula.

Similarly, for instructors, these activities perhaps offer a chance for more reflection on the conventions and expectations of visual communication in the composition discipline. In so doing, composition instructors might be better able to explicitly articulate the purposes and expectations of visual communication in the discipline so as to help students understand how they too can decipher the contexts, purposes, audiences, and field-specific processes of reading and creating visuals in the discipline as well as in other communication situations.

**Programmatic/Departmental/Disciplinary-level Recommendations**

These suggestions consider the context of visual communication beyond that of an individual classroom. Rather than focusing on specific actions that instructors can take, these recommendations affect the program, department, or discipline as a whole. While instructors can certainly be involved in these possible solutions, such as reflecting on their discipline’s visual communication conventions and their personal practices for composing and reading visuals, the general aim of these ideas is larger than one individual classroom.
Unified Awareness of Visual Communication Practices and Conventions

Just as individual instructors can take steps to become more aware of their discipline’s visual communication practices and conventions, programs, departments, and disciplinary professional associations can document these practices and conventions to present them in a widespread, unified manner. Organizations like the National Council of Teachers of English (NCTE), which “is devoted to improving the teaching and learning of English and the language arts at all levels of education,” (“Mission Statement”) and the National Association of Biology Teachers (NABT), which “empowers educators to provide the best possible biology and life science education for all students,” often provide documentation to support programs and instructors in teaching and researching (“Our Mission”). The NCTE in particular has created and housed a variety of Position Statements on Writing that guide the creation of curricula in writing programs and classes. Further documentation like these position statements focused on the individual discipline’s conventions and best practices of visual communication could perhaps be useful tools for creating more unified disciplinary awareness of using visuals effectively.

Individual programs or departments might also find value in creating their own documents. Most programs have documented the outcomes and objectives for their curricula, so having members of the program review these documents might be of use to locate gaps in expectations for visual communication. Using reflective activities to compile instructors’ practices for using visuals and methods for teaching visual communication could be a starting point for creating such documents. Also creating a programmatic repository for instructional resources and examples of visual communication best practices and/or a glossary of visual communication terms used within the discipline would be options for explicitly demonstrating the discipline’s visual communication values and aid instructors as they teach those practices.
Managing discussions with and resources for faculty about these topics could lead to unified perspectives on disciplinary visual communication practices and conventions.

Again, these ideas are also useful for WAC/WID classroom contexts. Discussions with faculty across disciplines, research to find examples of best practices of communicating visually, and teaching those practices in various disciplines can help to inform members of these programs of the types of communication conventions valued across academic disciplines. Repositories and glossaries could be created to help instructors, researchers, and students recognize similarities and differences of communicating in various disciplinary contexts and how visuals are used both on their own and in tandem with other modes of communication.

Faculty Development Opportunities

Often a hurdle for instructors wanting to adapt their pedagogy is lack of training in the desired topic. Instructors sometimes feel unprepared to teach visual communication. Cynthia Selfe reinforces this notion, explaining that few teachers “feel as comfortable in approaching a visual text unless they have some training in art or design” (71). And yet that is not a strong enough argument for programs to ignore visual communication instruction. Because every instructor has his/her own abilities and expertise, members of a program must come together to investigate the individual needs of their program to determine what types of faculty development opportunities are needed and who in their program already has certain skills or expertise. Investigations could include problems and techniques instructors have with teaching visual communication, problems or abilities students have with using visuals, and opportunities available in the institutional setting to expand visual communication instruction in the classroom.

As previously mentioned, the interview participants in this dissertation project identified that some of their own instructors did not provide critical feedback on visuals in their research
projects; thus, offering training on giving meaningful feedback on visuals might be useful. Similarly, Brenda notes some students “have only ever used Word and Power Point and Excel and that's about the gist of their experience.” These comments about students’ limited technological skills could likely be applied to instructors as well. Selfe agrees, noting that many technologies remain “relatively difficult to access and learn” (71). Hence, occasions for instructional development might be devoted to helping familiarize instructors with useful visual communication technologies and approaches for teaching those in the classroom.

In particular to biological sciences curricula, instructors might consider expanding chances for undergraduate research. Laursen, et al. in “Undergraduate Research in Science: Not Just for Scientists Anymore” note in their rationale for encouraging more undergraduate research projects that in 2002, “one-fifth of science and engineering students at research universities engage in [undergraduate research]” (56). In Undergraduate Research in the Sciences: Engaging Students in Real Science several of these same researchers found that according to a survey managed by the American Society for Biochemistry and Molecular Biology in 2008, “Although faculty placed a high value on ‘undergraduate research and integrative thinking’ (p. 3)...fully 80% of their classes, at all levels, emphasized lecture” (9). Based on studies like these, the President’s Council of Advisors on Science and Technology (PCAST) compiled a report in 2012 with suggestions to entice students to and retain them in STEM majors. One of their four recommendations is to replace “standard laboratory courses with discovery-based research courses” (iv). The advisory council argues, “Traditional introductory laboratory courses generally do not capture the creativity of STEM disciplines. They often involve repeating classical experiments to reproduce known results, rather than engaging students in experiments with the possibility of true discovery” (iv). Since Natalie made clear that her students do not
create visuals because they do not conduct their own research, the arguments for opportunities for undergraduate research could include the fact that students would also gain exposure to communicating as a disciplinary member using all modes of communication, including visual.

Textbook Creation and Selection

As previously mentioned, not all composition and biological sciences textbooks focus a great deal of attention on visual communication practices and conventions. To enhance visual communication instruction, programs might include visual communication as a criterion for selecting textbooks. Seeking textbooks that value visuals in these ways might also help to move the textbook publishers to invest more resources into textbooks containing expanded visual communication discussions. Similarly, current textbook authors might consider more closely their discipline’s visual communication conventions and practices. Discussions of visuals could appear in sections beyond those dealing with rhetorical analysis and ethical practices. As Brenda noted about visual communication, “The [textbook authors] cram it all into one little chapter,” so considering visuals more widely throughout textbooks to illustrate how they can be used for creating, displaying, and organizing arguments, as well as how to do those things persuasively and ethically might be valuable. Additionally, WAC/WID textbook authors who are displaying writing communication distinctions across disciplines might also consider how visuals appear both within the composing processes often used in the discipline and as components of the finalized documents. The integration of visuals in these ways may help inform students that visuals are sometimes essential components to disciplinary thinking, practice, and communication.

Likewise, individuals and programs doing innovative visual communication instruction might look for occasions to craft their own textbooks or supplemental teaching materials that
convey discipline-specific visual communication conventions and/or help instructors expand their teaching of visual communication practices. As Hyland explains, “Textbooks do not only represent the knowledge and methods of a discipline but, for many students, also provide a model of literacy practices, how the discipline states what it knows” (105). Hence, if authors who are more conscious of drawing on visual communication language and conventions begin to create textbooks, likely the awareness of these literacy and communication practices can be expanded for these novice members of the discipline.

WAC/WID Opportunities

For programs that value instruction that introduces students to a variety of academic communication contexts and skills, more conversations with faculty across disciplines might help uncover conventions and practices and the rationale for them. These conversations are particularly overdue when it comes to visual communication. It seems from the participants’ comments that visual communication is often neglected in conversations about communication practices even though participants in both disciplines articulated the significance of visuals in disciplinary communication.

Discussions like these might lead to the creation of institutional or discipline-wide resources for WAC/WID instruction. Glossaries like the one created by Appalachian State University’s WAC Program could be published on program, department, or institution websites as resources for both students and instructors. Documents that detail practices of, conventions of, and tips for communicating with writing and visuals in a specific discipline could be created and disseminated to instructors and students. Additional repositories of disciplinary resources as well as assignments inviting students to research disciplinary communication conventions could perhaps be maintained by programs to help WAC/WID instructors to feel confident teaching and
guiding students’ cross-disciplinary communication learning while not having to be experts in communication practices of all disciplines. And, finally, faculty development workshops that focus on visual communication would possibly help instructors consider how to help students better meet the outcomes of the courses.

**Biological Communication courses**

In addition to opportunities for general WAC/WID courses, considerations for Biological Communication, a specific WID course discussed through this dissertation, might also be worth considering for programs looking to expand communication instruction into the sciences. An in-depth study of the Biological Communication course is necessary to determine if students who take it demonstrate greater awareness of biological sciences communication conventions and stronger communication skills. However, it is clear from Brenda’s perspective that the students had more interaction with rhetorically analyzing types of science communication in order to recognize the moves scientists make to convey their research. Along with that, the students were asked to compare their own composing and composing processes to those of the scientists whose work they read. They spent time considering how to create “written texts, visual texts, their own ethos, their own way of representing their science, and…finding their voice…to tell the world why their science matters” (Brenda).

This class, as Brenda taught it, bridged many of the goals of composition and biological sciences classes by being both writing-process and science-process oriented. As mentioned, one of the recommendations from PCAST is that students have chances for doing their own research. One rationale for this recommendation is that by generating their own knowledge in this way, students are more likely to “identify as a scientist” (25). And this desire for students to identify as scientists and to feel confident presenting themselves as professionals were some of Brenda’s
foremost objectives for her course. She asked students to consider their goals for communicating science, saying, “Students tend to think about it in terms of, ‘Oh, I have to dumb it down for my audience’... It's not dumbing it down, it's helping, you're job as the author or the writer or the speaker or whatever is to help guide your audience.... You have to do the cognitive work to help them understand things to show why your work is important.” And through that sort of work, she guided them to understand why they are expected to do certain types of work:

They don't understand necessarily, “Well, I'm just going to be a veterinarian and I know that I need to be able to pass these classes, like pass Mol[ecular] Bio[logy] and pass O[rganic] Chem[istry] and stuff like that, but I'm not actually going to have to use those when I'm practicing as a veterinarian.” Which is absolutely true. They're not going to be performing organic chemistry experiments or molecular biology experiments, but then they have to be able to still read those articles or talk to people who have that expertise when things come up or know what's changing in their field. So I think that's why helping them read or see scientific research in a way that isn't so intimidating [is important].

Of all the participants, Brenda had the most concrete information to share about how she integrated the instruction of visuals into her classes. She mentioned having conversations with her students about how to integrate and cite visuals from others’ work in their own documents; how to be critical of font, color, and graphics choices; how to use grids for designing scientific posters; and why one should balance the visuals and written text and ensure a clear relationship. Brenda had the abilities and confidence to teach these topics to biological sciences students because of her educational background in biology and the fact that she kept up with science research, reading articles and other science communication for her own edification. Since most
faculty in composition and CAC programs come out of rhetoric and composition, professional communication, literature, or other humanities fields, few would likely feel as confident and knowledgeable as Brenda. Thus, if courses like this are to be offered by writing departments, instructor training and resource repositories might be beneficial for ensuring success.

**For Further Research**

I have mentioned a variety of opportunities for instructors and programs to advance their awareness of and instruction for their own and other disciplines’ visual communication conventions and practices, and these investigations can also be addressed in scholarship to expand awareness and practical instructional practices more broadly. Instructors and researchers working to enhance understanding of visual communication conventions within or across disciplines can publish and present their findings. Classroom activities, assignments and instructional resources for teaching visual communication could be compiled and published as textbooks or supplemental teaching texts. Faculty training best practices can be disseminated through workshops and presentations at national conferences. Based on the results from the textbook and interview analyses in this dissertation, additional research into communication conventions and practices, especially visual communication, would perhaps enhance instructional practices for guiding students’ understanding of effective disciplinary communication in composition and beyond. While having those resources available at the instructor and programmatic levels does expand visual communication awareness at local levels, an efficient way to garner greater understanding of the conventions and practices of visual communication and to find instances of transfer would be for research to continue to disseminate ideas to a widespread audience of instructors and programs.
For instance, the research performed in this dissertation project open doors for future research to be done on other modes of communication within various disciplines and on visual communication conventions in disciplines beyond composition and the biological sciences. The practices of analyzing textbooks and interviewing instructors provides insight into the ways in which communication occurs within disciplinary contexts and is disseminated to students. As Hyland argues, students are sometimes burdened with the “lack [of] the vocabulary and analytical skills to distinguish heterogeneity of the discourses and practices typical of the different disciplinary cultures they encounter” (147). Thus, extending the awareness of and disciplinary visual communication practices can guide both students’ and instructors’ abilities to evaluate effective communication and, in turn, to communicate effectively. Students might also be more attuned to alternative methods of composing than simply those valued by the composition discipline, perhaps enhancing their abilities to transfer their learning to new contexts.

Also, part of my original research plan was to interview each of the composition participants with a participant from the biological sciences. These discourse-based interviews built upon Yves’s crossed autoconfrontation methodology (what I called “crossed self-reflection”) described in “Clinic of Activity.” This process called for a 60-minute interview in which two participants from different disciplines were partnered together to review the documents both participants submitted and clips from the initial 90-minute interviews to discuss similarities and differences in visual communication terminology and reading, composing, and teaching practices. This crossed self-reflection process allowed participants to use language not just as “a means of explaining what he or she does or sees, [but it] becomes a means of action, of bringing somebody else to think, to feel, and to act also according to his or her own perspective”
(Kostulski, qtd. in Clot). The juxtaposition of the two participants’ processes created the opportunity for analyzing agreements, disagreements, hesitations, and/or surprise at the other’s ways of operating within and perceiving their discipline’s visual communication conventions. That research is still necessary in order to discover, at least at the basic level, the types of communication valued by one discipline or specializations within one discipline, and which might be valued more universally to help researchers study of the transfer of learning. This awareness might then aid instructional practices so that students are better prepared to communicate effectively as they move across disciplines and move toward expertise in a particular discipline.

**Conclusion**

The major findings in this dissertation project indicate that there are similarities and differences in visual communication practices between the composition and biological sciences fields. The key differences are demonstrated in the professional practices by the interview participants and in the topics covered within disciplinary instruction. For instance, because of the types of data being employed in the two fields, the biological sciences participants typically use visuals much earlier in their composing processes than the composition participants do. Because of the content of the classes offered in these two disciplines, composition participants and textbooks tend to describe visuals in a much more general way than the biological sciences participants and science-writing textbooks do. Related to these observations, that data in composition is often discursive rather than numerical and visuals are not necessary to organizing and conveying main ideas as in the natural sciences, stems the notion that the composition discipline as a whole views visuals as secondary to written communication. While many scholars and instructors disagree with that notion, adapting the instruction and professional practices of
the discipline is a slow process. And even in the biological sciences the participants acknowledge the importance of visuals to science communication but often find the instructional practices of visual communication lacking.

What might be surprising to note is that the key similarities noted in this dissertation center around instructional goals and practices. Instructors and textbooks acknowledge some pedagogical topics that are covered in both disciplines. While not all topics are covered equally in both disciplines’ classrooms, the concern for visual communication instruction exists in both contexts. The textbooks indicate that visuals are at least somewhat important, noting the purposes for and ethical practices of using visuals. And the six instructors all noted that visuals are a crucial component of effective communication; they have the desire for students to read and/or create visuals in meaningful ways.

They also all mentioned gaps in their own learning when it came to visual communication and have endeavored to provide more guidance to their own students. They worry that students do not have the literacy skills to read and interpret visuals and question whether the textbooks’ use of visuals inhibit students’ creativity and ability to create long-lasting and significant visuals of their own. In sum, the research presented in this dissertation only begins to fill the gap of learning about cross-disciplinary visual communication knowledge. Continued research of visual communication disciplinary conventions and practices and expanded tools for teaching students to use visuals can help position visual communication as a fully recognized component of learning, teaching, and communicating in these two disciplines and perhaps beyond.
Works Cited


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## APPENDIX A

**IRB APPROVAL FORM**

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**IOWA STATE UNIVERSITY**

**OF SCIENCE AND TECHNOLOGY**

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**Institutional Review Board**
**Office for Responsible Research**
**Vice President for Research**
1138 Pearson Hall
Ames, Iowa 50011-2167
515-294-4566
FAX 515-294-2287

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**Date:** 6/15/2015

**To:** Erin Zimmerman
451 Ross Hall

**CC:** Dr. David R. Russell
203 Ross Hall

**From:** Office for Responsible Research

**Title:** Examining Instructors Teaching Visual Communication: Composition and Biology

**IRB ID:** 15-339

**Approval Date:** 6/12/2015

**Date for Continuing Review:** 6/1/2017

**Submission Type:** New

**Review Type:** Full Committee

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The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- Use only the approved study materials in your research, including the recruitment materials and informed consent documents that have the IRB approval stamp.
- Retain signed informed consent documents for 3 years after the close of the study, when documented consent is required.
- Obtain IRB approval prior to implementing any changes to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.
- Immediately inform the IRB of (1) all serious and/or unexpected adverse experiences involving risks to subjects or others; and (2) any other unanticipated problems involving risks to subjects or others.
- Stop all research activity if IRB approval lapses, unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.
- Complete a new continuing review form at least three to four weeks prior to the date for continuing review as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. Approval from other entities may also be needed. For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. IRB approval in no way implies or guarantees that permission from these other entities will be granted.

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.
APPENDIX B

INFORMED CONSENT FORM – FALL 2016

This form describes a research project. It has information to help you decide whether or not you wish to participate. Research studies include only people who choose to take part—your participation is completely voluntary. Please discuss any questions you have about the study or about this form with the project staff before deciding to participate.

Who is conducting this study?
This study is being conducted by Erin Zimmerman as dissertation research.

Why am I invited to participate in this study?
You are being asked to take part in this study because you are an experienced biology, biological communication, or composition instructor at Iowa State University who is committed to student learning.

What is the purpose of this study?
The purpose of this study is to examine disciplinary conventions of reading, composing, and teaching visual communication skills in biology and composition. Interviews of composition, biological communication, and biology instructors seek to find the ways individuals within these disciplinary communities use and teach visual communication skills, essentially bringing more awareness to the ways individuals communicate and are taught how to communicate in these disciplines.

What will I be asked to do?
If you agree to participate, you will be asked to complete the following tasks over the course of approximately three weeks:

1. You will provide me with the following documents. 1) One of your classroom assignments or activities that features visual communication; 2) A textbook/resource excerpt that you use to teach visual communication; 3) A scholarly article that you think exemplifies good visual communication conventions in your discipline. Excerpts, and possibly the entireties, of these documents will appear in the published dissertation (with your names removed) unless you request that they not be.

2. You will participate in a 90-minute video-recorded interview about how you use visuals in your research and teach them to your students. We will specifically talk about visual communication terminology and discuss the 3 documents you gave me.

3. You will participate in a 1-hour video-recorded interview with me and a participant from another discipline (someone from biology will be paired with someone from composition or biological communication). During this time you will view and discuss the 3 documents you both submitted and clips of the individual interviews selected by me that highlight similarities or differences.

4. Within 72 hours of the partnered interview, you will audio record responses to a follow-up questionnaire, lasting approximately 30-minutes, that will ask you to reflect on the experience and material covered in the partnered interview.

You will also be given the opportunity to read parts of the pre-published manuscript in order to correct any misinterpretations or add missing information to my written results.
What are the possible risks or discomforts and benefits of my participation?

Risks or Discomforts—There are no foreseeable risks or discomforts related to your participation in this research.

Benefits—You may not receive any direct benefit from taking part in this study, though taking time to discuss your discipline’s visual communication conventions might aid your teaching practices. Also, the goal of this research is to advance visual communication knowledge within the fields of composition and biology.

How will the information I provide be used?
The information you provide will be published in a dissertation, with the goal that better understanding of disciplinary conventions and expectations of visual communication can enhance the teaching of reading and composing in composition and biology.

What measures will be taken to ensure the confidentiality of the data or to protect my privacy?
Records identifying participants will be kept confidential to the extent allowed by applicable laws and regulations. Records will not be made publicly available. However, you will meet with another study participant in person and view some of each other’s recorded comments made during the initial interviews of the study.

To ensure confidentiality to the extent permitted by law, the following measures will be taken:

1. All electronic materials will be safely stored in CyBox, a highly secure online storage system that provides robust security for Sensitive Identifiable Human Subject Research.
2. All recordings will be immediately uploaded to CyBox and erased from recording devices.
3. All names of participants will be changed in all published versions of the research.

Also, federal government regulatory agencies, auditing departments of Iowa State University, and the ISU IRB may inspect and/or copy study records for quality assurance and analysis. These records may contain private information.

All participants’ names will be changed in publication materials; however, in the publication of the manuscript, stills of the video recordings may be used to illustrate gestures used when discussing visual communication. In these instances it might be impossible to disguise your identity.

Please initial to confirm if you agree to the use of your still video image in publications or research presentations and that you understand that you might be identifiable in these images.

Will I incur any costs from participating or will I be compensated?
You will not have any costs from nor be compensated for participating in this study.

What are my rights as a human research participant?
Participating in this study is completely voluntary. You may choose not to take part in the study or to stop participating at any time, for any reason, without penalty or negative consequences. You may refuse to answer any questions. Your choice to participate or not will have no impact on you as an employee. You will not be paired with someone who has any sort of evaluative position over you.

If you have any questions about the rights of research subjects or research-related injury, please contact the IRB Administrator, (515) 294-4566, IRB@iastate.edu, or Director, (515) 294-3115, Office for Responsible Research, 1138 Pearson Hall, Iowa State University, Ames, Iowa 50011.
Whom can I call if I have questions about the study?
You are encouraged to ask questions at any time during this study. To do so, please contact Erin Zimmerman, ebzimmer@iastate.edu or her major professor, Dr. David Russell, drussel@iastate.edu

Consent and Authorization Provisions
Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will also receive a copy of the written informed consent.

Participant’s Name (printed) ____________________________________________________________

_________________________________  __________________________________________
Participant’s Signature                        Date
APPENDIX C

INTERVIEW QUESTIONS

Disciplinary background
1. What is your disciplinary background?
2. How long have you been teaching in your discipline, and what courses do you teach?
3. How did you learn your discipline’s communication conventions?
4. How is visual communication valued similarly to/differently from written communication in your discipline?
5. What stands out about the ways you were taught the practices and expectations of visual communication in your discipline?

Visual communication terminology
6. What visual communication terms are used in your discipline?
7. How do you define each of these terms? In what ways do you use them?
8. I am going to show you the most-used key terms that I found in my own research of composition and science-writing textbooks. Aside from the terms you mentioned, are any of these used regularly in your discipline? Rarely/never used in your discipline? In what ways are they used?
9. How would you define them?

Composing visual communication in disciplinary documents
10. What are 2-3 key expectations or conventions of visual communication that someone composing a scholarly document in your discipline should know to do it successfully? Feel free to use the scholarly article that you provided to illustrate these elements.
11. When students try to do this and go wrong, how do they typically go wrong?
12. When you create a scholarly document in your discipline, what is your composing process, and where do visuals fall within that process?
13. What percentage of time do you spend on the visuals (versus the written text) when you compose a scholarly document in your discipline?

Reading visual communication in disciplinary documents
14. What are 2-3 key expectations or conventions of visual communication that someone reading a scholarly document in your discipline typically follows?
15. When students try to do this and go wrong, how do they typically go wrong?
16. When you read a scholarly document in your discipline, what is your reading process, and where do visuals fall within that process? Feel free to use the scholarly article that you provided to demonstrate this process.
17. What percentage of time do you spend on the visuals (versus the written text) when you read a scholarly document in your discipline?

Visual communication in student documents

18. How similar are your expectations and processes for reading disciplinary documents and student documents?
19. What key elements of visual communication do you look for in student writing? In other words, what aspects of visual communication appear on your rubrics?

Visual communication pedagogy

I am going to ask you to look at the classroom activity that you provided as you think about your answers to the following questions.

20. What are the visual communication goals of the classroom activity that you provided?
21. What do you think students find useful about this classroom activity?
22. Pretend I’m a student. If you were to explain to me how to do this activity/assignment well, what would you say?

I am going to ask you to look at the textbook excerpt that you provided as you think about your answers to the following questions.

23. What do you find useful about the textbook excerpt you provided?
24. How do you use it in your classes to help prepare students to read or compose with visuals?
25. I am going to show you the visual communication topics that I found when I researched composition and science-writing textbooks. Which, if any, of these topics is covered in this particular textbook excerpt?
26. Are these topics typically covered in your teaching of visual communication? Are any not covered? Are any others covered?

Teaching for transfer

27. What specific visual, composing, or reading communication skills do students have when they arrive in your class? When they leave your class?
28. What specific visual, composing, or reading communication skills would you like students to have when they arrived in your class? When they leave your class?
29. In what ways do you see yourself promoting knowledge transfer of visual communication or more generally for students as they come into or as they leave your class?
APPENDIX D

BRENDA’S VISUAL CLASSROOM ACTIVITY/ASSIGNMENT

Assignment 3: Presenting Research: Poster and Presentation

Due Date: ______________________

Assignment Goals

A growing trend in presenting research to other scientists is the conference research poster presentation. Typically, you would set up a poster in a large room, where attendees can circulate among the various posters, asking researchers questions and offering advice. Sometimes you would be able to give a more formal presentation, as you will for this assignment.

Using PowerPoint or similar appropriate software (InDesign), each individual student will create a research poster appropriate for display at a conference in your field. Posters generally follow the IMRAD format, though in a truncated form and usually including specific research questions and future work to be done. Significant focus is placed on visuals (graphs, charts, photographs) and overall layout (white space, colors, blocks of text, fonts). You may use data from your in-class exercise, past research, or someone else’s data with permission.

You will not be printing these posters, as you might for a real conference (sometimes a very expensive task). Instead, you will be projecting them in class and giving a maximum five minute presentation (including Q&A time) that explains the science displayed on the poster. Presentations will take place over two days (October 8 & 10). You will upload your poster in PDF format to Moodle on the first day of presentations.

Format Requirements

Your poster should be in standard poster dimensions, typically 36” w x 24” h, designed in a program of your choosing (generally PowerPoint, although we’ll discuss the advantages of using more advanced software like InDesign). Your presentation will be limited to five minutes—conferences often have strict time frames for presenters—which includes an opportunity for...
questions from your peers. This presentation will cover the details included on your poster, as well as any necessary background information. Use visual design skills to create a poster that helps your research stand out among the crowd.

**Evaluation Criteria**

The overall assignment is worth 20% of your class grade. Of this assignment, the poster is worth 75% and the presentation worth 25%.

**Poster Evaluation Criteria**

- **Title** effectively highlights the poster’s subject matter
- **Author** and institutional affiliation listed clearly
- **Introduction** adequate background included, given the limitations of medium. The poster should be hypothesis driven – research questions should be clear and may be listed separately.
- **Methods** are a clear outline of procedures; show thoroughness of research.
- **Results** give adequate summary of findings. References listed as needed, in a way not distracting from main content. The results of the research are placed in relation to the broader context of the field of study.
- **Tables & Figures** effectively communicate key facts and concepts, with appropriate descriptive captions.
- **Conclusions/Future Directions** are accurate, appropriate, and realistic. The hypothesis is addressed again.
- **Acknowledgements / Funding Attributions** listed if necessary.
- **Legibility** of information – adequate font size, organization, logical flow of information, and contrast of color, image, and text.
- **Overall visual appeal** – includes font choices, color choices, visuals used.

**Presentation Evaluation Criteria**

- **Grasp and understanding** of materials demonstrated, including responses to questions and clear explanation of poster content.
- **Timeliness** – completed within the 5 minute limit.
- **Language use** (grammar) should be professional, appropriate, and engaging.
- **Movements and gestures** should be controlled, purposeful, and not distracting.
- **Vocal delivery and enunciation** – the audience should be able to easily hear every word, so pay attention to volume and clarity.
- **Eye contact** should be made with audience members.
- **Use of notes** indicates that you practiced.

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• **Professionalism and demeanor** – wear appropriate attire and display a relaxed, confident attitude.
• **Introduction and conclusion** – you should start and end your presentation in a noteworthy way.
Visual Analysis Assignment

Visual arguments surround us. They come in a variety of multi-media forms, sometimes “in your face” and sometimes more subtle. No matter what the form, though, there are similar strategies the creator of a visual argument will use to be persuasive for a particular audience. For this assignment you will choose an artifact that you find interesting and talk about the way it makes an argument. Your audience will be me and your classmates. It will be an assignment with both an oral presentation and a written paper.

- You can choose an ad from TV, a billboard, a bus, a magazine, a newspaper, or a website.
- You can choose a website
- You can choose a documentary film
- Or you can choose another artifact that you discuss with me (everything is persuasive in some way!)

General questions to ask as you analyze your artifact:

- Who is the target audience for the visual?
- What is it selling? (This question doesn’t just apply to an obvious commercial ad. It can apply to anything associated with a lifestyle or set of values people want to identify with.)
- What graphic and textual strategies carry the messages? (You’ll want to discuss design principles and other concepts like types of appeal from our reading)
- Are the visual and verbal strategies effective for the target audience?
- Are the message and the way it’s presented both honest and ethical? (Are there any fallacies?)

Things to be careful about:

- There is an obvious creator of the visual. Talk about the creator as someone who actually made choices about how it should look and how people will react to it. (The creator may be a company. You can talk about a company if you don’t know the specific person or people who created it, but use the company’s name, don’t talk about some vague “they.”)
- You’ll need to include the visual within your paper so that your readers can see what you’re talking about. (If it’s impossible to get it on a page, you’ll need to provide a very good summary and description), and you will need to keep track of where you find the visual so you can cite it properly. Also, whenever you include a visual within a paper you should label it and then refer to it in the text of your paper.
- The opening part of your paper should orient your audience to where you found the visual, who produced it, and who their intended audience is.
- You need a thesis. What is the main point you would like to make about this visual argument?

Your oral presentation will be on 9/24, rough draft will be due on 9/26, and the final paper will be due on 10/1, complete with your draft and your prewriting notes.
APPENDIX F

LAUREN’S VISUAL CLASSROOM ACTIVITY/ASSIGNMENT

Analyze the following two posters that contain information about a drama club’s upcoming spring break trip to London. Which poster do you think is more effective? Why?

The Drama Club is sponsoring a Spring Break trip to London
March 8-16, 2005

You’ll see six outstanding plays including the Royal Shakespeare Company. During the day you’ll see the famous sights of London, including Buckingham Palace, the Tower of London, Westminster Abbey, St. Paul’s Cathedral, the Houses of Parliament, Big Ben, and 10 Downing Street—the residence of the Prime Minister. We will also visit the National Gallery of Art, the new Tate Modern, the restored Globe Theatre, and the British Museum.

For more information please contact
Karen Clark, President
Drama Club
405 Memorial Union
482-1564
London

Spring Break
March 8-16, 2005

You'll see

Plays
Six outstanding plays including a
performance by the Royal
Shakespeare Company

Sights of London
Buckingham Palace, the Tower of
London, Westminster Abbey, St.
Paul's Cathedral, the Houses of
Parliament, Big Ben, 10 Downing
Street—the residence of the Prime
Minister

Museums
National Gallery of Art, the new
Tate Modern, the restored Globe
Theatre, the British Museum

For information contact
Karen Clark, President
Drama Club
405 Memorial Union
482-1964

Sponsored by the Drama Club
APPENDIX G

LYANN’S VISUAL CLASSROOM ACTIVITY/ASSIGNMENT

Instructions for Laboratory Notebook Illustrations

In this course, laboratory notebook illustrations (line drawings) and the eFile (photographic images) count for 150 points (one-third) of your final grade. The accompanying checklist provides an easy way to keep track of the required illustrations/images. These illustrations and images are not intended to be works of art, but rather to 1) call your attention to structures that might otherwise be overlooked, 2) vividly impress upon your memory the structures observed, and 3) provide a permanent record of your observations for later review. While artistic quality is not a criterion, keep in mind that the accuracy and clarity of your diagrams will be best if you take time to observe the slides and try to draw faithfully the subject at hand or take photographs with good focus and contrast. Accurate, clear labeling is critical.

General guidelines for keeping a notebook:

• Laboratory notebooks can be a spiral bound “art notebook” or a three-ring binder filled with loose drawing paper. Whatever notebook you choose, the paper in your notebook should be drawing paper as this will produce a better final drawing.
• Use a pencil with a hard lead (such as a 4H drawing pencil, available in the bookstore) and keep it well-sharpened! For cleaning up stray marks, a soft gum eraser works well. You may use colored pens/pencils to highlight different structures, but this is not required.
• Illustrations should not be crowded together but you can have up to several per page.
• Each illustration should have a brief description or title above it, with the number from the lab notebook, and relevant structures should be accurately labeled and indicated by lines or arrows. You must also include the magnification.

Two types of illustrations will be asked for in the laboratory exercises: “outlines” and “drawings”. These are defined below and examples are provided.

• Outlines—These usually involve a large scale but accurate outlining of the entire section. Within this outline you will be asked to include certain features, e.g., vascular bundles. Outline drawings do not include any cellular detail unless specified in the lab manual.
• Drawings—These are detailed enlargements of small areas, and they include cellular detail. They are often required in addition to an outline drawing. A good way to depict the two is to show the drawing as an enlarged sector of the outline drawing. For example, an outline drawing of a stem section and a drawing of one vascular bundle could be done in this way:
The eFile will consist of 20 photographic images taken from prepared slides or preparations that you make in lab (not scanned drawings of the material). You get to choose which 20 of the 127 required images you wish to present in digital format, but these should be indicated in the checklist by placing an “e” in the space in front of the illustration number. Your eFile should consist of 20 PowerPoint frames, each frame corresponding to one required illustration (but note that a frame might include multiple parts, for example the three wood plane illustrations from Lab 10 for Pinus). Each frame must contain the appropriate labeling.

You will be provided with instructions and demonstrations on how to use the digital imaging system during the laboratory. Keep in mind that there will be plenty of competition for the imaging system on the compound microscope, so plan accordingly. If necessary, there will be a sign up sheet for open lab times (see syllabus) to make sure that everyone has an opportunity to access the system.

You will turn in your lab notebook at the time of the mid-term for a quick review and guidance. You may also turn in your eFile to that date for a similar review. They will not be graded at this time—this is simply a way to provide some feedback on your progress and where you can strengthen the notebook and eFile. Your lab notebook drawings and the eFile (which you should turn in by e-mail as a pdf) are due at the time of the final exam. The completed checklist must be printed out and included with the lab notebook drawings. If you wish to scan your drawings and turn the “notebook” in as a pdf, that is also acceptable, but you must include the checklist at the beginning of the pdf.
APPENDIX H
MIKE’S VISUAL CLASSROOM ACTIVITY/ASSIGNMENT

PLP 628 – Presentation Rating Rubric

Fall Semester 2015

Presenter Name _________________________          Date _____________

CHECK THE APPROPRIATE BOX

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Visual Aids

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COMMENTS:
Looking at Figures in publications...

Is there a Difference between Group 1 and Group 2?

Comparing Treatment 1 (standard) to Treatment 2 (new compound)
Is there a Difference between Group 1 and Group 2?

![Graph showing % change from Control (untreated) cells for Group 1 and Group 2.]

Is there a Difference between Group 3 & 4?

![Graph comparing Treatment 3 (standard) to Treatment 4 (new compound).]
Data Manipulation 101: Raw Data

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